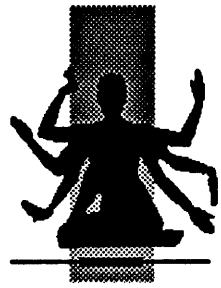
ARCOME SA

ARCHITECTURE DE COMMUNICATION POUR LES ENTREPRISES

12, rue Delerue
92120 MONTROUGE — FRANCE
Tel: (33) (1) 42 53 89 97 — Fax: (33) (1) 46 54 05 27



ARCOME SA

EUROPEAN COMMISSION DG XIII
EQUAL ACCESS & INTERCONNECTION

Study on the issues related to Fair and Equal Access
and the provision of harmonised offerings for
Interconnection to Public Telecommunications Networks
and Services in the context of Open Network Provision (ONP)

FINAL REPORT

ARCOME SA — Suzanne Debaille, Joël Repiquet

SMITH System Engineering — Mark Cartwright, Simon Dunkley

Version 3.0
Reference: SD/229/97
10 April 1997

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

1.1. About this Report

This document has been prepared by Arcome SA (France) and Smith System Engineering Ltd (UK) for DGXIII of the European Commission under Contract 48330. It presents the final report of a study for DGXIII on "issues related to fair and Equal Access and the provision of harmonised offerings for interconnection to public networks and services in the context of ONP (Open Network Provision)".

The aim of the study has been to provide a practical set of recommendations for implementing European Directives on the interconnection of telecommunications networks.

This report provides our findings and presents the study results. It summarises our analysis, and on this basis it proposes mechanisms for the harmonisation which is required at the European level, and provides guidelines for NRAs (National Regulatory Authorities) and telecommunications operators. Detailed country surveys and experiences on interconnection, and detailed analysis of technical issues, have been separately bound into two appendices.

This report is structured into three major parts following our work plan:

- reviewing existing interconnection arrangements and experiences in liberalised telecommunications markets,
- analysing interconnection standards and technical issues,
- analysing interconnection operational conditions and defining:
  - interconnection set of services offerings,
  - guidance to help regulators and operators develop a common understanding of what an RIO should contain,
  - guidance on operational and contractual aspects of an Interconnection Agreement,
  - guidance to help regulators and operators migrate operations towards an open interconnection services environment.

1.2. Background to the Study

1.2.1. Preparing full competition of telecommunications networks in 1998

On 1 January 1998, public voice telephony networks and telecommunications infrastructures will be liberalised in Europe to enable full competition within the telecommunications market. Two major issues are associated with the implementation of full competition in public voice telephony networks and services:

- Equal Access-Carrier selection: the mechanisms by which a customer has a fair choice of network service provider, including those to which he is not connected directly;
- Network interconnection: the mechanisms by which independently managed telecommunications networks connect to one another to provide an efficiently functioning service to their customers.

1.2.2. The European approach to Interconnection and Equal Access

For interconnection and equal access issues, the core of the European regulatory framework is contained in the ONP Interconnection Directive which is currently in development *(OJ C220, 29.7.96)*. Inter alia, the Interconnection Directive mandates NRAs to ensure the production of a Reference Interconnection Offer (RIO), including prices, terms and conditions is produced by mid-1997. This represents a national list of interconnection services, together with associated terms and conditions (including tariffs).

Also bearing on the issues of interconnection and equal access are:

- other Directives produced under the ONP programme, including particularly the Voice Telephony Directive *(OJ L 321, 30.12.95)*;
- the 'Article 90' Directive for the introduction of full competition in telecommunications services *(OJ L 74, 22.3.96)*.

In addition there are a number of Commission discussion documents ('Green Papers'), covering areas such as licensing harmonisation and numbering policy.

1.2.3. The need for a technical/operational interconnection framework in Europe

Among EU (European Commission) Member States, only the UK allows full competition and has developed a detailed approach to interconnection and carrier selection. In Sweden and Finland, competition has been brought on fixed long distance networks, bringing some experience in interconnection and carrier selection implementation. But most of the other Member States allow competition only in cellular mobile services, where interconnection with public fixed networks has been handled on a case by case basis without any catalogues from the incumbents nor reference offerings or framework.

In order to cope with the practicalities of interconnection and carrier selection, a comprehensive technical/operational framework will need to be in place at the European level to allow multiple operators to interconnect and to operate in the same geographical areas. In addition, the effective management of the technicalities and the involvement of national regulatory authorities in network interconnection will be a significant factor in the implementation of the process.

The main goal of the study is to prepare the development and the management of such a European Framework for telecommunications interconnection by producing guidelines for the industry (NRAs, operators, service providers, etc.) in order to help the practical implementation at a national level of the Interconnection Directive.

As the interconnection regulatory framework requires TOs to publish a reference offer including prices, terms and conditions, a major concern of the study is to help regulators and operators to identify what offerings should be included in their reference interconnect offers. For those purposes, the study proposes :

- a structure and a list of contents of a RIO (Reference Interconnect Offer),
- recommendations and timetable for the implementation of a minimum set of interconnection offerings to be provided in the RIO.

In order to help with the RIO implementation and harmonisation of actions in the Member states, the study defines a EII (European Interconnection Initiative). The EII is the programmatic mechanism by which the provisions of the Interconnection Directive might be managed into being. It aims at providing the following elements:

- guidance to NRAs on the technical goals of interconnection and the migration planning required;
- recommendations on standardisation and research activities;
- a proposed structure for implementing and monitoring the EII at the European level.

1.2.4. The Terms of Reference of the study

DGXIII's Terms of Reference identified two main objectives for the study:

- to make specific recommendations on measures needed to speed up the availability of fair and equal access in the EU, taking into account the technical dimensions of the problem and the necessary harmonisation from the end-user perception,
- to review interconnection arrangements in existing liberalised telecommunications markets and make proposals towards harmonised interconnect offerings in Europe.

The study was to achieve this by:

- developing guidelines for NRAs and TOs on how to implement the directives,
- taking an operational and technical approach: other studies had already explored the issues of cost accounting methods and interconnection tariffs[1] and proposed guidelines on interconnection charges.

The study was limited in principle to voice telephony services (as defined in the Voice Telephony Directive). However reflections on IN (Intelligent Networks), VPN (Virtual Private Networks) and Bandwidth services have been included in the light of comments from industry players, country experiences and technical analysis.

1.2.5. Approach for the study

To meet these objectives the study team adopted a three-phase approach:

- Phase 1
  - we surveyed experience world-wide of interconnection and equal access implementations in telecommunications networks, and reviewed existing interconnection frameworks and agreements,
  - we conducted a large workshop in Brussels to present initial ideas and gain feedback from the telecommunications provider, user and regulator communities,
- Phase 2
  - we reviewed user needs for equal access and interconnection services and analysed their technical impacts on interconnection interfaces,
  - we analysed appropriate developments in standards, and analysed a wide range of specific technical issues that might be involved in the EC framework,
  - we defined a technical strategy and standardisation programme,
- Phase 3
  - we analysed organisational and operational aspects related to interconnection implementation and management,
  - we proposed guidelines and recommendations for both NRAs and TOs,

---

[1] *On these subjects, the reader can refer to the two following studies for DGXIII:*
-"Network Interconnection in the Domain of ONP", WIK/EAC, 1994
-"Cost Allocation and the General Accounting Principles to be used in the Establishment of Interconnection/Access Charges", Arthur Andersen, 1994

– we defined an outline implementation programme and action plan, together with a proposed management structure.

The recommendations that have emerged from this analytical process form a coherent proposal for RIOs components and a EII. The following figure summaries the approach for developing these proposals.

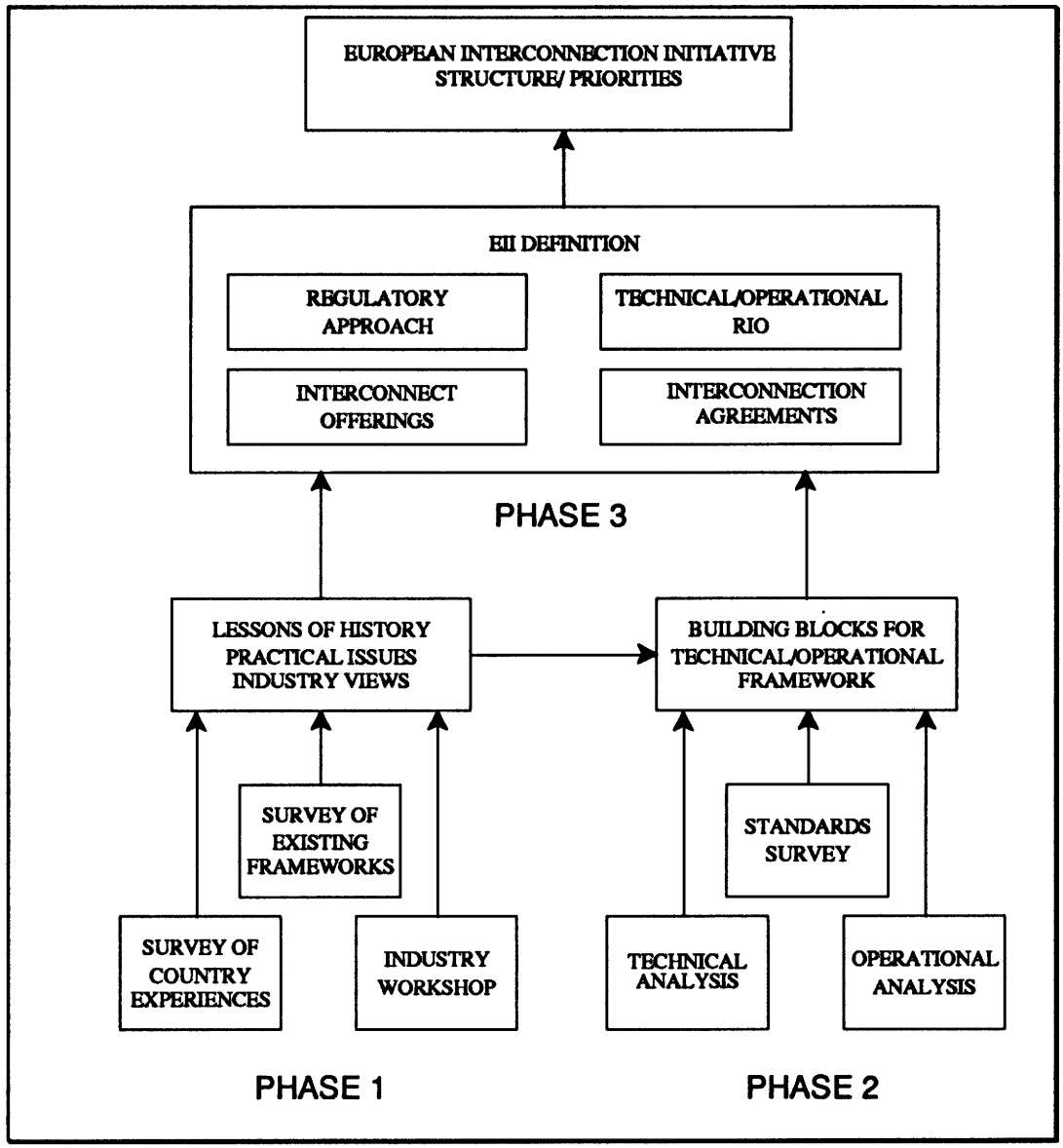


Figure 1: Study milestones

1.3. Report Structure

The report is structured into three major parts, based on the three study phases:

- Part I - Current status and country experiences of interconnection—this contains the analysis of the European regulatory framework related to Interconnection and Equal Access, the survey of interconnection experiences in liberalised telecommunications markets, the review of existing interconnection arrangements and frameworks.
- Part II - Analysis of interconnection standards and technical issues—this contains the definition of interconnection and equal access services, the analysis of technical issues related to interconnection services implementation, the state of the art of interconnection standards, and the manufacturers views.
- Part III - Towards a European Framework—this includes the analysis of interconnection operational issues and mechanisms and the proposal for harmonised

sets of interconnect offerings, RIOs, guidelines for their practical implementation, and the definition of an EII.

1.4. Appendices

There are in addition two appendices to the report which have been separately bound. These are as follows:

- Appendix 1: presents the country surveys, the analysis on existing interconnect frameworks and catalogues, the EIF Interconnect reference agreement, the detailed comments from attendees to the June 96 workshop.
- Appendix 2: presents the detailed technical analysis, including the IN and non-IN interconnection means to provide end user services, the SS7 (Signalling System number 7) state of the art and the detailed report of the enquiry to manufacturers.

PART I. REGULATORY BACKGROUND AND COUNTRY SURVEY

2. EUROPEAN REGULATORY BACKGROUND

The core of the European regulatory framework on interconnection is contained in :

- **The ONP Interconnection Directive**[2]
- **The Full Competition Directive**[3]

These directives set out a number of notification requirements aimed at ensuring their effective implementation. The following requirements in particular enforce the implementation of interconnection and equal access:

- **no later than 1 July 1997**:
  - publication of licensing or declaration schemes, availability of adequate numbering schemes (Article 3 of 96/19/EC).
  - "Member States shall ensure in particular that the telecommunications organisations publish, the terms and conditions for interconnection to the basic functional components of their voice telephony services and their public switched telecommunications networks, including the interconnection points and the interfaces offered according to market needs"(Article 4a, § 2 of 96/19/EC).
- **by 31 December 1997**: "Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with Interconnection Directive." (Article 23 – Transposition – of 34/96/EC)
- **before 1 January 2003**: "NRAs shall encourage the earliest possible introduction of the number portability facility whereby end-users who so request can retain their number(s) on the fixed public telephone network at a specific location independent of the organisation providing service, and shall ensure that this facility is available at least in all major centres of population." (Article 12 – Numbering – § 5 of Interconnection Directive 34/96/EC)

In addition to these Directives, the Commission has issued a Green Paper in 1996 on numbering policy for telecommunications services. Among the proposed actions, this Green Paper defines an action plan for the implementation of carrier selection and number portability in the European Member States.

---

[2] ***Common position 34/96 of 18 June 1996 adopted by the council with a view to adopting Directive 96/.../EC of the European Parliament and of the Council on interconnection in telecommunications with regard to ensuring universal service and interoperability through application of the principles of open network provision (ONP) (OJ C220/13, 29.7.96).***(& Joint Text approved by the Conciliation Committee on 21 March 1997)

[3] ***Commission Directive 96/19/EC of 13 March 1996 amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications market (OJ L 74/113, 22.3.96)***

2.1. Interconnection Directive

In order to set out a transparent and stable regulatory framework for network interconnection in the European Union, the Commission proposed an ONP Interconnection Directive in 1995. A Common Position on Interconnection Directive was adopted by the European Council in June 1996 with the view of adopting this Directive.

The major principles which underline the framework include:

- **giving power to the national regulatory authorities to rule the dominant position of an incumbent operator,**
- **requiring incumbent operators to publish a reference interconnection offer providing the highest possible degree of interconnect,**
- **requiring agreements to be transparent, non-discriminatory and cost oriented.**

Implementation of interconnection is mainly addressed in the following areas of this Directive:

- **General principles**

  The text of the Common Position on Interconnection Directive says (Article 1) that it: "*establishes a regulatory framework for securing in the Community the interconnection of telecommunications networks and in particular the interoperability of service, and with regard to ensuring provision of universal service in an environment of open and competitive markets.*"

- **Dominant player regulation/Reference interconnection offer**

  Article 4 aims at defining rights and obligations for interconnection for TOs providing public telecommunications networks and publicly available telecommunications services.

  Articles 6 and 7 consider a specific regulation of interconnection offerings for organisations which have a significant market power *(a share of more than 25% of a particular telecommunications market in the geographical area in a Member State within it is authorised to operate)* by ensuring:

  - *"these organisations adhere to the principle of non discrimination with regard to interconnection offered to others, they shall provide interconnection facilities and information under the same conditions and of the same quality that they provide for their own services, or subsidiaries or partners."*
  - *"all necessary information and specifications are made available to organisations considering interconnection"*,
  - *"interconnection arrangements are communicated to the NRA"*,
  - *"charges for interconnection shall follow the principles of transparency and cost orientation"*,
  - *"the NRA shall ensure the publication of a reference interconnection offer. This reference interconnection offer shall include a description of the interconnection offerings, broken down into components according to market needs and the associated terms and conditions including tariffs"*,
  - *"different tariffs and conditions for interconnection may be set for different categories of organisations where such differences can be objectively justified on the basis of the type of interconnection provided and/or the relevant national licensing conditions"*,

- *"charges for interconnection shall, in accordance with community law, be sufficiently unbundled so that the applicant is not required to pay for anything not strictly related to the service requested".*

In order to ensure those principles for interconnection charges, Article 8 addresses cost accounting procedures, and cost accounting systems adaptations to be adopted by organisations having significant market power.

- **NRA responsibilities**

Articles 9 and 14 define the general responsibilities of NRAs concerning interconnection regulation and implementation. Those provisions cover in some detail the areas in which NRAs have a duty to rule and the decisions they make:

- *"national regulatory authorities shall encourage and secure adequate interconnection in the interests of all users...",*
- *"national regulatory authorities may set ex ante conditions or shall encourage coverage in interconnection agreements of the issues listed in Part 2 of Annex VII" (Framework for negotiation of interconnection agreements),*
- *"national regulatory authorities shall have the right to inspect all interconnection agreements in their entirety",*
- *"in the case of an interconnection dispute in a Member State, the NRA shall, at the request of either party, take steps to resolve the dispute",*
- *"national regulatory authorities shall ensure that up-to-date information is published in an appropriate manner in order to provide easy access to that information to interested parties".*

- **Technical aspects and numbering**

Article 10 considers that essential requirements (security of network operations, maintenance of network integrity, interoperability of services, protection of data) shall apply to interconnection to public telecommunications networks and publicly available telecommunications services. However in many areas the advice is quite general; for instance:

- *"Member States shall take all necessary steps to ensure that the availability of services is maintained..."*
- *"Member States may impose conditions on interconnection agreements in order to ensure interoperability of services..."*

Article 12 defines the actions to be undertaken by Member states and the responsibilities of NRAs concerning numbering management and implementation of carrier selection and number portability services:

- *"Member States shall ensure the provision of adequate numbers for all publicly available telecommunications services",*
- *"Member States shall ensure that national telecommunications numbering plans are controlled by the national regulatory authorities",*
- *"national regulatory authorities may lay down conditions to ensure equal access",*
- *"national regulatory authorities shall encourage the earliest possible introduction of the number portability facility... and shall ensure this facility is available at least in all major centres of population before 1 January 2003".*

Article 13 considers the technical standards for interconnection and in particular recommends NRAs to encourage the provision of technical interfaces for interconnection according to European standards.

- **Organisations with rights and obligations to negotiate interconnection**

  Annex II of the Directive defines the organisations which have both rights and obligations to interconnect with each other.

- **Issues the coverage of which interconnection agreement is to be encouraged**

  Annex VII/ Part 2 of the Directive defines issues to be covered in an interconnect agreement. Proposed technical and operational aspects are the following:

  - description of services to be provided,
  - locations of points of interconnection,
  - technical standards for interconnection,
  - interoperability tests,
  - measures to comply with essential requirements,
  - procedures in the event of alteration,
  - achievement of equal access,
  - provision of facility sharing,
  - access to ancillary/supplementary and advanced services,
  - traffic/network management,
  - maintenance and quality of interconnection services,
  - billing procedures.

- **Collocation/Level of unbundling**

  In Article 11, the directive encourages collocation of telecommunications organisation's equipment on the premises of an incumbent operator, and facility sharing in order to remove an unnecessary cost burden of a new entrant.

  Interconnection is defined in the directive as: *"the physical and logical linking of telecommunications networks used by the same or a different organisation in order to allow the users of one organisation to communicate with users of the same or another organisation, or to access services provided by another organisation"*. On the basis of this definition, the level of unbundling, considered in the directive does not require to allow new entrants to rent local loop from incumbent so as to provide direct connection to the customers. In the case however that unbundling at the local loop is provided by the incumbent, it falls under the scope of the Interconnection Directive.

2.2. Full Competition Directive 96/19/EC amending the Service Directive 90/388/EC

The Commission Full Competition Directive amending Service Directive with regard to the implementation of full competition aims at:

- abolishing exclusive and special rights as regard to the provision of voice telephony services from 1 January 1998, and the current exclusive rights on the provision and use of infrastructure,
- limiting essential requirements to the use of scarce resources.

The EC interconnection policy is emphasised in Article 4:

- *"member states shall ensure that the telecommunications organisations provide interconnection to their voice telephony services and their public switched telecommunications networks on non-discriminatory, proportional and transparent terms"*,
- *"member states shall ensure in particular that the telecommunications organisations publish, no later than 1 July 1997, the terms and conditions for interconnection to the basic functional components of their voice telephony services and their public switched telecommunications networks, including the interconnection points and the interfaces offered according to market needs"*,
- *"member states shall not prevent access to public switched telecommunications network regarding special network access"*.
- *"member states shall ensure that the cost accounting system...identifies the cost elements for pricing interconnection offerings"*.

These measures shall apply for a period of 5 years from the date of effective abolition of special and exclusive rights.

2.3. ONP Framework Directive

ONP 1st Package aimed at harmonising conditions for open and efficient access to as well as use of public telecommunications networks and services, in order to promote European-wide telecommunications services and to create conditions for open and fair competition in telecommunications services. These principles established that ONP conditions should:

- be based on objective criteria;
- be transparent and published in an appropriate manner;
- guarantee equality of access and be non-discriminatory, in accordance with Community law.

The ONP Framework Directive also specified that ONP conditions should apply to the three following main areas:

- technical interfaces, in particular the encouragement of the use of European standards or, in their absence, international standards;
- usage conditions (e.g. delivery period, quality of service, maintenance, etc.) and supply conditions (e.g. conditions for resale of capacity, shared use or interconnection, etc.);
- tariff principles, in particular cost-orientation and unbundling.

2.4. Green Paper on Numbering Policy in Europe

The Commission issued a Green Paper on numbering policy for telecommunications services in 1996. The Green Paper stresses that discussions on numbering must be part of the general regulatory debate and that a comprehensive approach is needed to competition and single market aspects of numbering.

❑ Key Issues for Numbering Policy within the European Union

The Green Paper identifies the key issues for numbering policy within the European union:

- Ensuring effective competition, and in particular:
  - Carrier selection.
  - Number portability.

- Restructuring of national numbering plans to foster competition and ensure that adequate numbers are available.

- **Facilitating the single market and in particular:**
  - The creation of a European Telephony Numbering Space, and within that the need for common access codes for pan-European services (such as freephone, shared cost, premium rate services).
  - The need for European numbering to be administered by an appropriate administrative structure at a European level.

❑ **Proposed Action Plan and Timetable**

The Green Paper proposes the following action plan:

- **From 1 January 1998**
  1. The implementation of carrier selection (i.e. users are offered a simple, non-discriminatory mechanism enabling them to select the carrier of their choice on a call by call basis).
  2. The implementation as soon as possible of number portability for the local loop but no later than 2000 (i.e. allowing users in all major centres of population to keep their telephone number at a particular location when changing to another operator or service provider).
  3. The promotion of action at a national level to open up and to ensure the convergence of national numbering plans including the harmonisation of specific access codes and the adoption of a common standard for keypads supporting alpha-numeric dialling (i.e. allowing users to 'dial' names instead of numbers).
  4. The implementation of a European Telephony Numbering Space (i.e. the implementation of a common numbering scheme and common access codes for special pan-European services.
  5. The establishment of a common framework for the regulation and administration of a common European numbering scheme (including the allocation of European service access codes and carrier selection codes, as well as the promotion of the community's interest in international numbering form).
  6. The review of the issues associated with naming and addressing in the context of the Internet and to consider the need, if any, of regulatory action.
- **From 1 January 2000**
  7. The implementation of carrier pre-selection (i.e. allowing users a simple, non-discriminatory mechanism enabling them to pre-select the carrier of their choice on a permanent or default basis).
  8. The extension of number portability for users of mobile and personal communications networks as well as for users of special services (e.g. allowing users to retain valuable numbers for freephone or personal communications services), taking into account the state of network development and the level of demand.
- **From 2000 onwards**
  9. The implementation of a long-term numbering plan, involving the creation of European country code ("3"-XX) with the administration and management of the code transferred to the European level.

A consultation on these proposals for action has taken place and the Commission will follow up on it by a Communication, summarising and evaluating the comments made and drawing conclusions for concrete action to be taken.

2.5. Regulatory Definitions

"Interconnection" means the physical and logical linking of telecommunications networks used by the same or a different organisation in order to allow the users of one organisation to communicate with users of the same or another organisation, or to access services provided by another organisation. Services may be provided by the parties involved or other parties who have access to the network.

"Public telecommunications network" means a telecommunications network used, in all or part, for the provision of publicly available telecommunications services.

"Telecommunications network" means transmission systems and, where applicable, switching equipment and other resources which permit the conveyance of signals between defined termination points by wire, by radio, by optical or by other electromagnetic means.

"Telecommunications services" means services whose provision consists wholly or partly in the transmission and routing of signals on telecommunications networks, with the exception of radio and television broadcasting.

"Users" means individuals, including consumers, or organisations using or requesting publicly available telecommunications services.

"Fixed public telephone network" means the public switched telecommunications network which is used, inter alia, for the provision of voice telephony service between network termination points at fixed locations.

"Network termination point" means all physical connections and their technical access specifications which form part of the public telecommunications network and are necessary for access to and efficient communication through that public network.

"Essential requirements" means the non-economic reasons in the general interest which may cause a Member State to restrict access to the public telecommunications network or public telecommunications services. These reasons are security of network operations, maintenance of network integrity and, in justified cases, interoperability of services and data protection. Data protection may include protection of personal data, the confidentiality of information transmitted or stored as well as the protection of privacy.

"Telecommunication organisations" means public or private bodies, and the subsidiaries they control, to which a Member State grants special or exclusive rights for the provision of a public telecommunications network and, when applicable, telecommunications services.

"Voice telephony" means the commercial provision for the public of the direct transport and switching of speech in real-time between public switched network termination points, enabling any user to use equipment connected to such a network termination point in order to communicate with another termination point.

"Authorisations" means any permission setting out rights and obligations specific to the telecommunications sector and allowing undertakings to provide telecommunications services and, where applicable, to establish and/or operate telecommunications networks in the form of a "General Authorisation" or an "Individual Licence" as defined below:

- **"General Authorisations"** means an authorisation regardless of whether it is regulated by a «class licence» or under general law and regardless of whether such regulation requires registration, which does not require the undertaking concerned to

obtain an explicit decision by the national regulatory authority before exercising the rights stemming from the authorisation.

- **"Individual Licences"** means an authorisation which is granted a the national regulatory authority and which gives an undertaking specific rights or which subjects that undertaking's operations to specific obligations supplementing the general authorisation where applicable, where the undertaking is not entitled to exercise the rights concerned until it has received the decision by the national regulatory authority.

3. SUMMARY OF COUNTRY EXPERIENCES

This section summarises the results of surveys conducted in Europe and other liberalised countries on interconnection experiences and equal access implementations in telecommunications networks.

Country surveys were undertaken from January 1996 to July 1996. Detailed country analysis is provided in Appendix 1. As far as the regulatory environment is very much evolving in each country, some detailed information in the appendix may not reflect the 1997 situation.

The aim of the country survey was to provide in-depth analysis of the issues related to interconnection in a significant number of countries. A particular attention was given to:

- the experiences in the countries outside and inside Europe, where the telecommunications market is already open,
- the ongoing approach to Equal Access and Interconnection in Member States of the European Union, in order to identify the major current issues.

Countries to visit have been chosen in order to analyse a mix of large countries/small countries and to reflect the various interconnection experiences and different regulatory situations:

- liberalised countries where a large number of interconnection agreements have been achieved,
- less competitive countries where the incumbent has been keeping to date a monopoly situation for public fixed telephony services.

The countries analysed in the study are given in Table 1.

European Community Member States	Other countries
Finland	Australia
France	Japan
Germany	New Zealand
Portugal	United States
Spain	
Sweden	
United Kingdom	

Table 1: List of countries visited

In each country, representatives of the different players have been interviewed providing inputs covering a large review of the issues related to the study. These players were National Regulatory Authorities, incumbents, mobile operators, alternative carriers and service providers as indicated in Table 2. The consultants brought back available interconnection frameworks, interconnection catalogues and interconnection contracts from their missions. Those documents were subsequently analysed and compared as a first input for the required guidelines.

Country	NRA	Incumbent	Alternative Carrier	Mobile Operator	Service Provider	User Association
United Kingdom	Oftel	BT		Orange	Imminus	
France	DGPT	France Télécom	SIRIS	SFR Bouygues Telecom		CIGREF CNPF
Germany	BMPT	Deutsche Telekom	Thyssen Telekom CNI MFS	E-plus		VTM
Spain	DGTEL	Telefonica	Retevision	Airtel		
Portugal	ICP	Portugal Telecom		Telecel	France Télécom	
Sweden	P & T	Telia	Tele 2	Comviq	France Télécom	
Finland	MTC TAC	Telecom Finland Finnet Group		Telecom Finland Finnet Group		Cyberlink International
United States	FCC				Frontier Communications	CTIA (cellular industry)
Australia	AUSTEL	Telstra	Optus	Vodafone	AAPT	ATUG (users)
New Zealand	Ministry of Commerce	Telecom New Zealand		Clear	Bell South	
Japan	MPT	NTT	Japan Telecom TTNet	IDO Tokyo Digital Phone		

Table 2: List of organisations visited

3.1. Country Survey on Interconnection

3.1.1. Interconnection Background

Interconnection experiences of the visited countries is closely related to the deregulation level and the structure of the telecommunications market of each country. The different Interconnection experiences can be differentiated within two main families of countries (see Table 3) where deregulation has reached two different levels:

- the "precursors" family where the development of competition has led to several interconnected fixed and mobile networks offerings the same type of services within the same country and competing for the same customers. Those countries opened the telecommunications market during the 80ties or the early 90ties. and have experienced in many cases a large number of interconnection agreements.
- the "mobile only" family where in the past few years interconnection has been developed between public fixed and mobile networks. Those countries are mostly members of the European Union where the incumbent has been keeping until January 98 a monopoly situation for public fixed telephony services. Therefore, the interconnection agreements are still limited to one or two majors interconnection agreements between the incumbent and the mobile operators.

Detailed country surveys are presented in Appendix 1 document.

Precursors		Mobile only	
Country	Number of interconnection agreements (voice networks)	Country	Number of interconnection agreements (voice networks)
United States	>1000	France	2 major
United Kingdom	>150	Germany	2 major
Sweden	>10	Spain	2 major
Finland	>70	Portugal	1 major
Australia	>5		
Japan	>100		
New Zealand	>5		

Table 3: Two main families of countries

United States

The United States has over 1,000 incumbent local exchange carriers with non-overlapping franchise areas. Prior to the AT&T divestiture in 1984, these carriers had interconnected for many decades through a fully integrated network. After 1984, AT&T formed a long-distance company that became separate from its previously-owned local exchange carriers.

Since 1984, interconnection between the local exchange carriers and the toll carriers has been formalised through "access tariffs". Access can be switched or special:

- switched access is used by smaller users to reach their long-distance carrier by dialling through the local exchange carriers central office switch,
- special access is used by larger users to connect to the long-distance carrier through private lines.

Local exchange carriers must also interconnect with cellular carriers and with value-added networks which provide data services.

In August 96, the FCC (Federal Communications Commission) issued a new telecommunications law: the Telecommunications Act of 1996 which changes fundamentally telecommunications regulation. The principal goals established by the telephony provisions of the 1996 Act are the following:

- opening the local loop exchange and exchange access markets to competitive entry,
- promoting increased competition in telecommunications markets including long distance markets,
- reforming universal service system so that universal service is preserved and advanced as the local exchange market move to competition.

In particular incumbent LECs (Local Exchange Carriers) including Bell Operating Companies are mandated to open their networks to competition including providing interconnection, offering access to undbundled elements of their networks and making their retail service available at wholesale rates. LECs are required to provide to requesting TOs non discriminatory access to network elements at technically any feasible points. The FCC has identified the following network elements where interconnection can take place:

- network interface devices,
- local loops,

- local and tandem switches (including software features in those switches),
- interoffice transmission facilities,
- signalling and call related data base facilities,
- operation support systems and information
- operator and directory assistance facilities.

When the survey was conducted the undbundling of local networks was the major regulatory issue in the US: on the one hand LECs consider that the undbundling of local networks into a number of resale elements requires intensive engineering effort to modify system architecture in order to put price on a range of discrete functions, on the other hand US long distance operators accuse LECs of using technical barriers as an excuse to competition in the local loop.

FCC has established rules restricting the terms of interconnection agreements. A particularly important requirement is that a local exchange carrier may not give preferential treatment to a mobile carrier it owns. However, unless a party complains, the FCC does not review every such agreement.

The Telecommunications Act of 1996 has established new general guidelines about interconnection arrangements. In particular, it empowers the FCC to formulate more detailed rules and to ensure that state regulators follow these rules, at least in the case of local exchange companies wanting to get approval to enter the long distance market. In addition the Telecommunications Act of 1996 requires number portability.

United Kingdom

The United Kingdom is the European precursor for telecommunications liberalisation and can take advantage of a 10 years experience in interconnection. Apart the limited experience with Kingston, the first interconnection agreement took place between BT and Mercury during the early 80ties with the creation of a duopoly for the fixed telecommunications services. That first step has been soon followed by the creation of an other duopoly for the mobile services and the set up of interconnection agreements with Cellnet, which is a 60% owned by BT, and Vodafone.

The 1991 Duopoly Review White Paper - Competition and Choice- introduced proposals for opening up the UK market to full competition for the supply of telecommunications. This ended the BT/MCL duopoly and introduced International Simple Resellers, Cable companies to offer services independent of BT or MCL, and opened the way to many new operators. Then local number portability was introduced. Nowadays, BT has more than 150 interconnection agreements and additional agreements involving Mercury, Energis, mobile operators, cable TV operators and regional operators have been set up as well.

With the increasing number of interconnect agreements, BT completed a standard contract (analysed in section 4.1.) and a detailed price list for interconnection. In addition an interim price list for standard interconnection services was determined by Oftel in January 1996. Where the service required is not on the price list, an agreement must be negotiated and if no agreement is reached, an appeal may be made to Oftel for a determination.

The fundamental principle of interconnection in UK is that: «any customer on any network must be able to contact any customer on any other UK network or in the world ».

In 1991 the British government created a consultative committee the NICC (Network Interoperability Consultative Committee) to represent the British industry structure (which were Oftel, TOs, SP, and user representatives) and to monitor telecommunications

liberalisation. Inside NICC the IG/PNO is on charge with technical aspects of interconnection.

The level of Oftel's involvement on interconnection issues and in promoting competition in telecommunications networks has been very high. Since its creation Oftel has issued many public consultations on how to rule the UK telecommunications market. In 1996, Oftel issued new consultative documents to debate on how the UK regulatory regime needs adjustments:

- to encourage competition in the provision of services over fixed telecommunications networks, this consultation has led to the introduction of the fair trading Condition in BT licence,
- to determine the pricing of telecommunications services from 1997, this consultation has led to new price cap of RPI-4,5%, on services to residential and SME customers,
- to consider the implications of the pricing arrangements for IPLC (International Private Leased Circuits) in a liberalised international facilities market. This regime is now overtaken by International Facilities Liberalisation. Oftel will determine prices in 1997, but will be looking to remove from BT licence the obligation to provide IPLCs.

In 96 the BT/MCL monopoly on International Facilities operation formally ended. In December 96, International Facilities Licences (IFL) were issued to 45 applicants including Trunk Network operators, Satellite operators, international Simple Resellers.

Several interconnection agreements between BT and other interconnecting parties have been rewied and summarised in section 4.1.

Sweden

The complete liberalisation of the Swedish market has been achieved by the 1993 Telecommunications Act. A quite large number of interconnection agreements have been consequently concluded. Telia has now three interconnection agreements with the GSM operators (Telia Mobitel, Comviq and Europolitan), and six other agreements with the alternative fixed network operators: Tele2, Telenordia, France Télécom Nordphone, Telecom Finland, MFS and Cyberlink.

The current legal framework has been set out in the Telelag in 1993. The role of the NRA (PTS) is limited to assessing whether interconnection charges are cost based, if asked to do so by a negotiating operator. Anyway, the competition law forbids anti-competitive interconnection agreements.

Telia has an interconnection agreement model which is publicly available. This model sets out interconnection terms and conditions, including points of interconnection, structure of charges, invoicing routines and technical requirements

Telia interconnection model is analysed in section 4.2.

Finland

Due to the unusual structure of telecommunications market in Finland operators have many decades of interconnection experience. Nowadays there are over 70 operators providing publicly available telecommunications services. Interconnection has taken place between Telecom Finland, Finnet Group and the local companies over a long period. There are several new operators negotiating interconnection with the traditional operators. Most

of these new entrants have a licence for operating and constructing public telecommunications networks.

Local services are still mainly provided by local companies (46) joined within Finnet Group and Telecom Finland, but 7 new operators have entered on this market. However their market share last year was only 1%.

In national and international services there is tough competition: in national long distance, Telecom Findland's market has been reduced to 40%, and reduced to 70% in international telecommunications.

The Telecommunications Act 1987 includes general rules interconnection. It has been revised several times to gradually introduce competition, recently in August 96. Nowadays there are two main categories of public telecommunications operators in interconnection:

- the traditional network operator which has rights to construct and maintain a public telecommunications network as well as to operate public telecommunications services,
- new type of market players (Service Operator) which has switching facilities but has no right to build a network outside its own premises. This operator has the right to access to an operator's network and has facilities to control customer connections.

Australia

The Telstra/ Optus duopoly was implemented during the early 90ties, as the licensing of Vodafone as a third mobile operator. To enable interconnection arrangements Austel completed an interconnection services model, economic guidelines and a technical/operational framework in mid 91. Austel acted as a mediator able to assist in interconnection arrangements rather than an arbitrator.

The interconnection policy has been based on the following principles:

- ability of telecommunications users to call other customers irrespective of the TO network they are connected to (Any to any communication / connectivity),
- availability of customer choice, and minimum customer inconvenience.

As the issues have become more complex, Austel through a progressive industry involvement (NIIF: Network Interconnect Industry Forum) undertook to develop a new interconnection model in 94. This new model has been used to consider a number of case studies and to prepare for the end of the duopoly to settle with the post 97 telecommunications regime.

The framework is now under revision for the post 97 telecommunications regime leading to full telecommunications services and network liberalisation and a lighter level of regulation will be ensured by ACCC (Australian Competition and Consumer Commission). With this new regulation SP providing publicly available telecommunications services (Service Deliverer) will get the right to interconnect and to provide their own transmission links but they will have to comply to specific undertakings especially to guarantee financial liability and with respect to network integrity. TOs and SPs will be required to belong to an Industry Access Forum and to comply with a code of practice to be developed within this forum.

Detailed analysis of Austel framework is provided in section 4.3.

New Zealand

The Telecom monopoly has been ended in New Zealand during the early 90ties as well. Interconnection agreements have been reached between Telecom and Clear, the newly licensed alternative fixed operator, followed by an other agreement with the new mobile operator, BellSouth. A third interconnection agreement have been signed between Telecom and Sprint, which got a fixed operator license, some time ago and Telstra has recently entered the New Zealand market and is about to sign an interconnection agreement with Telecom.

The New Zealand government has adopted a light handed approach to regulation. It has deliberately not created a regulator leaving the industry free to develop within a small number of constraints.

Japan

Since the opening of the Japanese market to full competition in 1985, many operators entered the different telecommunications segments under type I (network operator) or type II (service provider) licence and 106 interconnection contracts have been made public by NTT between 06/1995 and 02/96.

Any type I / special type II carrier can enter interconnection with any other one, independently of the type of services offered. Therefore interconnection agreements include mobile to mobile, mobile to long-distance, local to long-distance.

Interconnection regulation is defined in very broad terms in the TBL (Telecommunications Business Law): interconnection is to be negotiated between parties, and the MPT, the Japanese regulator can be asked to issue an interconnection order and then an arbitration. In Japan, the business mentality is so that players would rather compromise on their own than asking the public authority to intervene. Therefore, there were just two cases where MPT (the NRA) was asked to issue an order to interconnect and MPT never went as far as issuing an arbitration

In February 96, a report from the Telecommunications Council called for an increase in the level of ex-ante regulation for interconnection from MPT.

France

Until the beginning of 97, experience of interconnection in France was limited to mobile to fixed networks interconnection:

- France Télécom have interconnection agreements with two competitive mobile operators: a GSM operator (SFR) and a DCS 1800 operator (Bouygues Telecom),
- France Télécom has set up an interconnection agreement with its own GSM subsidiary (Itinéris).
- France Télécom has also limited interconnection agreements with three Telepoint operators: France Télécom subsidiary, KAPT' (both using CT2/CAI standard) and CGRP (DECT).

In mid 96, DGPT, the French regulator, issued a new telecommunications law for preparing 98 full competition. This new regulation settles in particular the creation of an independent body (the ART) for the regulation of telecommunications competitive aspects, and gives the right to interconnect both to TOs and SP offering public voice telephony services.

In mid 96, DGPT issued also an interim law for the introduction of competition in the local loop by promoting information highway experiences using cable TV networks and wireless local loops. Operators awarded of these experimental licences (LEX) have the right to interconnect. Five TOs have got this LEX:

- Cegetel,
- Lyonnaise des Eaux,
- ADP (Paris Airports),
- Roubaix Euroteleport,
- Marseille Teleport.

In order to prepare the specific regulatory framework for interconnection DGPT has issued end of 96 a public consultation on interconnection regulation conditions and on reference offer components. In addition DGPT has launched in 1996 industry groups with TOs representatives in order to discuss about interconnection issues, carrier selection solutions and number portability implementation.

Germany

The German regulatory situation and interconnection experiences are very similar to France:

- Deutsche Telekom has only interconnection agreements with two competitive mobile operators: a GSM operator (Mannesmann Mobilfunk) and a DCS 1800 operator (E-plus),
- Deutsche Telekom set up also an interconnection agreement with its own GSM subsidiary (DeTeMobil).

A new regulatory framework has been put in place in mid 96. Among other actions, this law settles the creation of a new regulatory authority, and specifies rights and obligations to interconnect. Like in France, Interconnect Catalogue from the incumbents and Reference Interconnection Offer are under preparation.

New entrants created an organisation called VTM to highlight their requirements and negotiate their rights to interconnect with Deutsche Telecom. When the survey was conducted the new regulatory framework did not consider the right to interconnect for Service Providers.

A numbering plan has been settled to take into account the new entrant requirements. Its implementation is planned for 98.

Competition on the fixed networks is already taking place successfully. In the near future, several important players will emerge on the long distance market.

Spain

Like France and Germany, Spain is on the way to adopt a new law for telecommunications market opening. In particular this law aims at settling the creation of an independent regulatory authority, and introducing a competition for fixed public networks and infrastructure provision in accordance with European regulatory framework.

A Decree is already applicable since June 96. Retevision is being licensed as the second public operator for fixed voice telephony and infrastructure.

Interconnection experience is limited up to now to interconnection between Airtel GSM operator and Telefonica fixed network. No interconnection framework and catalogue were available when the survey was conducted. DGTEL when regulating mobile networks established in 94 the first tariff basis for interconnection.

Portugal

Portugal asked for a transition period until the year 2000 to fully liberalise its telecommunications market, under the scope of EC Directives.

The obligation/right to interconnect and access conditions to the public network are defined in the telecommunications Basic Law, in the regime for the Establishment, Management and Exploitation of the Infrastructures and Provision of Complementary Telecommunications Services as well as in the granted licences, and the Portugal Telecom Concession Contract.

Interconnection and access conditions must follow the transparency and non-discrimination principles. They should aim at cost orientation.

Regarding interconnection charges, the Telecommunications Price Convention settles direct negotiations between operators. ICPs intervention is only required when an agreement is not reached. Recently an agreement on interconnection charges and leased lines tariffs was reached between Portugal Telecom and all the operators in the market (including data and mobile) involving price reductions up to 15%.

In case of specific issues on interconnection where a lack of agreement with Portugal Telecom occurs, ICP is asked to intervene to give all parties the right to express their views.

3.1.2. Summary of Interconnection Experiences

Current interconnection experience shows the tools available at the regulatory level are not sufficient to tackle technical and operational issues of interconnection.

Right to interconnection

In most countries visited, operators need an individual licence to get right to interconnect. This individual licence settles the obligation to provide publicly available telecommunications services and networks. Right to interconnect for Service Providers varies from one country to another:

- in US and Sweden, public TOs and SPs may be granted an individual licence and interconnection, but mobile SPs have no right to interconnect,
- in UK and Australia, the SPs status which will be revised in 97, does not give the right to interconnect. In UK, TOs need to comply with interconnection conditions (Relevant Connectable System) in addition to individual licence conditions. If a TO does not run a Relevant Connectable System, he must interconnect at the network termination point at the full retail tariffs.
- in Finland the position for SPs is under revision and special access provision for SPs could be made an obligation,
- in Japan, right to interconnect is awarded for SPs and TOs,
- in France according to the 1996 Telecommunications Law public voice telephony service providers have the right to interconnect, and other SP may require special access,

- when the survey was conducted, in Germany, Spain and Portugal, SPs were not given the right to interconnect.

Interconnection policy

In the different countries visited, interconnection was recognised as crucial for the existence of competition and the availability of a wide choice of telecommunications services for the end users. New entrants considered that interconnection to an incumbent TO's allows an access to essential facilities and has to be viewed with both angles:

- the provision of any to any communications,
- the capability for customers to get access to any provider's services, usually known as indirect Access.

However competition models chosen by individual countries have led to different interconnection policies :

- some countries like the UK have put emphasis on infrastructure competition,
- while other countries like US have put emphasis on service competition and competition on the local loop, or on Equal Access services like Finland and Australia,
- countries who are liberalising only from 1998 onwards and who wish to introduce competition quickly might put a strong emphasis on the resale of existing infrastructure especially in the access network.

Such policy differences are reflected in the costs of interconnection services and in the implementation policy of Equal Access and carrier selection services.

Difficulties to reach an interconnection agreement

From new entrants experiences, the major obstacles for competition and for reaching an agreement on interconnection were the following:

- interconnection charges, which have been the most controversial issue in all countries, in most cases whether interconnection charges were cost based or tariffs based they were considered as too high,
- in most cases, the incumbent's dominance concerning the local loop making the connection to customers expensive for new entrants,
- the availability of a detailed Reference Interconnection Offer in consistency with ONP provisions and new entrants requirements,
- the lack of information, price list, and interconnection catalogue from the incumbent, preventing a new entrant from planning its network deployment and developing a global approach for the provisioning of access service/end to end services through interconnected networks ,
- in many countries, interconnection agreements relied on a long duration negotiation process between the operators, and NRA arbitration in many cases was necessary to reach an agreement,
- in many cases (but UK, US and Australia) an insufficient level of ex-ante regulation, particularly in respect with: maximum time limit for negotiation, and availability of precise regulatory framework settling principles, timetable and requirements to comply with,
- in most cases an insufficient level of information provided by the incumbent with respect to interconnection catalogue, POI location, technical specifications,

- in most European countries, where interconnection was limited to mobile to fixed networks, agreements were negotiated on a case by case basis avoiding a new entrant to take advantage of previous experiences

Interconnection charges are the most controversial issue from the different interconnection experiences. Two main different structures are used in the interconnection agreements world wide: tariff based or cost based structure (see Table 4 below). The tariff based structure is derived from the retail prices, with a level of discount that may be fixed by NRAs, whereas the cost based structure is established estimated on interconnection service costs.

Tariff based countries	Cost based countries
France: the new law will introduce a cost based structure which will be defined from an audit on France Télécom costs. Germany: the association of operators (VTM) is asking for cost based prices. For them, it is the main key issue for interconnection in the future. Spain: with discounts proposed by DGTEL Portugal: Portugal Telecom do not have any analytic accounts but have an obligation to implement it. There are a lot of complaints from the other operators New Zealand: the Telecom/Clear agreement had a highly controversial tariff based structure.	United Kingdom: charges are derived from BT's fully allocated costing system with certain overheads excluded. BT's competitors would prefer long run incremental cost. A new interconnection charging system will be introduced in 1997. Sweden: Cost based for fixed operators, not regulated for mobile Finland: Cost based but use also retail prices United States: Cost based Japan: charges used to be tariff based and are cost based since 1994 but competitors are not fully satisfied with NTT cost data. Australia: Cost based Directly Attributable Incremental Costs New Zealand: Unlike the Telecom/Clear agreement, the Telecom/Bellsouth agreement used a cost based structure.

Table 4: Interconnect charge structure

Involvement of the NRA

In the different countries which were analysed, the role of the NRA varied considerably for interconnection preparation and within the negotiation process. But it was recognised that:

- **the regulator has a vital role to play in interconnect negotiations** by ensuring that agreements achieved economic efficiency, and by promoting fair competition,
- **independence, effective powers and sufficient experience** are needed for a regulator to develop an interconnection policy.

It was also recognised that as long as the incumbent TO remains the dominant player, interconnection has to be negotiated between the parties under standard terms and conditions (Reference Interconnect offer) which has to be approved by the NRA. Under those conditions, RIO interconnection components should be sufficiently unbundled to allow interconnection at the most technically feasible points of a network.

Technical aspects

As well as interconnection charges, technical and operational aspects of interconnection represent a major component of interconnection conditions which may lead to bottlenecks and discriminatory conditions. Country experiences have highlighted the following aspects:

- availability of standardised interconnection interfaces rich in interconnection services, the use of national standards impedes new entrants to purchase other manufacturers that the incumbent's and requires software adaptations,
- the level of functionalities provided at the interconnection which is often limited to: basic call, emergency and directory enquiry services,
- the coverage in the incumbent's network of the CLI information provisioning or of a billing address information in order to provide unique billing and carrier selection services,
- linked to interconnect charges, the availability of POI located both at transit switch and local switch levels,
- the number of POI, and the lack of capability to choose interconnection spots geographically and by network level, bringing the disadvantage of not knowing the routing in the transit network and the problem to calculate interconnection related costs,
- the lack of guaranties from the incumbent for the quality of service and accessibility of interconnection links, thus it is difficult for other TOs to design quality based agreements with the end users,
- inter TO coordination procedures for the monitoring and the management of interconnection as well as the exchange of billing information,
- the availability of an open arena such as for industry forum to discuss interconnection technical/operational problems and evolution.

	FRANCE	GERMANY	PORTUGAL	SPAIN
STATUS TO GET INTERCONNECTED	Mobile TO's post 97 Individual Licenced PTOs + SPs (switched voice)	Mobile TOs + PagingTOs post 98 Individual Licenced PTOs	Mobile TOs Data TOs,Paging TOs (Special Access)	Mobile TOs (including mobile to mobile)
TIME FOR NEGOCIATION	No formal time limit	No formal time limit	3 months time limit	No formal time limit
DOMINANT MARKET PLAYER	Post 96 >25% market share	Post 96 >25% market share	-	>20%
INTERCONNECT CATALOGUE	Planned Mid 97	Under preparation	No	Yes
POI NUMBER / LEVEL	10 POI Local level 100 POI areas planned	10 POI Tandem level	50 POI/areas Transit level	20 POI areas Transit level
SIGNALLING SYSTEMS	SS7/National TUP + (SSUTR2) ISUP V2 planned 2000	SS7/ISUP V1	SS7/ISUP V1	SS7/ISUP V1 (national version)
INTERCONNECT SERVICES	Basic call + emergency + directory enquiries + call forward + free phone	Basic call + emergency + directory enquiries + call forward + free phone	Basic call + emergency + directory enquiries	Basic call + emergency + directory enquiries + call forward + free phone
PROVISION OF CLI	ISDN+ PSTN users	ISDN users	ISDN users	ISDN users
NUMBERING PLAN MANAGEMENT	Post 98 DGPT	Post 98 BMPT	ICP (shortages) + PT	DGTEL

Table 5: Summary of interconnection experiences in Europe (1)

	FINLAND	SWEDEN	UK
STATUS TO GET INTERCONNECTED	Mobile + Fixed TO's (including mobile to mobile) SP Special Access	Individual licenced Mobile + Fixed TOs + SPs	Individual Licenced PTOs (including mobile to mobile)
TIME FOR NEGOCIATION	No formal time limit	No formal time limit	No formal time limit + ex ante regulation increasing
DOMINANT MARKET PLAYER	-	-	>25%
INTERCONNECT CATALOGUE	No	Telia Interconnect Model	BT Standard interconnect price list
POI NUMBER / LEVEL	13 POI areas (duplication) transit level (local switch + local loop planned)	13 POI areas (duplication) Transit level/Local level (Local loop level planned)	Local level + Transit level (>60 POI)
SIGNALLING SYSTEMS	SS7/TUP planned ISUP V2	SS7/ISUP V1 + ISDN special access	SS7/National TUP (NUP) ISUPV2 planned 98
INTERCONNECT SERVICES	Basic call + emergency + directory enquiries + call forward + free phone	Basic call + emergency + directory enquiries + call forward + free phone	Basic call + emergency + directory enquiries + call forward + free phone
INTERCONNECT ANCILLARY SERVICES	Premium rate services Separate company for operator assistance	Premium rate services Traffic data recording Operator assistance	Premium rate services Traffic data recording Operator assistance
PROVISION OF CLI	ISDN+PSTN users where available	ISDN+PSTN users where available	ISDN+PSTN users where available
NUMBERING PLAN MANAGEMENT	TAC	PTS	OFTEL

Table 6: Summary of interconnection experiences in Europe (2)

3.1.3. Interconnection Major Issues for the Future

With the development of competition and the increasing number of interconnection agreements, the same issues were identified in the different countries visited:

- the regulation of dominant player and the way to determine whether a player has significant market power in the context of telecommunications network interconnection,
- the clarification of the Service Providers status regarding rights/obligations to interconnect,
- the level of undbundling in the interconnection provision, especially the capability to interconnect at the local loop level at transmission level access points at customer line level,
- the extension of an interconnection catalogue to the provision of basic carriages services such as leased lines capacity at wholesale prices,
- the numbering management of non geographic numbers by an independent organisation,
- the interconnection of intelligent networks.

3.2. Country Survey on Portability and Carrier Selection

3.2.1. Carrier Selection

Carrier selection is the facility which allows a user to choose the long-distance carrier independently of the local loop provider. This can be achieved in different ways:

- By pre-selection: the carrier is chosen by the user at the time of his/her subscription. The local loop provider will use this carrier for all calls unless a call-by-call procedure is applied by the user for overriding the pre-selection.

  An option to pre-selection is the prohibition of overriding by a call-by-call procedure.

- By applying a call-by-call procedure: typically by inserting a prefix in front of the dialled number. This procedure allows a subscriber to explicitly mention the carrier to be selected for this call.
- By letting the local loop provider choose the carrier based on such criteria as market share or any other.

Carrier selection can be qualified as:

- Equal Access: when no carrier is favoured (i.e. pre-selection and use of a prefix of same length ensuring the dialling parity).
- Easy Access: when the default carrier is determined by the local operator with the possibility of override through dialling by the user on a call by call basis.

'Table 7: Carrier selection in some countries outside European Union' and 'Table 8: Carrier selection in some European Union Member States' summarise the situation in a number of countries, as per the survey which was conducted[4] (refer to appendix 1 document).

---

[4] *Accordingly, the assertions which are made are based on the time this survey was performed (July 96).*

Following acronyms are used in these tables:

- CIC (Carrier Identification Code)
- CC (Country Code)
- NDC (National Destination Code)
- SN (Subscriber Number)

Following observations can be made regarding carrier selections in the studied countries:

- The US (from 1984) and Australia (from 1993) have given a fair attention to Equal Access, i.e. the availability of pre-selection and over-ride codes. The FCC and Austel have had a major role in this process.
- The UK are only offering an easy access at present time. Moreover this service is available only for BT users.
- In France, the DGPT—the NRA— has created TOs' fora related to Interconnect and numbering (portability and carrier selection). Regarding carrier selection the provision of equal access is planned for 1 Jan 2000 with an intermediate service planned for 1 Jan 1998 which is closer to easy access.

		Pre-selection	Call by Call Carrier Selection	Default Selection
AUSTRALIA	National	From 1993. Currently possible in most areas, with the option to prohibit any call-by-call selection.	Where pre-selection is offered: via an over-ride code. Examples: 1411 Telstra 1456 Optus Elsewhere: '1' as prefix for Optus	Where pre-selection is offered: the pre-selected carrier if any, else the local carrier Elsewhere: the local carrier
	International			
JAPAN	National	Not available.	No prefix for NTT, else 00XY format: Japan Telecom 0088 DDI Corporation 0077 Teleway Japan Corporation 0070	NTT by default.
	International	Not available.	Note: 3-digit prefix for KDD while 4-digit prefix for IDC and ITJ: KDD 001 ITJ 0061 IDC 0041	Not applicable (NTT subscribers automatically get a contract with KDD, ITJ and IDC and then choose on a call by call basis)
NEW ZEALAND	National	Available for NZT, Clear and Sprint.		
	International			
UNITED STATES	National	Available since Sept 84[5].	Code XXX assigned to each operator. Prefix 10XXX, and later on 101XXX.	With prefix '0' or '1'.
	International			

Table 7: Carrier selection in some countries outside European Union

[5] *Pre-selection was introduced in the US from September 1984 as local exchanges were given equal access capabilities in rolling conversation programmes. To begin with, once an exchange had been converted to equal access, their was no immediate requirement for all customers to be balloted on their preferred long-distance carrier. By early 1985, it became apparent hat only around 30% of customers connected to equal access exchanges were pre-selecting a long-distance carrier (either AT&T or one of the other long-distance carriers) whilst the remaining 70% are staying with AT&T by default.*

		Pre-selection	Call by Call Carrier Selection	Default Selection
FINLAND	National	Available from 1994: By agreement with any of the carriers.	Possible. Numbering from 12 Oct 96: CIC format: '10V(W)', examples: 101 Telecom Finland 1041 Telivo 109 Kaukoverkko Dialled digits: [10V(W)] 0X(Y) SN where 'X(Y)' is one of the 13 area codes.	Statistically: based on market share during the last two months.
	International	Not available.	From 12 Oct 96: Either via CIC, format: '99X', examples: 990 Telecom Finland 994 Telivo 999 Finnet International Dialled digits: 99X CC NDC SN Or via '00' access code	With '00' access code: statistically: based on market share per numbering area during the last 2-6 months.
FRANCE	National	From 1 Jan 2000. 2 options: – for local calls – for long-distance calls (via first digit: '0')	Via first digit (different from '0') for 'national-covering' operators else via a '16XY' prefix for other operators.	i.e. via first digit '0': – Before 1 Jan 2000: up to local operator. – From 1 Jan 2000: depending on pre-selection options.
	International	Not defined yet.	Not defined yet.	Not defined yet.
GERMANY	National	Should be available from 1 Jan 1998.	Each carrier is assigned an XX code. Prefix format: 010XX.	
	International			
PORTUGAL	National	Not defined yet.	Not defined yet.	Not defined yet.
	International	Not defined yet.	Not defined yet.	Not defined yet.
SPAIN	National	Not defined yet.	Not defined yet.	Not defined yet.
	International	Not defined yet.	Not defined yet.	Not defined yet.
SWEDEN	National		Now: Telia: 0 NDC SN others: 00X(X) 0 NDC SN Future (from 1998): everyone: 95XX 0 NDC SN, or 119XX 0 NDC SN	
	International		Now: Telia: 009 CC NDC SN Tele2: 007 CC NDC SN others: 008X CC NDC SN Future (from 1998): everyone: 95XX 00 NDC SN, or 119XX 00 NDC SN	
UNITED KINGDOM	National	Not available (planned from 1 Jan 2000).	Currently: possible for BT subscribers: no prefix for selecting BT. To select Mercury: 132 + number, or 131 + access code + number Mercury subscribers can only select Mercury (even from BT). Cablecos subscribers cannot select. From 1 Jan 98: carrier selection code for each operator (easy access).	Till Jan 98: BT by default for BT subscibers.
	International	Not available.	For BT subscribers: to select BT 00 Mercury 132 00, or + 00	BT by default

Table 8: Carrier selection in some European Union Member States

3.2.2. Number Portability

Number Portability refers to the ability of end users to retain their geographic or non-geographic telephone number when they change any of the following: a) their service provider, b) their location, c) their service. Accordingly, the three types of portability are defined as follows:

- **Operator portability** (or Service Provider portability, or Local portability): the ability of an end-user to retain the same telephone number as he/she changes from one operator to another. In addition, emphasis on operator portability carries the constraint of a fixed location, the assumption that the end user has not changed his/her permanent physical location or rate centre
- **Location portability**: the ability of an end user to retain the same telephone number as he/she moves from one permanent physical location to another.
- **Service portability**: the ability of an end user to retain the same telephone number as he/she changes from one type of service to another (e.g. POTS to ISDN).

Most countries which have experienced number portability have focused primarily on operator portability of geographic numbers. Actually, introduction of operator portability is a strong requirement from new entrants in the telecommunications market. In some countries where competition was introduced early, as for example the US, Australia, Finland, and the UK, experiences have been conducted and number portability is operational to some extent. Moreover, number portability is explicitly required in the most recent telecommunications directives of some nations.

Depending on timetable constraints, two main types of solutions are considered for number portability:

- short-term or interim solutions usually based on on-switch existing technology: mainly RCF (Remote Call Forwarding),
- long-term solutions which are based on IN (Intelligent Network) technology and database systems.

However, operator portability is further defined —as for example in the US 1996 Act— as "*the ability of users of telecommunications services to retain, at the same location, existing telecommunications **numbers without impairment of quality, reliability, or convenience** when switching from one telecommunications carrier to another*". Actually, interim solutions suffer from certain limitations: strain on numbering resources, failure to support several services based on CLI (Calling Line Identification), preclusion of efficient routing of calls.

The US and Finland have given the priority to defining and planning the roll-out of a the long-term IN/database. The last report and order of the FCC, dated June 1996, defines that long-term number portability must be provided by all LECs in the 100 largest Metropolitan Statistical Areas (MSAs), according to a phased deployment schedule that begins fourth quarter 1997 and ends Dec 31, 1998. Finland plans the roll-out of a long-term database solution by 1999 with a smooth migration from its short-term solution. Conversely, the UK has studied a short-term solution first and only after has started the study of a long-term solution. Australia had started studying an IN-based solution but, because of the availability of portability due in June 1997 has then studied the short-term solution. Germany and France are in the process of specifying and implementing a short-term solution for 1998.

Table 9: Number portability in some European Union Member States and Table 10: Number portability in some countries outside European Union summarise the situation regarding the operator portability of non-geographic numbers.

The following are the different steps any solution for number portability must address and should help understand some options mentioned in the tables:

1) detect that a number was ported: this can be performed in the initial local terminating exchange or upstream by any crossed exchange,
2) retrieve the information regarding the new destination (within the original subscriber context, or via routing tables, or within a database)
3) route the call to the new local terminating exchange and conveying, in addition to the called number, information such as a carrier code or an exchange code (under the form of a prefix or an additional field). This information is to be passed over the POI(s) (Point of Interconnections) between the donor network and the receiver network (unless the call is originated in the recipient network).

		Schedule	Technical Solution	Comments
FINLAND	Short-term	From 1997	RCF-based solution refined according to the target solution. Use of a prefix to convey a 'X(Y)' carrier code. Format: 1D(hexa) + X(Y) + 01 + number	Smooth migration has been a major concern in the final design of this solution.
	Long-term	By the end of 1999	IN-based solution with a centralised database. Use of a prefix with same format as above.	Specifications of interfaces has been privileged rather than intra-operator procedures.
FRANCE	Short-term	Planned 1998	RCF-based solution foreseen.	
	Long-term	2000	Not considered yet.	
GERMANY	Short-term	From 1 Jan 1998	Adaptation of RCF with use of a prefix, under the form: C_{hex} + $XYZ_{networkID}$ + NDC + SN, conveyed in the 'called party address' parameter of the ISUP Initial Address message.	
	Long-term	Not yet defined.		
PORTUGAL	Short-term	Not considered yet.		
	Long-term	Not considered yet.		
SPAIN	Short-term	Not considered yet.		
	Long-term	Not considered yet.		
SWEDEN	Short-term	Under study.	Query-on-Release / IN option foreseen. Use of a prefix to convey the carrier code.	This solution would allow a smooth migration towards the target full-IN solution.
	Long-term	Under study.	Full IN	
UNITED KINGDOM	Short-term	Operational	'Data Decode': updating the routing tables. Use of a prefix to convey new carrier code. Prefix format: 5xxxxx (where xxxxx is the carrier code) Drop back option as an improvement.	
	Long-term	Very likely 1999-2000	IN based solution under study.	

Table 9: Number portability in some European Union Member States

		Schedule	Technical Solution	Comments
AUSTRALIA	Short-term	1 July 1997	Some form of 'data decode' solution similarly to the UK with use of a prefix to convey the carrier code.	
	Long-term	Not planned.		
JAPAN	Short-term	Under study.	Not defined.	The Telecommunications Council report from 29/02/96 calls for "number portability" schemes in order to facilitate interconnection.
	Long-term	Under study.	Not defined.	
NEW ZEALAND	Short-term	.Planned July 1997	Under study	
	Long-term			
UNITED STATES[6]	Short-term	Operational in most states	RCF-based, or Routing Tables modification, or Flexible DID	
	Long-term	To be operational in the 100 MSAs from Oct 97 to Dec 98.	IN-based solution. Local Routing Number (LRN) solution very likely to be the unique solution (instead of CPC and LANP).	National database system made up of 7 regional databases administered by an independent organisation.

Table 10: Number portability in some countries outside European Union

[6] *The recent Telecommunications Act specifies that the Regional Bell Operating Companies will be free to compete in the long-distance market, but only when they have opened up their own networks by complying with a 14 point checklist. This includes the obligation to provide full number portability. Local number portability trials have now started all over the US. Clearly the Act creates a lot of additional impetus to progress rapidly with the introduction of number portability.*

4. ANALYSIS OF EXISTING INTERCONNECT FRAMEWORKS

Interconnection Agreements are not available in the public domain, except to a limited extent in the UK, Sweden and the US. It is only possible therefore to analyse interconnection agreements from these countries. From the UK, it has been possible to review several interconnection agreements between BT and other interconnecting parties; from Sweden is has only been possible to review a general Interconnection Agreement for interconnection of mobile operators.

AUSTEL in Australia has achieved an interconnection technical and operational framework and completed several conceptual models defining interconnection and Equal Access services.

It should also be said that the consortium benefited largely from the work of the European Interconnection Forum and attended some of their meetings in 1996.

In Europe, the EIF is a group of organisations interested and concerned with telecommunications Interconnection. The EIF is in a close association with ONP-CCP Consultation and Co-ordination Platform. EIF is working on a Framework Interconnect Agreement in order to assist negotiations by drawing on experience from current interconnection agreements and to make available common solutions to interested parties.

Together with the outputs from the June 96 workshop, this information is analysed and constitute inputs to the proposed components of RIOs.

It should be noted that a more detailed analysis of interconnect frameworks is available in the "appendix 1" document.

4.1. BT Interconnect Agreements

Interconnection Agreements between BT, the incumbent PNO in the UK, and several long-distance carrier service providers have been reviewed. The content of the agreements is broadly similar, but the format has varied until recently (when a standard format was adopted) modified for each operator by the addition of Schedules (additional sections) at the end of each agreement.

The agreement document that was analysed at depth is that between BT and Torch (Torch is a private telecommunications operator with an individual licence which emerged from the electricity industry. It provides fixed link, directly connected subscriber services and operates primarily in the North of England). The document is a comprehensive description of the legal and technical aspects of interconnection required for regulation of the interconnection arrangement. The major areas that are addressed are:

- Location of interconnection points
- Technical specifications applicable
- Costs, billing and invoicing arrangements (with reference to BT's standard price catalogue)
- Legal aspects
- Numbering issues: including flow of numbering information and access to databases

- Maintenance (limited)
- Quality of service
- Description of services to be provided
- CLI handling
- Testing
- Network management

In summary, the document is detailed and would be a good basis as a generic interconnect agreement, however, by their nature, it is lacking required detailed information in the following areas:

- Network management

  The agreement requires only that network management information be exchanged between the two parties. No provisions are made for the interconnection or integration of management functions. No strategy is laid out for the development of the networks.

- Numbering issues

  Arrangements for a possible independent numbering authority, and issues of number portability and Equal Access are not addressed.

- CLI data exchange

  The exporting of data to third party operators and the conveyance of CLI data is restricted under the agreement.

- Quality of service

  Detailed quality of service requirements other than basic technical requirements of telephony services are lacking. These may include quality of service assurances for implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering. This is a significant omission.

- Future services

  Understandably for a contemporary agreement, future services such as ATM and broadband ISDN are not described.

4.2. Interconnect with TELIA

Telia offers interconnecting PNOs a termination service, an access service and a transit service. The termination service allows customers of the interconnecting PNO to call to points within Telia's network; the access service allows customers of the interconnecting PNO to be called from Telia's network; and the transit service allows customers of the interconnecting PNO to call third-party customers via Telia's network.

Interconnection agreements with other fixed service operators are not available in the public domain in Sweden. Telia's Model Interconnect Agreement for interconnection to mobile telephone operators' networks was available however, and has been reviewed for comparison with the BT-based agreements. This has provided useful background information. The major areas that are addressed are:

- Location of interconnection points

- Technical specifications applicable
- Costs, billing and invoicing arrangements
- Legal aspects
- Numbering issues: including flow of numbering information (though Telia does not appear to make its numbering database available to the interconnecting party)
- Description of services to be provided
- CLI handling
- Testing
- Network management

This agreement is not as detailed as the BT agreement, and is lacking required detailed information in the following areas:

- Network management

  The agreement requires only that network management information be exchanged between the two parties. No provisions are made for the interconnection or integration of management functions. No strategy is laid out for the development of the networks.

- Numbering issues

  Details are limited to reference to numbering capacity made by the NRA; arrangements for a possible independent numbering authority, and issues of number portability and Equal Access are not addressed.

- CLI data exchange

  The exporting of data to third party operators and the conveyance of CLI data is restricted under the agreement.

- Quality of service

  No details of quality of service targets are given. These may include quality of service assurances for implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering. This is a significant omission.

- Future services

  Understandably for a contemporary agreement, future services such as ATM and broadband ISDN are not described.

- Maintenance

  No reference to such provision is made.

- Testing

  No reference to the testing of hardware to be used to interconnect to Telia's network, except the specification of national standards with which the equipment must comply.

4.3. AUSTEL Interconnection Framework

4.3.1. AUSTEL Approach

Since 91, Austel has been very highly involved in preparing Interconnection/ Equal access arrangements and regulations. The Austel approach has been the following:

- definition of the scope of interconnection: provision of facilities to competing networks and service providers in order to achieve transparent/seamless connectivity between telecommunications users,
- definition of interconnection/ Equal Access principles:
  - Ability of telecommunications users to call other customers irrespective of the TO network they are connected to (Any to any communication / connectivity),
  - Availability of customer choice, and Minimum customer inconvenience,
  - Provision of access services between TOs and provision of a single customer bill per call,
- definition of a minimum set of interconnection requirements:
  - interconnection between networks,
  - access to facilities and ancillary services.

These requirements involve considering access and interconnection as follows:

- interconnection is considered as the physical connection of two networks to allow full interoperability for the provision of any to any capability for customers of all networks,
- access services relates to the access of functionality for the purpose of service provision (e.g. billing systems, databases, carrier pre-selection).

To sustain this approach and to facilitate interconnection arrangements Austel completed an interconnection services model and a technical/operational framework in mid 91. As the issues have become more complex since this start up date, Austel through a progressive industry involvement (NIIF: Network Interconnect Industry Forum) undertook to develop a new interconnection model in 94. This new model has been used to consider a number of case studies and is now under revision for the post 97 telecommunications regime leading to full telecommunications liberalisation.

4.3.2. AUSTEL Interconnection Scenarios – 1991

From the definition of a minimum set of interconnection requirements Austel has defined two interconnection models and scenarios (see Figure 2):

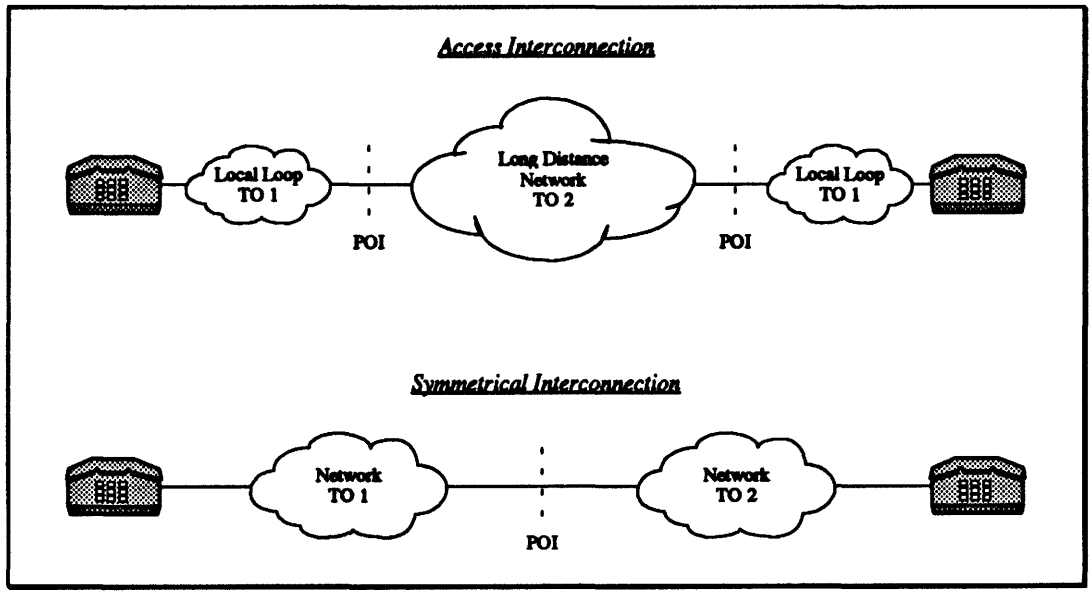


Figure 2: 1991 Austel interconnection conceptual models

Access interconnection

This corresponds to indirect access to a long distance network through another local loop TO by giving the capability for customers to select alternative TO.

The TO controlling the local access has to provide an access service to interconnecting TO.

Symmetrical interconnection

This corresponds to interconnection between two networks where each network delivers end to end services to its own customers.

This was considered for the interconnection between:

- Mobile / fixed networks,
- Fixed TOs having their own local loop.

With this model three types of access service are considered:

- Symmetrical interconnection,
- Access interconnection,
- Equal access service (corresponding to access interconnection in addition to TO preselection).

4.3.3. AUSTEL Interconnection Framework – 1991

On the basis of this conceptual model, Austel completed a technical/ operational interconnection framework (Documented Austel Interconnection Framework 1991) presenting the principles and operational arrangements for the technical aspects of network and service interconnection. It covers:

- fixed to fixed, fixed to mobile, mobile to mobile interconnection,
- access and symmetrical interconnections,
- access to ancillary/ operational support systems,

- end to end service quality and performance,
- co-ordination of technical planning, development and operations,
- access to additional facilities and services (billing, directory, operator services).

The framework defines 4 major building blocks to an interconnection agreement:

- Provision of POI (Point Of Interconnection) between the TOs,
- Specification of end to end service standards,
- Network co-ordination process to define respective roles of TOs for traffic handling support functions,
- Provision of end user services.

POI / Gateway exchanges

The gateway exchanges at the POI handle the carriage of traffic across the interconnection paths and provide the following functions:

- Handle traffic across the interconnection routes according to customer preference,
- Provide facilities / statistics for service quality supervision,
- Network traffic management,
- Network protection,
- Service assistance.

End to end services standards

End to end service standards encompass standards for transmission quality, and standards for signalling interfaces:

- Voice telephony signalling standards,
- Transmission quality,
- Call path integrity,
- Network congestion procedures.

Network co-ordination / forum

Network co-ordination encompasses network management, planning and development procedures to ensure that the roles of each TO with respect to traffic carriage and support functions are clearly defined:

- Customer and network operations,
- Network management,
- Network planning and development,
- Network functions consistency,
- POI dimensioning,
- Crisis situations / disaster,
- Fault handling.

End user services

The framework considers end user services and supplementary services to provide between interconnected networks:

- Basic and supplementary telephone services: local / long distance / international,
- Mobile services + inter working between GSM / ISDN-PSTN services,
- ISDN Services,
- Operator assisted services,
- Billing services,
- Directory enquiries,
- IN services (Calling card, VPN, Freephone services).

4.3.4. New Interconnection Model -1994

In 1994 Austel defined a new Interconnection Model. This Model attempted to facilitate mediation during negotiations and involved the industry consultation through the NIIF. This model (Documented in "Interconnection Model: Multi-Service Delivery Environment", March 1995) identifies 3 groups of services (see Figure 3):

- Fixed network calls to geographic numbers where the location of the called party is fixed and may be deduced by the dialled number. Calls involving preselection or selection by carrier's code are included in this group.
- Special service calls which utilise IN which are not mobile calls and where the location cannot be deduced by the dialled number.
- Calls made to mobile numbers where the network can be recognised but the location of the party is unknown.

For these groups of services, a set of specific rules were introduced where the exact relationships between the TO involved in service delivery have been spelt out and clearly separated:

- local call,
- long distance call,
- IN call,
- call to mobile,
- mobile to mobile call.

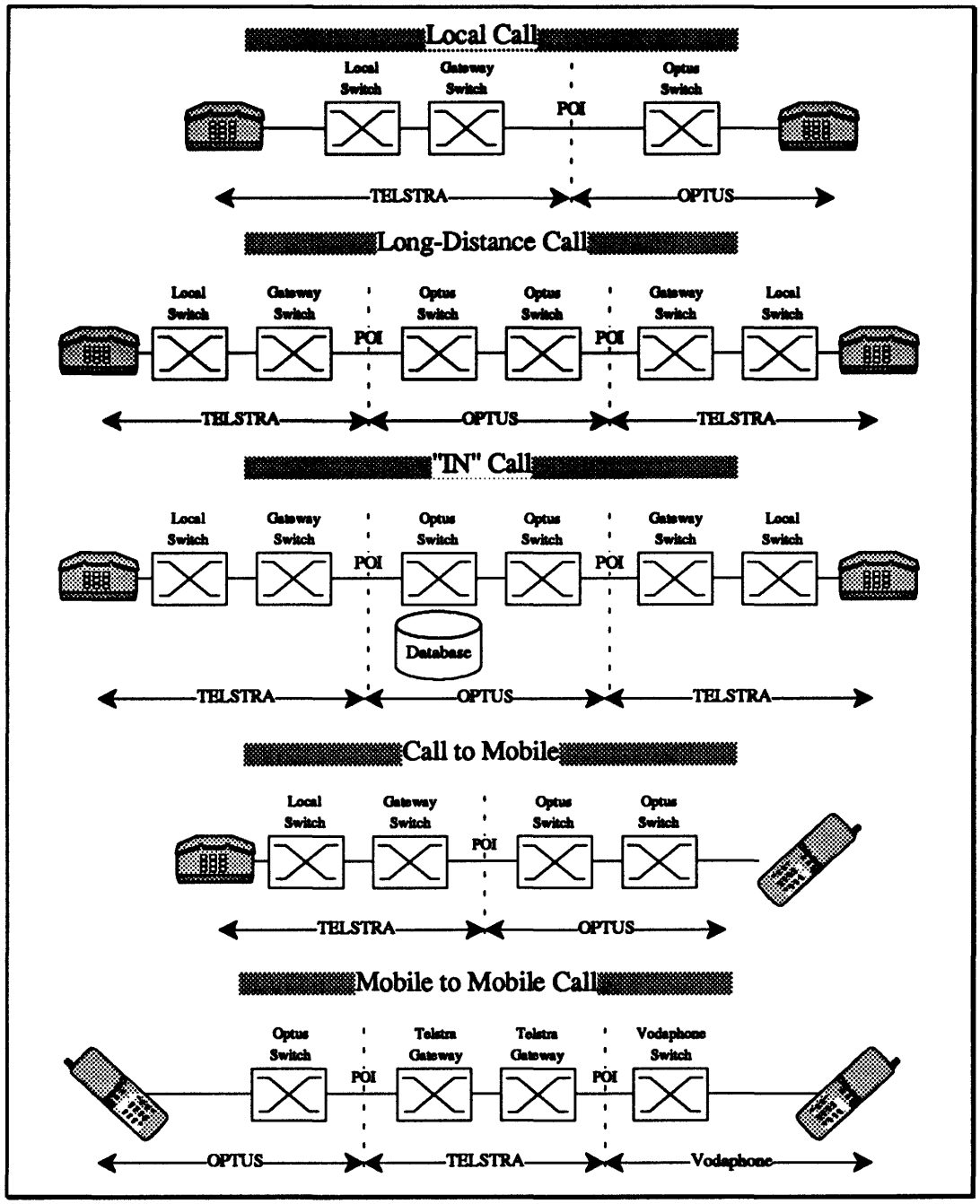


Figure 3: 1995 Austel interconnection conceptual models

Arising from the work on new interconnection model it was proposed to establish the NIIF industry forum in mid 95 in order to ensure consistent inter working between TOs and to provide the relevant specifications for new or enhanced interfaces.

The NIIF activities are focused on technical and operational issues associated with interconnection/Equal Access for Service Deliverers (TOs and SP) including outputs for the definition of a Code of Practise. In the post 97 arrangements this code of practise will be approved by the ACCC (Australian Competition Consumer Commission) which will be responsible for interconnection regulation.

In order to prepare post 97 full competition, Austel introduced, in addition to this model, the concept of Service Deliverer instead of carrier or TO, with the following types of service delivery:

- Originating or Terminating Access Service Deliverer,
- Transit Service Deliverer.

4.4. EIF Framework Interconnect Agreement

4.4.1. Background

The EIF framework interconnect agreement is intended to assist negotiations by drawing on experience from current interconnection agreements. It is to be viewed in the light of current EU regulations and national law and regulation at any given point in time. The document provides suggestions and examples, without prejudice to existing regulatory provisions and is not intended to be a substitute for regulatory obligations. Furthermore, the document is conceived as a 'living document' to be adapted to the changing realities in interconnection. Hence, suggestions and examples are not to be regarded as exhaustive.

The document is drafted under the assumption that interconnection takes place with non-discrimination and reciprocity of treatment.

The document discusses switched voice traffic interconnection, however similar principles apply to non-voice connection, e.g., packet switched services, and non-switched voice or data connections. This document does not address prices and access obligations.

4.4.2. Major Items Covered

The document is structured as a typical interconnect agreement, identifying key items that should be discussed in an interconnect agreement. For each section a description is given of the issues to be addressed and some guidelines are given as to the contact provisions. The complete document, dated October 96, is presented in the appendix 1 document associated to this final report.

Technical and operational aspects covered by the model are the following:

Points of Interconnect (POI) and Interconnect Links

The section aims at defining the conditions for the actual connection of one network to another network. The connection takes place at a Point of Interconnect (POI). The issues that need to be addressed are:

- At what network levels a POI may be provided in each operators network (local, intermediate, etc.). This may refer to a physical network or a system independent structure defined for the purpose of interconnection. Interconnect prices based on a system independent structure will reflect the costs of the physical network.
- The location of a POI in relation to the nodes/premises of the two operators. At what physical locations POIs are offered at a particular point in time (street addresses).
- Each Operator shall offer a reasonable number of locations for POI.
- Interconnect links, e.g. types of transmission links, transmission speeds, ownership of multiplexing and de-multiplexing equipment, arrangements for physical redundancy and alternative routing, national signalling standards (including national changes to SS No. 7) and whether the traffic routes are to be one-way or two-way.
- The lead times for providing a POI (from ordering to node-to-node testing) and interconnect links.

- Where the local law or license condition requires, or where the operators mutually agree, the mechanism for ordering and testing interconnection links furnished by either operator.

Services

Interconnect call services are provided in order to allow any-to-any communication, whereby customers of one operator can call customers of another operator. Interconnect services may also be provided in order to allow customers connected to one operator's network to access services offered by another operator, possibly in competition with the first operator. (The services should include ISDN and subsets thereof, or data services such as X.75.) For each service, principles for charging and call handover should be defined.

Intelligent Network Interconnection

The section deals with the interconnection of advanced network services such as cashless calling, call forwarding and other related value-added services. To offer such services to customers of other operators, the interconnecting operator may provide signalling, database access and call control capabilities. Operators that provide end-user access may seek to use another operator's intelligent network service to supplement it's own voice facilities, where access to services cannot be obtained over the PSTN.

Billing

The section aims at defining the principles and procedures for collecting billing information and settling invoices between the parties. All billing systems should be auditable and tested to verify their accuracy.

Network modification

The section aims at defining the obligation and principles for making changes in one operator's system caused by the implementation of another operator's numbers. An example is the implementation of functions to handle access codes and subscriber/service numbers associated with an interconnecting operator.

CLI

The section aims at defining conditions under which an operator will convey CLI to another operator requesting CLI. This may include:

- The purposes for which the CLI may be used by the receiving operator e.g. billing, call routing, display and validation
- Possible restrictions on the use of CLI including e.g. number presentation
- Free use of CLI for signalling and billing purposes

Quality of service

The section aims at defining the Quality of Service parameters that the parties shall meet, the way to measure the actual performance and the consequences of not meeting the agreed figures. Three types of QoS parameters are identified:

- QoS for Telephony,
- QoS for Interconnect Links,
- QoS for Data Management Amendments.

Interface standards and technical requirements

The section aims at defining the technical standards or specifications that each party shall comply with. The standards and specifications to be applied in the order of precedence set out in the relevant regulations, are as follows:

1. ETSI Recommendations
2. ITU-T Recommendations
3. National standards/specifications

Network design

The section aims at describing relevant network structures of the interconnecting operators and define principles for call routing. It may be based the physical network or a system independent structure, depending on the principles applied for POI provision. The routing principles shall cover routing in normal as well as abnormal situations (e.g. network failure).

Network planning

The section aims at defining the principles for the continuous planning process that must take place between the interconnecting parties. The planning process should include:

- New POIs.
- Changes to the transmission capacity at each POI during an appropriate planning period.
- Detailed rules for call routing.
- Changes to the signalling network.
- New numbering blocks.

Installation, operation and maintenance

The section aims at defining procedures for installation and testing in conjunction with the initial interconnect, as well as in conjunction with upgrading interconnect facilities, e.g. new POI, new services and new number blocks. This section shall also define the principles for the continuous operation of the interconnection, including network/traffic supervision, fault/disturbance reporting and fault recovery actions.

System protection and safety

The section aims at defining the obligations each party has to protect each others network and measures to prevent endangering people.

System alteration

The section aims at defining the principles for dealing with changes in the system of one operator, that may have an impact on the system of the other operator where the change is agreed or where the alteration is part of a planned upgrade programme.

Provision of Information

The section aims at defining rules for providing information on the existing network e.g. network structure and interfaces. Information should be provided on planned

changes to the network structure or hierarchy, as well as planned changes to transmission and signalling systems that may impact other operators.

4.4.3. Operators Position on EIF Framework

The EIF framework interconnect agreement is the result of negotiations between dominant PTTs and alternative operators. Therefore, finding a common position on most issues is difficult.

In particular, when developing the EIF Guidelines, no common position on the following issues has been achieved:

- alternative operators' ability to choose call routing or to see PTOs network architecture (thus the option for a "System Independent Structure")
- location of the point of interconnection: PTOs wanted the POI within the terminating equipment (DEF, MUX, LTE) whereas others wanted the POI located between both operators. The EIF Guidelines compromise was to draw a line on a diagram showing that the POI could be anywhere, inside or outside of the switch.
- Network modification costs: the PTOs should clearly state what kinds of additional charges they will impose for network modification, and fully justify them.
- Implementation times: most PTOs have an order interval that is much longer than a mobile operator requires, and much longer than a mobile operator experiences with self-provided microwave links. (90-180 days is a common installation interval across Europe, whereas the average microwave installation period for mobile is 50-60 days).
- Need for a good faith estimation process for capacity needs.

5. Main Outputs from the June 96 Workshop

It should be noted that a more detailed analysis of the outputs from the June 96 workshop is available in the "appendix 1" document.

The various surveys led to an interim workshop in Brussels (12 June 1996) attended by more than 100 participants from the industry. The purpose of this interim workshop was to share some first impressions and preliminary results with the participants, invite comments from them and integrate them in the process of the study. The workshop was the occasion of fruitful discussions around key points such as the emergence of infrastructure versus service competition and many written comments were received over the July-August period.

5.1. General Comments

Attendees considered that the issues presented in the workshop had sufficiently covered the current concerns of the various players and NRAs. There was a general request for a clarification of the direction of the regulatory framework (focus on infrastructures versus focus on services) proposed by the Interconnection Directive in order to better evaluate the technical recommendations and the framework to be proposed in the study.

In particular, a major question arose: do we want to open the telecommunications market by encouraging investment in new infrastructure or by opening the dominant network to new entrants who provide new services without owning their own network?

The industry participants thought that a clear idea of the policy objectives was necessary to prepare a technical interconnection framework.

5.2. Detailed Comments on Interconnection Regulation and Issues

Many detailed comments on interconnection specific issues were provided by the attendees. Main comments were related to the following aspects:

- framework policy objectives should aim at facilitating interconnect to the PSTN for new entrants. Incumbent PTOs and especially the local loop represent a "bottleneck" which prevents competitors from fair and equal access to the telecommunications market,
- mobile network interconnection could be ruled under a special framework,
- status and rights/obligations to interconnect between TOs and SPs need to be clarified,
- while an "any-to-any" interconnection principle is necessary to ensure complete interconnectivity, other important interconnection obligations should be the responsibility of the PTOs such as unbundled access at any technically feasible point,
- the technical/operational framework should be written at a European level by the EIF, with endorsement of the EC,
- once the general principles have been established by the EC, the EIF can be used to discuss interconnection practical implementation issues,

- numbering issues should not be addressed in the technical framework, these issues are already studied in the European numbering forum,
- a technical/operational framework at the European level is in addition and not in replacement of interconnect service catalogues to be provided by incumbents,
- VPN is an important issue which should be covered by the technical framework in the future,
- an interconnection framework for Trans-European service provision will be necessary in the future.

Interconnection rights and obligations

New entrants should have an affirmed right to interconnect to the public switched telephone network (PSTN). Such interconnection should be transparent, cost-oriented, and non-discriminatory as set forth in the Interconnection Directive Proposal. Certain obligations must be borne by the PTOs in order to ensure that emerging competitors are able to establish themselves in the telecommunications marketplace.

Extending similar affirmative interconnection obligations to all network providers including the former PTO monopolies, as suggested in the Interconnection Proposal, is counterproductive to rapid development of a competitive market and inconsistent with the concept of proportionality. Competitive network providers do not represent a bottleneck to the provision of emerging services, and therefore should not be obligated to connect other providers to their networks. The key to interconnectivity is the public switched telephone network: as long as all networks have the opportunity to connect to the PSTN, interconnectivity will be achieved. Therefore, a different and more stringent set of interconnection obligations should be imposed on the PTOs.

Direct interconnection between two competitive networks by bypassing the PTO will occur as dictated by market needs, in situations where the benefits outweigh the costs, in a manner which is far more efficient than that which could be promoted by regulation.

Dominant player regulation

In order to determine whether there is significant market power in the context of telecommunications network interconnection, many new entrants consider that it is necessary first to determine which particular telecommunications market is to be examined. The acquisition of a license to install or operate a telecommunications network or to perform specialised telecommunications services does not imply that the licensee enjoys a position of dominance with respect to the provision of interconnection. The market for which the analysis of significant power relative to interconnection should be undertaken should not be the overall telecommunications services market but rather the interconnection market.

Means to limit mediation process

It was recommended to include in the study a framework for Rules of Engagement among TOs, SPs and VPN service providers in order to limit mediation periods. The framework may be in a form of a template of agreed parameters between the TOs, SPs for ordering interconnection. It is not to dictate internal business processes but to provide guidelines to assist those TOs, SPs that have not experienced interconnections in this realm. Possible parameters may include at least the following: department identified for engagement, electrical interfaces, signalling interfaces, quality of service targets for interconnection, billing parameters and medium and fault management.

Mobile operators regulation

Attendees from the US expressed their preference for having a separate framework for fixed/wireless interconnection. They consider that the difference between fixed and mobile is justified. because mobile networks do not offer local exchange services as a substitute for those provided by the PTO networks. Wireless operators should not be treated as a PTO nor constrained by local exchange obligations. The US model treats mobile operators separately from Local Exchange Carriers, particularly to foster competition between the two.

Carrier selection issues

Some attendees think that "Easy Access" (carrier selection by prefix) would suit the level of competition in EU Member States as a first step. They consider that "Equal Access" (pre-selection) works well when alternative service providers are already highly competing with an incumbent PTO. The market competition in Europe is far from reaching this level as of now. They feel it will be necessary to review the efficiency of the method of carrier selection as the level of competition grows in the future. At that point Equal Access may become more appropriate than Easy Access.

VPN SP right to interconnect

Some TOs expressed the following viewpoint regarding Service Providers' and VPNs' right to interconnection:

- VPN and IN services are simply additional services and should be treated as such,
- there should not be an obligation for competitive operators to interconnect with SPs.

In contrast to this there was a request from Service Providers such as SITA and IBM that the interconnection rules being developed at the EC level should be made applicable to VPN service providers:

- Interconnection rules that classify telecommunications service providers in terms of types of licences will create discrimination against those service providers that can not benefit from these rules, such as VPN service providers.
- In the service markets where various types of telecommunications service providers compete with each other providing more or less the same services, creation of disadvantages to certain types of service providers in the regulatory framework will be harmful to the sound development of a fair playing field in the telecommunications markets.

Interconnection framework for VPN providers

From Service Providers' (like SITA and IBM) point of view, the scope of the study should include specialised providers of VPN services but in the current focus of the study, interests of "voice telephony service" providers alone are included. These providers in the study are defined as TOs and SPs, where the former own switched voice telephony network infrastructure and the latter do not own the infrastructure. These players believe that the focus is too narrow to correctly reflect the reality of competition in service provision.

Distinction between "voice telephony service providers" and other types of voice services (such as VPN) may make sense in terms of the status defined by a licence granted to each telecommunications service provider. In the market however, no substantial difference between services provided by TOs/SPs and VPN service providers may be observed in terms of the nature of the services provided to end-users. New market entrants (TOs and

SPs) in liberalised markets typically begin their business by providing services to large corporate customers, rather than to address individual households from the beginning of market entry. VPN service is a typical example of a service addressed to large corporations. In order to efficiently obtain a substantial share of the voice service market, TOs and SPs naturally focus their marketing efforts to a group of large customers.

TOs, SPs and VPN service providers will continue to compete with each other in many service markets for a number of years. VPN service providers thus play an important role in order to stimulate competition. In fact, the border between TOs/SPs and VPN service providers is blurring. TOs/SPs may provide value-added services serving a specific customer segment (such as large corporations).

Cross-border interconnection

A list of the unbundled pieces to be offered for interconnection with a fixed network is mandated in the draft EU Directive, and is essential in bringing down the monopolistic interconnection charges the PTOs currently offer. For cross-border interconnection, a standard list of products would make the interconnection process more efficient.

5.3. The Need for a Technical/Operational Framework at the European Level

In the opinion of the attendees of our workshop a technical/operational Interconnection Framework is necessary in addition to the regulatory framework proposed by the EC Interconnection Directive: without a specific framework, an incumbent public telecommunications operator (PTO) could easily control all aspects of fair competition especially by controlling the local loop. They consider that the proposed Framework Directive by the European Commission (EC) is not specific enough to prevent anti-competitive practices. The technical and numbering issues need to be adopted at the European-wide level in line with the EU policy in support of competition. If these issues were to be left at the national level, it is anticipated that half of the Member States would not conform to the principles of the Interconnection Directives.

Position with EIF framework approach

According to the attendees an interconnection framework approach proposed by an independent source in addition to the *EIF Interconnection Guideline* would be valuable. Most attendees believe that the technical/operational framework should be written at a European level by the EIF, with endorsement from the EC. Ownership by the EIF would be ideal, given that their membership comprises all sectors of the telecommunications industry.

Ownership at the national level would unnecessarily focus interconnection policy too low and thereby decentralise the resolution of interconnection issues. This would work against one of the key objectives for the framework and the EU – harmonisation. Industry forums are seen as useful in bringing together involved parties to resolve key issues. These forums should be conducted at the EU rather than national level and should be organised so as to avoid the challenges posed by industry competitors obstructing each other's initiatives for purely competitive reasons.

PART II. TECHNICAL ISSUES

The technical analysis surveys the options for technical regulation across a wide range of areas related to telecommunications interconnection and equal access, in order to draw conclusions about the technical directions that regulatory control and standardisation should take at a European level. It addresses:

- the requirements for interconnection and interworking which arise as a result of user service offerings and developments (e.g. call completion, number portability);
- currently supported standards and additional standardisation work required for interconnection, covering all relevant NNI interfaces;
- alignment of these standards with existing TO technical solutions;
- technical constraints related to interoperability testing, network integrity, billing needs, data security etc.,
- manufacturer views on interconnection and equal access.

The main focus of the analysis is on 'normal' current voice networks and services, based on local switching control – the PSTN, GSM, ISDN etc. – which corresponds to the type of interconnection currently operated in deregulated countries,

However there will be an increasing trend towards the use of IN solutions and value-added public services (e.g. through the SS7 INAP), and these have also been included to ensure that the EII does not become obsolete too quickly. Therefore IN network interconnection is considered on the service aspects and the standardisation state of the art.

6. DEFINITIONS

6.1. Type of Access to Public Operator Networks

The ONP Voice Telephony Directive identifies three types of network access:

- **Access at "commonly-provided" network termination points.** This is the normal type of customer access. **It corresponds technically to a User to Network Interface.** Charges are based on published retail tariffs.
- **Special Network Access.** End users, service providers and telecommunications organisations when not providing voice telephony services, may require "Special Network Access" to the fixed public network at other points that the network termination point. Technically there may be little difference between interfaces available under Special Network Access and interfaces available under Interconnection. **It may correspond technically to a User to Network Interface or Network to Network Interface.**
- **Interconnection.** It concerns the interconnection between telecommunications organisations providing fixed or mobile public telephone networks in the same Member States or in different Member States. **In most cases, it corresponds technically to Network to Network Interfaces.** Technical and commercial agreements for interconnection are a matter for agreement between the involved parties subject to intervention by the NRA.

This study refers to UNI and NNI as follows:

- User to Network Interfaces (UNI) are related to the access point where TOs provide telecommunications networks and services to users. The ITU-T (I112) definition settles that a UNI is the interface between the terminal equipment and a network termination at which interface the access protocols apply. UNI are provided at the Network Termination Point (NTP) which represents the regulatory boundary. UNI are ruled under approval conditions for approved telecommunications equipment compliant with essential requirements.
- Network to Network Interfaces (NNI) are related to interfaces between national TO networks or between international TO networks, they correspond to interconnection between telecommunications network logical peers. The ITU-T (I112) definition settles that a NNI is the interface at a network node which is used to interconnect with another node. The Point of Interconnection (POI) represents the regulatory boundary that marks each TO for the successful handling of internetwork traffic. NNIs are ruled under essential requirements. One major characteristic of NNI is the symmetrical relationship they establish.
- The major NNI component considered in the report is the inter-provider exchange of information within the service control layer of a public voice network (ISDN, PSTN, GSM, IN). This corresponds to the interconnection of signalling system interexchange messages in the majority of current networks (PSTN/ISDNs) but needs to be interpreted more subtly for newer services (VAN and IN services, including VPNs).

6.2. Voice Public Networks Classification

As far as public networks increasingly employ sophisticated and powerful computing and control functions resources in the delivery of services, we propose to define two basic types of public voice networks implemented by TOs. Technology for interconnection will be associated to each type:

- **Local processing: non IN or "current" public networks** such as PSTN and ISDN, where control functions and service management are provided locally and not separated from call handling functions in a switch. Non IN networks can provide numerous facilities such as CLASS services, ISDN supplementary services. Facilities such as call waiting or short code dialling may be provided without additional distributed network intelligence.
- **Remote processing: IN public networks** where service management and control functions are distributed and separated from the task of establishing a communication channel. The term IN is used both to describe an architectural concept which aims to ease the introduction of new services, and to define "advanced services" such as freephone and VPN, but may also provide more easily existing services.

IN applications embrace both voice telephony services, advanced services, back office applications such as billing and routing management, by using function entities in addition to non IN networks call processing entities. For example, GSM networks use IN service control and management functions for the provision of roaming capabilities, in addition to a non-IN network for the call completion and the provision of supplementary services such as CLI, call forwarding (PLMN part). Figure 4 shows the difference between the two kinds of service architecture.

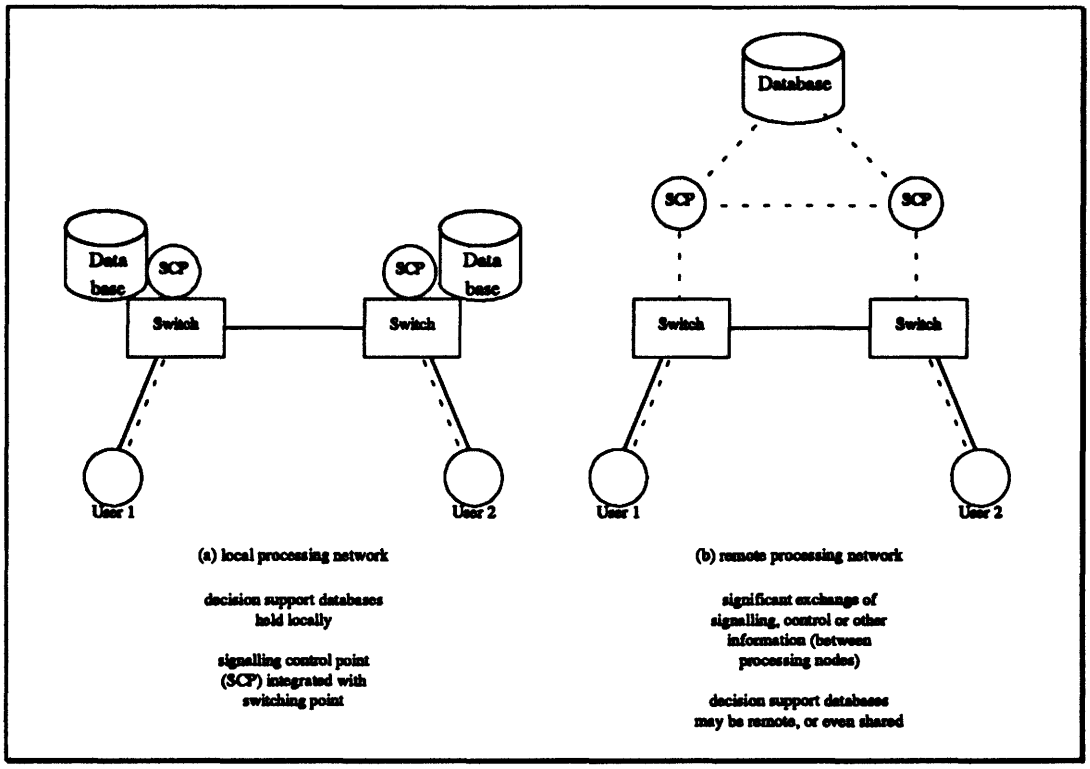


Figure 4: Network architectures and approaches

7. APPROACH TO INTERCONNECTION SERVICES

7.1. Users Requirements

The future regulatory environment will involve multiple TOs and multiple Service Providers. In such environment Interconnection and EA must be ensured to comply with two key principles:

- the capability of any TO's customer to call other TO's customers by using standard dialling procedures irrespective of the TO network they are connected to (end to end connectivity/any to any communication),
- the availability to any customer served by a TO or by a Service Provider to select other TO or SP networks (TO selection/ customer choice).

In addition the proposed ONP Interconnection Directive calls upon NRAs to encourage the earliest possible introduction of local portability, in order to allow a user to change his TO without changing his phone number.

Interconnection between competing networks and Service Providers has to achieve a seamless connectivity between the telecommunications users requiring public voice services. **The basis for the analysis of technical aspects is the requirements for service delivery and service development for users. This includes a range of aspects:**

- simple call functions – point-to-point voice telephony based on dialled numbers;
- call information functions – CLI functions etc;
- enhanced call functions – ISDN supplementary services;
- special call functions – emergency calls etc.;
- special billing functions – freephone, calling card, etc.;
- network functions – VPNs etc.;
- functions of a competitive supplier market – equal access, number portability etc.

Each one of these are analysed in respect to the constraints they impose on the interconnection of operators, for parameters such as:

- need to transfer call information;
- need to transfer routing information;
- need to transfer tariff information;
- need to transfer subscriber information.

In turn these impose a need for:

- harmonised information exchange standards;
- real-time (within signalling interexchanges messages) and non-real-time communications (exchange of management, billing information paths between operators);
- network security (e.g. to meet data protection and maintain quality of service).

7.2. Networks and Services

The usage of existing operator networks is still very largely based on 'simple' telephony functions provided by POTS, i.e. call connection on the basis of dialled number and call completion using TUP-like standards. Operators are at varying stages of updating their access, trunk and (particularly) signalling networks to provide more complex services, in both voice and data communications.

A broad distinction can be made between:

- network architectures and services that rely on ***local processing*** **(non IN networks)** for decision making – routing tables at exchanges based on the 'look up' of relevant flags and routing tree decisions. **In this kind of architecture a call has, during routing and switching, no 'memory' of where it has been.**
- network architectures and services that utilise ***remote processing*** **(IN networks)** for decision making – specifically 'intelligent network' architectures, with centralised switching control based on databases of customers, lines, services, tariffs or other aspects. **In this kind of architecture a call carries with it, during routing and switching, complex information regarding its nature and origin**

7.2. Networks and Services

The usage of existing operator networks is still very largely based on 'simple' telephony functions provided by POTS, i.e. call connection on the basis of dialled number and call completion using TUP-like standards. Operators are at varying stages of updating their access, trunk and (particularly) signalling networks to provide more complex services, in both voice and data communications.

A broad distinction can be made between:

- network architectures and services that rely on ***local processing*** **(non IN networks)** for decision making – routing tables at exchanges based on the 'look up' of relevant flags and routing tree decisions. **In this kind of architecture a call has, during routing and switching, no 'memory' of where it has been.**
- network architectures and services that utilise ***remote processing*** **(IN networks)** for decision making – specifically 'intelligent network' architectures, with centralised switching control based on databases of customers, lines, services, tariffs or other aspects. **In this kind of architecture a call carries with it, during routing and switching, complex information regarding its nature and origin.**

As they move from TUP towards ISUP and beyond, networks are undertaking more and more of the latter kind of function. For instance CLI is routinely transported in the signalling network, while certain specific services are handled by partly or fully centralised IN functions (e.g. phone card, freephone and premium rate services). In the long term, network services will increasingly be provided in this way, which provides a more flexible and potentially more efficient approach for operators. However the feasibility of harmonising interconnection arrangements is very different between the two service types.

7.3. Interconnection Set of Offerings

User requirements may be classified following 5 modules of services which need to be addressed at a pan European level between interconnected TO networks.

Module 1, 2 and 3 services correspond to end-user services which can be provided through interconnected networks. Module 4 and 5 services correspond to special service requirements arising from a competitive environment:

Module #	Title	Services
Module 1	Basic call/ customer care and billing services	Basic call connection CLI services (CLIP, CLIR, MCID) Access to Directory Enquiries Emergency services Billing services (AOC, provision of itemised and unique billing)
Module 2	ISDN/GSM supplementary services	End to end ISDN supplementary services between two fixed networks End to end GSM supplementary services between two mobile networks Common ISDN/GSM supplementary services between a fixed and a mobile network
Module 3	advanced services	VPN services IN advanced services (Freephone, Premium rate, Virtual calling Card, UPT)
Module 4	carrier selection services	Per default Carrier Selection call by call Dialling Parity or Carrier Pre-selection
Module 5	number portability	Local geographic number portability GSM number portability 800 number portability Non geographic number portability

Table 11: Service Modules

Module 1, Module 2 and Module 4 interconnection services can be provided by using non-IN network interconnection techniques and standards. Except for some local portability solutions, Module 3 and Module 5 interconnection services require IN interconnection solutions because these types of services rely fundamentally on the exchange of applications layer.

8. NON-IN NETWORK INTERCONNECTION

Interconnection of local processing networks requires primarily standards of two kinds:

- at the physical (electrical), data link and network (addressing) levels, using standards such as G.703, V5 interfaces,
- on exchange of circuit related signalling messages and charging details (the primary focus of ITU-T SS7 in interconnection).

This can be enhanced over time by the addition of specific SS7 information elements such as CLI exchange and non circuit related signalling information for supplementary services.

8.1. SS7 Standards for Interconnection

Signalling system No.7 (SS7) aims at providing a common channel signalling for use in circuit switched networks: PSTN, ISDN, CSDN and GSM. SS7 has primarily been defined by ITU-T for its use at the international level. In Europe, ETSI has transposed ITU-T standards to ETSI versions in order to define adaptations to European countries.

SS7 is now widely used in European and North American public networks although the national coverage of SS7 may vary from one country to another. **TUP and ISUP have been designed first at an international boundary (e.g. between two different networks). Therefore, in principle these standards are appropriate for the interconnections of different operators networks in the same country.**

Telephony User Part (TUP) which defines the formats and signalling procedures to be used for PSTN calls and ISUP for ISDN/GSM basic calls and supplementary services, have been designed first at an international boundary between two public voice networks. In principle these standards are appropriate for the interconnections of different TO networks in the same country for the provision of fixed or mobile voice telephony services.

As far as SS7 protocol architecture is structured according to OSI layered model, different SS7 layers (user part) may be concerned for the interconnection between two networks and may be considered in an interconnection agreement to provide the service modules. Figure 5 shows the different SS7 user parts which can be concerned for the interconnection between two networks and need to be considered in an interconnection agreement.

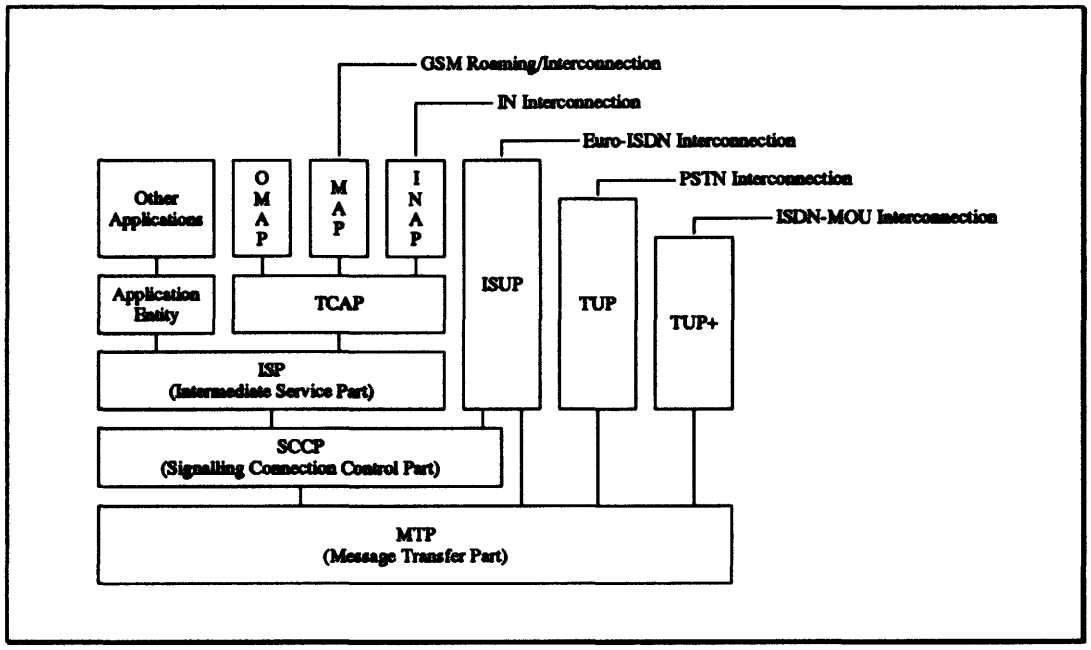


Figure 5: Current SS7 layered model

8.1.1. Provision of Interconnection Services

Module 1 services

Module 1 interconnection services require the exchange of the following information at the NNI:

- circuit related signalling information, for the call completion,
- customer related information (calling party number including presentation indicator and redirecting number),

This information is commonly included in the signalling messages of the TUP, TUP+, ISUP user parts. Therefore the basic voice services (those provided by a PSTN) corresponding to Module1 interconnection services can be provided on an end-to-end basis by using any of the following interconnection protocols:

- TUP,
- TUP+,
- ISUP.

Module 2 services

Module 2 services will require for the completion of some supplementary services like CCBS or call forwarding the exchange of non circuit related signalling information.

In order to provide ISDN supplementary services between two ISDN networks, the following interconnection protocols can be used:

- TUP+ (to have the ISDN MoU level of services and Module 1 interconnection services),
- ISUP V1 (to have the ISDN MoU level of services and Module 1 interconnection services),

- ISUP V2 (to have the full set of ISDN services/local number portability, Module 1 and Module 2 interconnection services).

In order to interconnect a GSM network to an ISDN network, ETSI has defined interworking standards 1 which are based on ISUP. Two ETSs exist:

- **ETS 300 303 which is based on ISUP V1** and provides the same level of service as ISUP V1 for the interconnection of GSM phase 1 networks to public ISDN (to have the ISDN MoU level of services/Module 1 interconnection services),
- **ETS 300-646-1 which is based on ISUP V2** and can potentially permit the same level of service as ISUP V2 for the interconnection of GSM phase 2 and DCS 1800 networks to ISDN (Module 1 and Module 3 interconnection services). It is worth noting that some of the services supported by ISUP V2 are not provided by GSM phase 2 networks (some are in phase 2+). However, ETS 300 646-1 does not limit the interface to those services supported by GSM phase 2 in order to facilitate the future extensions. In addition, specific services provided on GSM networks such as Call Barring and Advice of Charge do not impact the interconnection interfaces because they are provided locally by the GSM operator.

8.1.2. Migration from National TUP to ISUP

Because of the long time period to complete standardisation, many European PTOs, such as British Telecom, France Telecom, Deutsche Telecom, have first implemented specific national SS7 versions for their PSTN and ISDN in order to provide services which were not standardised. These proprietary upgrades have led to national ISDN software versions which are difficult to realign with ETSI/ISUP standards. With the implementation of Euro-ISDN, PTOs are now working on the migration of their national SS7 systems towards ETSI/ISUP compliant signalling systems.

In addition, the signalling protocol used at an interconnection interface can differ from the signalling protocol used inside a PTO network. However, in order to allow the interworking of end to end supplementary services between two TO networks it is critical to ensure the consistency between the signalling messages, information elements and procedures at the interconnection interface. This consistency requires the mapping between the internal protocol and the interconnection protocol.

When the interconnected networks are operating ISUP internally the situation is easy. However, if the internal protocol of a public network is different from ISUP and based on a national version, which could be the case for some years in some Member States, a mapping function is needed between the existing signalling protocol and ISUP. **Since it relies on specific signalling protocols used by incumbents, mapping functions should be achieved by the incumbent.**

Some interworking cases have already been standardised by ETSI and ITU-T between ISUP and older signalling protocols. The mapping of national protocols should comply with the existing ETSI interworking standards at least for the basic call and a Module 1 set of interconnect services.

8.2. Promotion of ISUP as an Interconnection Standard

Most European countries are migrating to ISUP (V1 or V2) to support their EURO-ISDN offering. In addition, the latest ETSI interconnection standards are based on ISUP. **Therefore, it appears that ISUP is the best candidate for the interconnection interface between two operator networks.**

The provision of ISUP starting in 1998 provides the following advantages:

- ISUP enables the operation of multi-vendors networks, therefore it can facilitate the entry of European manufacturers to provide the new operators,
- ISUP will enable new operators to be independent from the incumbents and to choose the equipment providers who are the most appropriate for their business,
- Even if there will always be a national specific part (e.g., charging procedure unless inter-operators charging is harmonised then standardised) a whole range of services are already available in stable ETSI standards,
- as far as ISUP is being permanently enhanced by ITU-T and ETSI to introduce new services (e.g. VPN with ISUP+ to support DSS1+) ISUP guarantees the evolution of telecommunication services which is the contrary with national standards that seem to arrive at a stage where any new additional service needs a lot of effort of specifications and engineering,
- the use of standardised equipment will decrease the price and promote the whole telecommunications market.

However, none of the European countries has a complete coverage of ISUP signalling system in its national public network. Therefore, even if the ISUP has to be considered as the target solution for interconnection signalling protocols, national protocols will certainly be used during a transition period. The transition period will depend on the investment that the public operators can put to complete the migration towards ISUP. In most cases, national standards will still be operated internally by an incumbent.

In order to ensure the consistency of end to end supplementary services PTO should provide, in a reasonable time scale, ISUP compliant interfaces at POI, ensure the interworking capabilities between ISUP and their national protocol, and provide to the new entrants the mapping capabilities.

The provision of ISUP interconnection interfaces by the incumbent has to be balanced with the number of available POI provided to the other TOs. Insufficient number of POI may impact on interconnection charges and the geographic coverage of services available to new TOs.

National Regulatory policy should decide if ISUP should be mandatory as interconnection interface starting from 1998 or if national standards can be accepted during a transition period. If the provision of SUP/POI is mandatory and if the incumbent cannot achieve a full coverage of ISUP in each interconnection area, NRA should ensure that interconnection is provided on distant POI at the same price that to the nearest area.

8.3. Continuity of Service at the Interconnection

8.3.1. Service Continuity Requirements

It is important to get successful market competition to enable new entrants to provide the same level of service as the dominant operators at least for voice services: basic call, and voice supplementary services. **Therefore the interconnection interface has to be as complete as possible to achieve at least the continuity of all end to end services offered by the incumbent, in order to avoid discriminatory conditions for the new entrants in the service provision.**

In addition, the interconnection interface should also have an inherent capability to support the future evolutions towards all the standardised services. Enhancement capabilities should be planned at the interconnection interface in order to allow competitors to offer the same level of standardised service if they want.

In a competitive market on the other hand, operators will try to introduce unique and special features especially intelligent network services to differentiate their offerings from their competitors. In this case, service differentiation is in contradiction with the provision of the full signalling capabilities at the interconnection interface. The provision of these special features at the interconnection interface should be left for commercial negotiation between operators. The major problem with these special features could be the lack of terminal portability between each operator's network. Incumbents will keep the advantage to introduce new services to more users.

8.3.2. Impacts on Interconnection

The services that digital telecommunication networks (e.g. ISDN) are able to provide can be divided into four categories:

- those which are **provided locally** such like CLASS services,
- **services requiring end to end transmission of Information Elements** like CLI services (CLIP, CLIR, MCID) and Advice of Charge services which are provided locally by the terminating local exchange. Because this information is based on data from the originating local exchange or from the long distance carrier they require the transmission at the interconnection interface of:
  - **CLI information** (with the screening and presentation indicators information),
  - **AOC information** elements,
- services like CW and CF (Call Waiting and Call Forwarding) which impact the internal SS7 signalling protocols and the interconnection interface for the **notification of the service** (for example to deliver the indication to called/busy party that a new call is arriving and to inform the calling party that the called person is busy and that the Call Waiting feature has been activated),
- services like CCBS (Call Completion on Busy Subscriber) which impact on the internal SS7 signalling protocol and at the interconnection interface for **processing reasons**. This kind of service requires the exchange of supplementary SS7 signalling messages and information elements between the terminating and the originating Local exchanges in addition to the call completion phase. This kind of service implies non circuit related signalling.

TUP+ and ISUP V1 ensure the mechanisms for the transportation of end to end information elements. ISUP V2 provides the mechanisms for the implementation of end to end services between two networks.

The provision of ISDN services at the interconnection interfaces should be aligned with the implementation of ISDN services in the incumbent's network.

8.3.3. ISDN Service Interoperability

In order to promote EURO-ISDN service and supplementary services in Europe, PTOs have developed, within the EURESCOM project and ETSI Project Team, a methodology for the testing of end to end ISDN services between two ISDN interconnected with ISUP standards.

This methodology is available and include test suites and test equipment. The EURESCOM approach for end to end service interoperability is the following:

- definition of functional test suites to verify end to end (UNI to UNI) service interoperability,
- definition of monitoring tools based on ISUP protocols for node to node interoperability at the NNI between two ISDN in order to monitor the signalling ISUP messages at the NNI and to provide fault localisation,
- specification of a traffic route testing system for end to end quality of service measurement.

This work is fully completed and available. EURESCOM is now working on the application of this approach to heterogeneous networks: for example for the interoperability of services between a GSM and a ISDN network.

We recommend to promote the EURESCOM approach and test suites to test end to end service interoperability at the interconnection between two TO networks.

8.4. Additional Technical Conditions

8.4.1. Reliability of User Identification at the Interconnection Interface

Calling party number

In the case of interconnection of a local loop operator with a long distance operator, reliable calling party number information at the interconnection interface is crucial because the long distance TO needs to identify the customer that has issued the call in order to:

- verify if the caller is authorised to ask for a call,
- apply any service or filtering required by the identified customer,
- send relevant AOC information during call if this is required by customer,
- register relevant information in order to be able to establish the bill.

The identification of the customer is made by the **calling party number** information. Care should be taken with ISDN where this number may be provided by the user. **The TO shall be confident in the calling party number received. So this information should be provided by the local loop provider and screened.**

If the call has been forwarded, the important information is no more the calling party number but the **redirecting number** which contains the number of the party that asked to forward the call to a new number. The user designated by the redirecting number is the one to be billed.

If the called user requests MCID, an indication to trace the call should be provided at the interface: it could be the **registration of a call reference** in order to be able to associate later on this reference with the information memorised by each involved TO.

Emergency calls

Handling of emergency calls is an important requirement for interconnected networks. Emergency calls shall be given priority to ensure the maximum chance of success whatever is the number of TOs involved.

In order to allow emergency service operators to obtain maximum information for the identification and localisation of the caller, CLI is necessary for inter-TO emergency calls.

8.4.2. AOC/Charging Settlement

Customer billing arrangements and the obligations of each TO with respect to billing services will be critical in an interconnection agreement. As far as SS7 standards are concerned charging aspects and procedures are not specified in the standards and left for specific implementation at a TO's network. For example in ISUP, charging aspects are only related to the provision of Advice of Charge services on the customer interface UNI and on the transport of charging information in the signalling messages.

AOC/UNI

Advice of Charge information (service provided at a UNI) requested by the caller may be a problem for interconnected calls. The caller may request advice of charge during the call or at the end of the call (total cost of the call including the cost of the supplementary services associated to the call):

- Only the local loop provider can send the AOC information to the caller. This is because he is the only one to have the knowledge of call reference value used on the link between the user and the local loop.
- If the choice is made to compute the AOC in the local loop exchange, the local loop operator should receive charging information computed by the interconnected TO and add its own cost before sending the AOC message to the caller.

Additional standardisation work should be completed to ensure that charging information is provided properly at the interconnection for the provision of real time AOC services for basic call and supplementary services,

Charging settlement/NNI

As far as GSM to PSTN/ISDN interconnection is concerned, each TO is completing call charging on his side: fixed TOs charge the calls from fixed to mobile, mobile TOs complete call charging from mobile to fixed. When several fixed networks are interconnected and used for handling a call, charging/billing services can be provided by one TO to another.

The provision of unique billing requires call traceability in order to ensure reliable identification of networks which have been crossed during a call, especially the originating network to which the caller is connected. This requirement will become crucial with local number portability.

8.4.3. Management of the Interconnection Interfaces

ITU-T and ETSI standardisation work on network management TMN (Telecommunications Network Management) should take into account interconnection requirements and specify the TMN management services—and TMN management functions—related to interconnection.

8.5. Approach to Network Integrity

For non IN networks, interconnection of signalling networks is implemented mainly to provide call processing (call set up, control, and release) between two networks. The signalling messages are exchanged at a physical POI between two signalling units (SCP) which are directly connected through a digital link. Physically separated signalling data links between the two networks ensure that signalling messages cannot be misdirected.

With interconnection based on ISUP standards and the associated mode establishing basic voice services and ISDN supplementary services, the risk is limited as signalling message exchanges are relatively low.

Basic principles and cautions need to be fulfilled:

- the systems are properly tested before being brought into service,
- the network which are interconnected are properly dimensioned,
- routing data are accurate and up-to-date, and are protected from unauthorised actions within the TO's organisations,
- back-up procedures are used in case of sub-system failure.

As the risks are rather linked to the dysfunction of equipment, it is possible to take a few simple contingency measures in order to limit the consequences of dysfunction on the integrity of the networks:

- by limiting the circuits that can be manipulated from outside the network to those of the interconnection interface.
- by limiting the level of services provided at the interconnection interface: only a User Part Sub System is put in place on the interconnection interface.
- by setting up validation procedures for equipment supplying interconnection in order to guarantee their good running order.

For non IN networks, interconnection is already taking place successfully and testing does not represent a major barrier as far as the PTO provides testing capabilities and specifications to new entrants.

9. Intelligent Network Interconnection

Most IN based services can be totally provided by each operator using its own IN infrastructure within its own network. However, some of these services become much more attractive if it can be provided globally: on a countrywide, pan-European or world-wide basis (e.g., UPT). In order to ensure the provision of such services at a global level, it is important to interconnect INs from different operators and service providers.

9.1. Services Requiring Intelligent Network Interconnection

In 1995, the commission has mandated ETSI to standardise five IN services which were considered to be of special interest: Freephone, Premium rate, Virtual calling Card, Virtual Private Networks (VPN) and Universal Personal Telecommunications providing the necessary protocols and mechanisms in order to ensure:

- the standardisation of these five IN services,
- the resolution of service interactions and impacts on service differentiation,
- the capability for independent service provider to offer this kind of services,
- the capability to interconnect different INs to increase the coverage area of services,
- the integrity and the security of the IN telecommunication networks and the IN equipment (including short term solutions such as mediation devices or functions),
- the appropriate level of management of the involved equipment,
- probably a scheme or a framework for charging and billing of this kind of services.

ETSI NA (Network Aspects) technical committee has allocated the different work items to sub-committees but **for the moment the ETSI has not yet put out precise specifications.**

9.2. Approach to IN Interconnection

The standardisation of IN is under development within several organisms. the most important in Europe are ITU-T (study groups XVIII et XI) and ETSI (NA6 and SPS).

Because of the complexity of the specification to be elaborated the standardisation bodies have adopted a phased approach: the work has been divided into Capability Sets (CS):

- CS-1 is almost finished regarding basic architecture which is widely accepted. Some work is still ongoing regarding aspects such like interactions with DSS1 and security. The CS-1 defines the interfaces necessary to introduce IN concepts into one single network. There is no set of services available under CS-1. As a result of the focus on "internal interfaces" network, interworking is very limited in CS-1.
- CS-2 should take into account problems linked to the interconnection of several INs and focus on specific IN services (Cordless Terminal Mobility, Corporate Networks, Global VPN, UPT). The standardisation of management interfaces and interconnection interfaces are planned in CS-2. With the interconnection of INs, problems of security and integrity naturally become a crucial issue. This is therefore a major issue for CS-2 in defining security procedures.

Until now, INAP-Capability Sets (CS1 and CS2) have been mainly designed to be used internally by one network. At the moment, most of the standardisation work for IN has

been concentrated on internal interfaces and generic procedures for the signalling and the interactions between these internal interfaces.

In addition, the standardisation technical model do not clearly define the interactions between TOs for IN interconnection.

As far as IN networks are concerned, interconnection is implemented to provide the cooperation between high layer signalling applications. The signalling messages and remote requests may access through the POI to any signalling control point (SCP) or functional entity of the other network.

Without specific protection mechanisms, failures can expand very easily in a network. As long as IN management and control functions have divided responsibilities, it is harder to protect network integrity.

Even if some of the standardised interfaces can be used for the interconnection of two INs, some security and integrity aspects needs to be solved to take into account the fact that one operator needs to access the data base of another.

IN standardisation and the provision of pan-European advanced services has to be balanced with the need for service differentiation in a very competitive environment. This will be particularly the case for VPN networks and services. In a competitive environment, voice telephony services on non-IN networks and advanced services on IN networks need to be addressed with a service oriented approach.

10. Implementation of Carrier Selection and Portability

Carrier selection and number portability are special requirements arising from competitive environment so that users can easily choose or even pre-select competing carriers and can keep their fixed or mobile telephone number when they change telephone companies or services providers.

10.1. Options for Carrier Selection

Carrier selection major issues are the following:

- to offer to the users the capability to choose any TO or service provider independently of the local loop provider,
- to have a procedure for choosing a TO or service provider that does not advantage any of the different providers. This procedure with equality between each operator is called **Equal Access,**
- to guarantee technical compatibility and interoperability between the user's terminal and the provider's network. This includes terminal equipment and intermediate systems which are crossed for the end-to-end communication path such as PBX and the TO's to Provider interconnection interface.

One possibility for carrier selection is through the use of prefixes (short codes) to be dialled in front of the subscriber number in a single stage dialling procedure. Identification of the calling party is done through the Calling Line Identification (CLI). Another possibility is by calling a special service access code to carrier services after which the dialled number is entered together with a special code for authentication of the subscriber. This latter possibility is a two stage procedure which is more prone to fraud and resembles calling card services in use today.

The EC Green Paper on numbering recommends carrier selection in a single stage dialling procedure with the following options:

A: *default carrier determined by access network operator* (local operator) with possibility of override by user on a call by call basis. This options is sometimes referred to as **Easy Access;**

B: *pre-selection of carrier by the customer* plus possibility to override on call by call basis. There are some variants on this method e.g. change default carrier through instant DTMF dialling (change pre-selected carrier on-line) or pre-selected carrier determined by regulator on the basis of market share. This option is referred to as **Equal Access.**

10.2. Carrier Selection Impacts on Interconnection

Impacts on interconnection

Pre-selection or carrier selection by code does not impose special technical constraints on interconnection interfaces, but the provision of the Calling Line Identification (CLI) at the interconnection to achieve the identification of the calling party.

In order to ensure the consistency and the liability of the information, at the NNI, the calling party number should be provided by the local loop TO and screened.

Impacts on local exchange

Pre-selection procedures impose technical requirements on local loop exchanges: the memory of the local exchange needs to be able to select several operators, the local exchange needs be capable to analyse over-ride codes and also to register if override capability is forbidden (barred).

Impacts on terminals

Carrier selection by code imposes technical conditions on the user terminal to allow the capability to send all the digits required for selecting the TO.

It is worth noting that ISDN terminals have the capability to specify a TO by using the Transit Network Selection Information Element. Today it seems that no terminal has implemented this information element. ETSI's ETS 300 403 indicates that for national identification plan the TO is coded according to national specifications. A clear description of the method to define a national TO identification code should be provided by ETSI. As several pan-European networks will exist, ETSI may have to define pan-European (international) TO identification codes.

Signalling standards

Like Module 1 interconnection services, Module 4 carrier selection services can be provided by the usual TUP, TUP+, ISUP interconnection interfaces with the provision of Transit Network Information (to route the call to the selected carrier) and calling party number identification (CLI).

10.3. Options for Number Portability

Number Portability Service issues

As described in the Commission Green Paper on numbering, number portability can in fact relate to three issues:

- Location portability: the ability of the user to keep a number when changing location either in the same exchange area or anywhere in the Member State. Since users expect the numbers they dial to give some indication of what the call will cost (perceived relationship between number and geographic location) location portability should concern specific users such as GSM users;
- Service portability: the ability to keep a number when changing to a different service in the same service area, (e.g. the user keeps his or her PSTN number when taking a subscription to an ISDN service, though it is actually provided via a different exchange in the same areas),
- Service provider portability: the ability for a user to keep a number when changing operators at the same location, or within the same exchange area.

Technical Implementation

Technical implementations and solutions will depend on the type of portability in need to be covered. It will also depend on the planned schedule:

- **short term solutions** are already available for local number portability. They rely on **call forwarding or routing table techniques.** These solutions may present a major drawback because they don't optimise network ressources and they may waste a lot of numbering capacities. They are relevant for a limited percentage of users (about 10% of subscribers attached to a local exchange);
- **long term solutions** rely in IN architectures and **interconnection of IN databases** between the different network operators (SDF: "Service Data Function" entities). Because of the lack of interface standardisation in IN, interworking of distributed databases in a multi-TO environment will result in specific developments. In addition, they may cause network integrity problems.

10.4. Number Portability Impacts on Interconnection

The study does not deal explicitly with number portability technical solutions, but their implementation may impact on interconnection interfaces and signalling systems.

Local number portability

The Commission Green Paper on numbering requires the implementation as soon as possible of number portability for the local loop to allow a user to keep his phone number when changing his network operator, at the condition he will not move and change his location.

Technical implementation of local number portability on non IN networks does not impose special technical constraints on interconnection interfaces, but the provision of the called party identification which is provided in ISUP call establishment messages. The information element to carry the called party identification/address may differ depending on TO's protocol implementation. Therefore it is necessary to complete implementation guidelines defining which information elements for calling party identification to use in ISUP signalling messages and their content.

To facilitate short term implementation of local number portability, ISUP standards should include an additional Information element indicating that the number has been ported.

The major impacts of local number portability on interconnection concern both service aspects and architecture aspects:

- interactions of local portability service with other supplementary services, which in some cases introduce regression on current services such as DID, CLI, call forwarding;
- the consistency between TOs directories and the way emergency services are ensured;
- the location of POIs and the location of user areas where local number portability is supported by an incumbent may impact on the interconnection architecture and routing structures to be planned by a new entrant.

Local number portability could create problems for emergency services to know on which operator the user is really connected. It is important for the emergency service to access only one data base for the translation even if the number has been ported to another local loop provider. The data base access for CLI to caller address conversion purposes should be independent of the TO or of the local loop provider. The problem to solve is to designate the body in charge of maintaining such a data base taking care of the exact address of customer even if several operators are involved in the number allocation.

Non Geographic number portability

Implementation of non geographic number portability require IN based solutions and the interconnection between TOs data base. It will strongly impact on interconnection and give an incentive to TOs to provide IN interconnection.

ETSI standards on IN based number portability are urgently needed to be applicable from 2000 onwards.

11. MANUFACTURERS VIEWS

Manufacturers are in a unique position in the chain of provision of telecommunications services. They dictate the availability of equipment and the direction of development of equipment which is used by the telecommunications community. Having a global presence; existing product ranges reflecting the global market; and being in a position to plan new market offerings (both wider world as well as European markets), they are in a position potentially to influence greatly the future of telecommunications services.

Manufacturers have been operating in a competitive environment for many years, and therefore provide a link of continuity through the deregulatory phase: as PNOs move into a new era of competitive operation, and Service providers emerge.

The experience and views of the manufacturers, therefore, is likely to have a significant impact on the direction of movement of the sector. The views of the manufacturers are an important component of the input required before new legislation is introduced.

11.1. Regulatory Issues

Level of Regulation

Manufacturers see the balance of regulation versus freedom of competition within a European legislative framework as being imperative for the success of the newly deregulated markets. In most countries the framework has been set up such that the NRA acts in a reactive role to resolve disputes between PTOs and user groups and PNOs and other operators.

Manufacturers feel that their level of involvement in regulatory affairs is low. In the UK their influence is via Oftel's consultative organisation, the NICC, and indirectly through contact with the PTOs.

In the area of interconnection, testing of new network connections and manufacturers' equipment will become increasingly relevant as the PNO loses its central organisational role. Until now all testing of new networks and type testing of new equipment has been carried out by the PNO. In a more complex multi-operator environment, a testing regime to satisfy the requirements of all of the PTOs, as well as testing against international connection points will be less easy to define.

Manufacturers see no requirement for special access for Service Providers (SPs) in addition to the existing 'retail' UNI and SS7-based NNI access already provided.

Network Integrity

Several manufacturers expressed deep concern at the implications of ONP for the integrity of the European telecommunications network. Care must be exercised in allowing SPs access to network signalling functions: network operators are unhappy to allow SPs access to SS7.

Development of an effective testing regime is important, building on and developing the experience of PNOs in interconnecting with new PTOs.

The nature of the integration of European networks is breaking new ground, and so many problems are likely to lie ahead. Easy answers are not available and it is unclear as to what action is possible to mitigate potential problems, particularly when the overriding concern of most players is not to over regulate the market. In general, guidance from NRAs will be sought.

11.2. Standards

The standards process

Most manufacturers believe that ETSI's standards process which is working towards a standard ISUP works well. Complaints against the process include:

- progress is slow;
- it is dominated by the PTOs;
- it is hindered by the plethora of N-TUPs available in the member countries;
- it is not well suited to facilitate competition in the telecommunications sector.

Some manufacturers believe that some PNOs are able to slow down the process to suit national agendas and protect their national market.

Most of the manufacturers agree that a common agreement on at least lower levels of the specification needs to be established within a reasonable time scale (perhaps five years); variations at higher levels within the standard to accommodate local market variations may be desirable.

Standardisation work on IN and network management standards are required to allow effective management of networks, national networks and the super network or 'network-of-networks'.

ISUP harmonisation

ETSI's original aim was to arrive at a fully defined and internationally accepted ISUP towards which all PTOs would migrate away from the existing N-TUPs. Generally, new market entrants adopt ETSI standard protocols within their networks. Incumbent PNOs, however, have significant investment in existing signalling system protocols and are reluctant to make immediate changes, because:

- of the massive network upheaval that would be required;
- some of the functionality included in the N-TUPs is not included in ISUP.

In developing new standards, therefore, ETSI needs to be pragmatic in its recommendations. Most manufacturers believe that a common partial standard is required defining the lower-level functionality of ISUP to enable the networks to inter-operate, but that higher level functionality should be treated more carefully. This lower-level functionality should be in place within a reasonable time frame – perhaps five years. In some areas of functionality it may be desirable for national variants of ISUP to exist to suit local market needs.

Migration to open networks

To implement harmonisation of switching systems subsequent to a directive will take an additional five years to implement. Implementation of network-wide functionality such as call forwarding and number portability would require five years to implement.

Management of the networks (including service upgrades)- both nationally and internationally – will be complex to implement and maintain. Individual networks will be managed by the network operators, but management of national and international networks is less clear. National networks could be managed by the NRAs or the PTOs. At an international level, management could be organised by a new 'super regulator'.

11.3. Other Technical Issues

Number portability

Number portability – the opportunity for customers to retain a 'number for life' is perceived to be a strong requirement of consumers. Current technology, however, means that the cheapest way to implement the function is by re-routing calls from local switches. This option is cheap but requires operator co-ordination, and as the number of customers with this re-routing facility increases, becomes more and more cumbersome.

Alternatively, Intelligent Network (IN) technology could be implemented, requiring all dialled numbers to be referenced to a central resource library before being routed. Though simple to manage, this option is impractical to implement at present until IN services for other uses become more widespread.

In the UK a small number of companies have been set up to provide personal number portability, but customers are forced to change to a new number with an 07 prefix initially. Limited number portability is to be implemented in the near future allowing alternative local loop providers to transfer existing numbers within a customer's premises, more easily facilitating Equal Access.

Pan-national organisations, such as AT&T and MFS with single networks covering the whole of Europe are more easily able to co-ordinate such services within its own network.

Manufacturers believe that full Europe-wide Universal Personal Telephony (UPT) – a system able to automatically redirect incoming calls to the individuals – is demanded by subscribers, though it is not clear whether this service will be offered by network operators or service providers; whether it will be implemented using IN or call diversion; and what the exact nature of the service will be. UPT may imply full number portability out of local areas – potentially requiring a complete reorganisation of geographically—based numbering schemes—, or the ability to transfer numbers between operators at a fixed location, as is being implemented in the UK.

Intelligent Network Services (IN)

IN technology is still establishing itself commercially and is likely to play a significant role in the operation and management of the future 'network of networks'. Technical standards based originally on Bellcore standards are emerging via the standards processes, but little is known about future IN requirements of these networks. The technology is currently used for premium services, paid for by the customer, or special numbers, e.g. 0800-freephone services, paid for by the service provider. Implementation is straightforward – IN-requiring services being identified by a limited set of number prefixes.

Some of the first new uses of IN functions are number portability and personal numbering services. Examples of service providers offering personal numbering services in the UK are Flextel and the Personal Number Company.

As the use of these services becomes more widespread, the growth of IN services will grow rapidly. It is thought that an initial 'shake-out' period of two to three years will be required for the newly deregulated telecommunications market to settle, before network operators are prepared to make significant investments in IN facilities. In the manufacturers' view it is, therefore, imperative that work on IN standards continue.

12. Regulation of Technical Aspects

The standards position for local processing networks is relatively robust and well supported by suppliers. A structured approach to regulating and managing the limitations on providing advanced services across interconnected networks is necessary. Interconnection of remote processing networks and the development of industry standards (which take account of the particular functional and non-functional requirements of telecommunications networks) is at a very early stage.

Therefore regulation of interconnection technical conditions may be summarised as follows:

- **Regulation of the new regime must be balanced** to weigh the need to maintain the integrity and development of networks against the operators' and manufacturers' ability to remain competitive and innovative.
- **The interconnection of 'basic' networks (primarily PSTN but also ISDN, GSM etc.) does not present a significant technical problem.** The standards position and the experience of nations and TOs with interconnection agreements provides a sound basis for achieving and regulating the interconnection of such networks.
- **The interconnection of newer services based on IN-type remote processing principles is much less well developed.** As a short term solution, interconnection mechanisms based on GSM-type usage of SS7 are proposed. In the longer term there is much more work required on the agreement of suitable application-level standards and products that support them.
- Network integrity may well be threatened during and after the transition to a deregulated regime, both deliberately by unscrupulous service providers and individuals, and accidentally for unforeseen technical reasons. **The development of an effective testing regime is vitally important as are the development of network management standards.**

12.1. Service Oriented Regulation

It is important for the competition in a liberalised market that interconnection enables the provision of the same level of voice services between new entrants and the incumbent. As far as the market share of new entrants will not be significant before several years it does not make any sense to provide only supplementary services within their network, especially if they operate long distance networks through the incumbent's local loop. Therefore, the interconnection interface has to be as complete as necessary to achieve at least the continuity of all end to end services offered by the incumbent, in order to avoid discriminatory conditions for the new entrants.

Until now the primary role for interconnection has been the achievement of transparency of call management, end-to-end across a number of PTO domains.

In the future a service oriented approach is necessary to rule interconnection.

But the feasibility of managing the services will be different depending on the service modules: for 'simple' telephony (Module 1 services) this is technically straightforward, but newer service offerings – specifically those that are based on remote processing capabilities (Module 3 and 5 services) – are more challenging.

Therefore module 1 services need to be a necessary class of services to be provided through interconnected networks while an advisory approach and more flexible arrangements could be considered for module 2 and 3 services. However for the implementation of module 1 services relevant information from the incumbent need to be available to the other TOs. This can be done trough the RIO.

Technical solutions used for carrier selection (Module 4 services) have very little impact on the interconnection interfaces. **The necessary technical condition is the provision of reliable calling line identification, and charging information at the interconnection interfaces.** A code of practice for the provision of calling party and customer billing information at the interconnection should be defined at the national level by NRAs

As far as supplementary services (Module 2 services) are concerned, the provision of end to end ISDN/GSM supplementary services between interconnected networks should be aligned with the PTOs implementation phases of EURO-ISDN services/GSM services. Precise rules for the introduction of new supplementary services at the interconnection should be achieved at each national level.

Number portability (Module 5 services) represents a strong service requirement of consumers. These could be implemented in a number of ways, which may differ in time to implement, short term efficiency, long term efficiency and long term flexibility. In the long term, UPT is likely to remain the goal of telecommunications service providers. Local number portability which is the most important portability service to ensure competition may be achieved by using non-IN means. **The precise way in which this service may be implemented will depend on the existing PTO's architecture in each Member State and is likely to affect the provisions and the technical components of RIOs.**

In particular for emergency calls, the data base access for caller address identification should be independent of the TO or of the local loop provider. The problem to solve is to designate the body in charge of maintaining such a data base taking care of the exact address of customer even if several operators are involved in the number allocation. **Advice should be given to NRA in how numbers should be allocated and managed.**

The completion of Module 3 services is based on the implementation of Intelligent Network architectures and databases. Even if the interconnection for the provision basic call and voice supplementary service is the first issue between competitive operators, the interconnection of services based on IN will be a major issue in the near future. **Therefore, it is recommended to complete interconnection standards and solutions for IN as soon as possible.**

12.2. Network Integrity

Operational aspects (such as the testing of new network connections and equipment) will become increasingly relevant. There is deep concern at the implications of widespread interconnection for the integrity of the European telecommunications network. Care must be exercised in allowing access to network signalling functions to organisations without adequate regulatory control. It will be important to achieve both technical standardisation and operational regulatory control to enable interconnection without integrity fears.

Interconnection testing combined with network management have so far prevented from a breach in network integrity. However IN interconnection and the provision of non-circuit related services (such as Call Completion services) will require enhanced testing levels and constantly reviewed controls.

In addition to national testing procedures, a follow up of network integrity issues needs to be competed at the European level: by creating an observatory for QoS and network integrity issues at the interconnection.

EIF who is already working on network integrity issues should be in charge of the gathering and publishing of country experiences related to network integrity problems and solutions achieved.

12.3. Involvement of NRA in Technical Aspects

The balance of regulation versus freedom of competition within a European legislative framework as being imperative for the success of the newly deregulated markets. In most countries the framework has been set up so that the NRA acts in a reactive role acting to resolve disputes between PTOs and user groups, and between TOs and other operators.

The nature of the integration of European networks is breaking new ground, and so many problems are likely to lie ahead. Easy answers are not available and it is unclear as to what extend is possible to mitigate potential problems, particularly when the overriding concern of most players is not to over regulate the market. NRAs are likely to be simultaneously asked to rule on many deeply technical points, and asked to limit their regulatory control to avoid constraining market development.

It is important that NRAs get more involved in the technical and operational process of interconnection. In addition guidance for service implementation and support for business practices will be sought from NRAs.

There is at present a general move towards NRAs acting as numbering authorities, managing the number allocation process and strategy, since issues such as number portability impinge deeply on network structure and TO services. As INs emerge, other aspects of telecommunications – such as the operation of a national customer/number database – may be provided centrally, either directly by the NRA or by a specially licensed Government agency (i.e. not a PTO).

13. STANDARDISATION PROGRAMME

13.1. Focus on ETSI Standardisation Policy

Until now, ETSI standardisation work has been completed in a restricted environment: service definitions and technical architectures have been designed to be used internally by one network, in a public national network context where the local loop and the long distance networks were operated by the same organisation. As a consequence, the current standardisation work is very much influenced by public operators, and very much oriented towards internal interfaces.

On the other hand, the first priority of new entrants has been related to interconnection charges and infrastructure roll-outs rather than involvement in standardisation bodies which is considered as a costly activity.

The scope and the involved parties in the ETSI standardisation work related to interconnection should be extended:

- **It may be appropriate for ETSI to facilitate the involvement of new entrants in the standardisation process by promoting interconnection standards and work programmes. We recommend ETSI to create a new horizontal project related to interconnection. To ensure alignment with competitive environment, inputs to this project could be provided by achieving an ETSI Interconnection Panel involving new TOs.**
- **ETSI should refocus on interconnection standards by introducing new principles in the development of standards for an interconnected environment. For example: the standardisation work for a new service or a new UNI should include the corresponding enhancements and standards at the NNI,**
- **NRAs should get involved in ETSI process for service definition in order to ensure that proposed solutions and standards allow the non-discriminatory provision of a service by the competitive TOs,**
- **In order to get stable standards in a reasonable time frame, ETSI should avoid to define too many types of interconnection interfaces. In particular, special access should use existing standardised NNI and UNI interfaces.**
- **ETSI should start work items regarding enhancements of existing SS7 standards to network security/integrity and include these aspects in all the future documents and standards. These mechanisms of security and protection in the signalling networks could benefit from those that have been defined by the Internet Community with the concept of firewalls.**

13.2. Technical Tool Box for Regulating Non IN Network Interconnection

ETSI's standards process which is working towards a standard ISUP is perceived to work effectively, but slowly. Implementation of standards is slowed down by the plethora of N-TUPs available in various member countries, which makes a slowly-evolving formal standards environment acceptable. Generally, new market entrants adopt ETSI standard protocols within their networks. Incumbent PNOs, however, have significant investment in existing signalling system protocols and are reluctant to make immediate changes, because:

- of the massive network upheaval that would be required;

- some of the functionality included in the N-TUPs is not included in ISUP.

In developing new standards, therefore, ETSI needs to be pragmatic in its recommendations. A common partial standard is required defining the lower-level functionality of ISUP to enable the networks to inter-operate. This lower-level functionality should be in place within a reasonable time frame – perhaps two years.

At the European level, we recommend to promote:

- **Access network V5 interfaces for the access to the transmission part of a public voice network at the local loop level,**
- **ISUP V1 and V2 standards for the interconnection of fixed networks,**
- **ETS 300 303, based on ISUP V1 or ETS 300-646-1, based on ISUP V2 for GSM to ISDN interconnection.**

In case of provision of POI based on national signalling systems mapping functions with ISUP standards should be achieved by the incumbent at least for the basic call and a minimum set of interconnect services (module 1 services).

For the introduction of new supplementary services at the interconnection between two TO networks, we recommend to promote the EURESCOM approach and test suites for end to end service interoperability.

In addition to present ISUP standardisation work in ETSI, we recommend ETSI to achieve implementation guidelines related to:

- **call charging and billing procedures, reliability of customer information between interconnected networks.**
- **methods for defining a national TO identification code, and the encoding in Transit Network Selection Information Elements for the provision of carrier selection services:**
- **implementation and management of a reference data base for non geographic numbers,**
- **management of interconnection interface.**

The key points to consider are the following:

- The capability to provide real time AOC (Advice Of Charge) services for basic call and supplementary services by the transmission of charging information in the signalling messages at the interconnection interface,
- The provision of call traceability procedures with the transmission of a Originating Network Identification for charging settlement procedures in order to provide unique billing and reliable AOC information to the users,
- Procedures to ensure the confidence in the calling party number received by a TO at a NNI,
- The provision of additional information elements to calling party number in order to provide a customer billing address.
- Description of the method to define a national TO identification
- Definition of pan-European TO identification codes including an identity code specifying Europe.
- Fault management, procedures for tracking network faults, management of information delivered to interconnected TO.

- Performance/quality of service at the interconnection interface (probability of traffic congestion, provision of alternate path, continuity of service in the event of link/node failures).
- End to end performance and quality of service (transmission quality, call path integrity, network congestion, call performance, network availability).

13.3. Development of a Tool Box for IN Network Interconnection

Standardisation work on IN and network management standards is required to allow effective management of single-operator networks, and multi-operator (national, European) networks. A more responsive approach to standardisation is needed for higher layers that allows (for instance) new signalling message types to be developed, agreed upon and implemented on a short time scale, but within a co-ordinated and public plan. Regulators (national and supra-national) need to use this as a mechanism for planning and imposing regulatory deadlines.

IN standardisation and the provision of pan-European advanced services have to be balanced with the need for service differentiation in a very competitive environment. This will be particularly the case for VPN networks and services.

To fasten IN interconnection standards, we recommend ETSI to work according to the following approach:

- **concentrate on a very limited number of advanced services which need to be addressed on a pan-European basis such as Freephone or provided in each Member State such as Number Portability,**
- **provide for these advanced services a common service definition,**
- **define for each service the interworking procedures and a unique interconnection interface,**
- **use the same approach as achieved for the definition and the standardisation of roaming services between GSM networks,**
- **complete a technical framework for charging, accounting and apportionment procedures and interactions on signalling systems in the provision of these IN services.**

PART III. TOWARDS A EUROPEAN FRAMEWORK FOR INTERCONNECTION

14. OPERATIONAL ISSUES

The implementation and exploitation of interconnection services (as defined in the technical analysis) will require alterations to a wide range of operational activities related to running a network. This section addresses the impact on the operational activities for an individual operator or service provider in an interconnected environment, and the 'knock-on' implications for NRAs and other organisations.

The principles underlying this analysis are:

- operators will be required to develop and offer a new set of 'interconnection services' as a condition of their licence;
- operators will be required to provide and support these services to a new set of customers (peer TOs);
- the other services that TOs offer may be affected by the need to develop them with interconnection offerings in mind.

14.1. Readiness for Interconnection

An interconnection environment will impose new requirements on a TO's planning. There are two aspects of this:

- additional planning for networks, systems and support that is required to ensure that the relevant interconnection services can be *offered* by the TO;
- the planning for networks, systems and support that is enabled because other operators are offering interconnection services that the TO can *exploit*.

Ultimately, as telecommunications interconnection becomes a reality, these will both be built into the normal planning process:

- the TO will be required as a matter of regulatory control to offer interconnection services;
- planning will always be done in the context of a supply market which is rich in interconnection service offerings for the TO to exploit, and he will naturally seek to position himself to make best use of the services on offer.

The provision and exploitation of interconnection services needs to be taken into account across the whole gamut of telecommunications planning, including the following:

- identification of interconnection services to be offered (the 'Interconnection Catalogue');
- development of charging schedule;
- network architecture design, standards selection etc;
- specification, development and procurement of network systems/software;

- specification, development and procurement of back-office systems/software (e.g. customer and billing systems);
- validation of systems integrity;
- engineering staff recruitment and training;
- support staff recruitment and training;
- preparation of marketing/sales material – fliers, catalogues, price schedules etc;
- submissions to and liaison with regulator to ensure compliance with NRA requirements – system plans, time scales, standards etc.

Further, the regulatory 'ground-rules' are expected to change over time. The Interconnection Directive requires NRAs to ensure the publication of a Reference Interconnection Offer which, in the first instance, is likely to be obligatory only for the incumbent provider in many states. Requirements which NRAs regard as optional or restricted to certain types of TO in the first instance may become necessary later in the evolution of the competitive telecommunications market. Equally, a TO may be granted a derogation from certain interconnection obligations which lapses after a certain point.

It will be important for both regulators and operators to be aware of this development.

NRAs should publish their approach to imposing obligations, which should not normally change suddenly in a way that imposes unforeseen consequences on any operator. Equally, operators must maintain an awareness of the current regulatory position as it affects them, both now and in the future, and be prepared to create or develop their interconnection catalogue to meet the obligations placed on them.

14.2. Provision and Support of Interconnection Services

Once planning is complete an individual TO/SP will be in a position to provide a specified range of interconnection services. The activities required for this are not very different in principle from those required to provide 'retail' telecommunications services on request from a customer; however the practice may be different, as:

- interconnection services are more complex than UNI services;
- the configuration and management of interconnection services requires more joint work between a TO and his 'customer' than is typical of UNI services;
- it is much more likely that there will be regulatory scrutiny of the individual contract and operational arrangement.

The activities needed to provide and support interconnection services include:

- agreement of interconnection services to be provided and the surrounding financial/contractual aspects (the 'Interconnection Agreement');
- engineering planning for the connection;
- network system/software interconnection and testing;
- support systems interconnection and testing;
- systems health monitoring (capacity profile etc.);
- engineering maintenance and repair of interconnection links;
- inter network accounting and billing;
- call tracing as necessary;
- fraud monitoring and alerting;

- directory collation and support (e.g. integration of/access to databases);
- operator support and inter working (e.g. hand-over of operator calls, exchange of call information, mutual access to databases);
- management and updating of interconnection agreement.

14.3. NRA Role in Implementation

An Interconnection Agreement is a contractual document between two TOs. *A priori* there is no need for this document to be countersigned, authorised or otherwise overseen by the NRA. Nevertheless both the NRA and (some) TOs might wish for the NRA to:

- monitor the process of negotiation of an agreement;
- ensure that the drafted agreement is consistent with TO licences;
- notarise the agreement on this basis;
- hold a copy of the agreement;

Note also that the Interconnection Directive mandates the publication of Interconnection Agreements (except for the commercial provisions) through NRAs.

By contrast, a TOs Interconnection Catalogue is a service offering. It is seen as an inherent part of the TOs rights and obligations, and therefore as a licence condition, that it offer a 'suitable' set of interconnection services (with, of course, derogations where appropriate).

It is therefore essential that the NRAs take an active part in authorising the Catalogue from the point of view of:

- ***completeness*: is the NRA satisfied that the TO is offering all NNI services it should, given the nature of the TO and the nature of the UNI services it is licensed to provide?**
- ***fairness*: is the NRA satisfied that the NNI services are being offered on a fair basis (as indicated by the ONP Directives – in terms of pricing, geography etc.)?**

The Interconnection Directive mandates NRAs to ensure a Reference Interconnection Offer (RIO) is produced. This represents a list of interconnection services, by user type where justified, and associated terms and conditions (including tariffs). **The incumbent's Interconnection Catalogue will initially be synonymous with the RIO;** however all Interconnection Catalogues would be be expected to make relevant reference to the relevant RIO(s).

To achieve this the NRA needs both to follow and influence development of EU-wide activities, and to ensure that it has a sound understanding of specific TO architectures and operations.

Since interconnection regulation is likely to be a significant role of NRAs over the coming few years, it may be appropriate for each NRA to have a dedicated Interconnection Team. In order to fulfil the Interconnection Directive requirements, the policy departments in Member States should ensure that their NRAs are given authority in these areas.

The other main role of the NRA is to ensure that TOs comply with their licence conditions, including those regarding the provision and support of NNI services. Given the effort involved this is most likely to be based on:

- reviewing the planning and progress of TOs' implementation of NNI services;
- reactively responding to problems experienced by other operators seeking to connect at NNI.

An alternative option is that *the NRA should identify and mandate specific technical interconnection requirements*, based on its analysis of the TO (or TOs) involved. This is not a preferred solution, since it imposes a large burden or work on the NRA, and it removes the freedom of TOs to agree 'optimal' solutions. However it may be necessary to adopt this approach as a fallback position, for instance if a TO is behaving obstructively.

14.4. The Pivotal Role of the NRA

For the purpose of this section 'the NRA' includes both the national telecommunications policy-making authority and the policy administration authority.

Although it is beyond the remit of ONP (and indeed the European Communities as a whole) to mandate on Member States the full scope of activities for an NRA, it is reasonable to assume that *the NRA's mission is to maintain and implement a strategic plan for nationally-provided telecommunications services* which complies with ONP principles, and best balances the needs of users and suppliers.

NRAs operate by means of:

- maintaining an understanding of user requirements;
- maintaining an understanding of existing and evolving national infrastructure, services and systems;
- granting operating licences which impose suitable conditions on operators and monitoring compliance with them;
- providing additional services which must be undertaken nationally (e.g. number allocation, arbitration in disputes).

However the mechanisms for this in practice are not simple. For instance it might be argued that once IN architectures become commonplace, the NRA will need to operate a numbering database. This may happen in one of a number of ways:

- Member States with a relatively 'centralist' policy may choose to run a database service directly from national Government (maybe linked to a 'citizens register' etc.);
- Member States with a strong preference for privatisation are more likely to get a private sector organisation to run the system under licence.

As far as the management of interconnection is considered, this has a dual consequence for NRAs:

- the NRA is the linchpin of the process. It is directly responsible for implementing national policy, which will take into account the relevant European policy. If the EC provides a 'European Interconnection Framework' this will directly affect NRA's remits.
- the NRA must not be constrained inappropriately, particularly in view of the rapid development in telecommunications technology. The important issue is to ensure that there are mechanisms in place for agreements on points of detail to be reached – with arbitration if necessary – not to impose a very specific technical 'answer' that will inevitably become outdated rapidly.

14.5. Resource Implications

It is not feasible to estimate precise numbers for the resources that will be needed for any individual TO or other organisation in the above activities, since this will depend on individual circumstances. However it is anticipated that the following will be required.

Each incumbent TO will need to launch (if it does not already have one) an 'Interconnection Readiness Project'. This project team will:

- **liaise with the NRA to establish requirements;**
- **develop and obtain approval for a change plan;**
- **liaise with network planners and developers to develop a time/cost plan for relevant network changes;**
- **liaise with systems planners and developers to develop a time/cost plan for relevant system changes;**
- **work with the NRA towards the launch of an Interconnection Catalogue, as the RIO;**
- **plan subsequent stages of Catalogue/RIO development.**

Other, non-incumbent, large TOs may also need to adopt this approach, but this will depend on the scope of services offered relative to the technical framework requirements. For instance mobile-only operators might not be affected in the first tranche of interconnection planning.

Smaller 'niche' TOs and SPs may or may not be required to prepare to offer NNI services. However in this case the change project may be expected to be much more modest, since:

- the scale of change planning in terms of declared POIs, software upgrades, staff changes etc. will be very much smaller;
- much of the change may be expected to be 'off the shelf' from manufacturers;
- the TO is more likely to have modern equipment than an incumbent's, for which upgrades are easier to manage;
- smaller suppliers may well be granted derogation by their NRA anyway.

On the other hand, smaller TOs/SPs may well want to set up an 'Interconnection Watch Project' to watch and exploit the emergence of interconnection services offered by incumbents and other large players. This would be expected to be tightly coupled to their business strategy and business planning activities.

Regulatory authorities will also need to undertake a substantial programme of work to ensure the successful roll out of interconnection services. Some of this will be in the interpretation, refinement and/or extension of relevant European guidelines to match local circumstances. The precise balance of what an NRA will need to do is likely to be subject both to national political drivers and to the nature of the national network, but in general this will include the following:

- the setting up of a suitable national organisation;
- the collation and validation of user requirements for interconnection and related services, via appropriate user fora and consultative activities;

- the definition of a 'national framework' of acceptable principles, and business practices;
- decision on implementation policy (e.g. covering the nature and applicability of derogations) and determining the local regulatory position on interconnection;
- ensuring the production of the RIO probably via the dominant TO;
- the publication and promotion of the national framework, implementation policy and RIO;
- defining an approach to licensing and imposition of relevant licence conditions on TOs (in a way which is sensitive to existing planning and regulatory assumptions);
- review and arbitration of Interconnection Agreements;
- monitoring of compliance of TOs with the national framework.

Depending on the national position it may also include:

- convening and/or chairing national technical committees;
- the definition of a portfolio of nationally acceptable standards, operational practice etc. as part of the national framework;
- the definition of a National Interconnection Service Approach;
- the specification, implementation and/or operation of a national numbering database;
- adoption of a 'template' Interconnection Agreement for national TOs' use (eg as a cut-down version of the RIO).

Manufacturers will, in the main, be affected only indirectly. Suppliers may all be expected to have development strategies which are a mix of maintaining support for existing infrastructure, following the trend towards the key 'mainstream' standards (e.g. ETSI ISUP) and developing unique selling points (new functionality etc.).

Their development plans may be altered by a perception of how regulatory control will require new services to roll out (e.g. by putting more effort into developing NNI management functionality). However the main impact is likely to be from incumbent (and other) TOs requesting systems upgrades and implementations that meet specific goals.

Users and user groups should not need to do more than maintain a watching brief on the developments of the market from the point of view of ensuring an optimal approach to balancing competition and service delivery needs. Their technical needs are likely to be picked up the normal process of regulatory control.

15. REFERENCE INTERCONNECTION OFFERS (RIO)

15.1. RIO Requirements

The Interconnection Directive mandates all NRAs in EU Member States to ensure a Reference Interconnection Offer (RIO) is produced by TOs with significant market power. This represents a list of interconnection services - by user type where justified - and associated terms and conditions (including tariffs).

The two major aspects which RIOs should aim at implementing are:

- **to support service competition: availability of customer choice and carrier selection services;**
- **to support interoperability of interconnection services: transparent seamless connectivity between users.**

It is expected that in most cases RIOs will be prepared by incumbents and approved by NRAs.

In addition to service and price lists, a RIO should carefully define the requirements and conditions to ensure that:

- two networks can interwork effectively and efficiently,
- services to end users are met,
- facilities offered and interconnection provisions are available in a given timescale,
- CLI information or customer billing information (ie name and address) is provided to facilitate billing services and carrier selection services,
- no network is able to disrupt another party's services,
- mechanisms for liaison and contact are specified to allow interconnection planning, maintenance, and evolution.

15.2. RIO Principles

In answering the suitability of the RIO prepared by a TO, the key principles should be the following:

- an **end user service focus** for public voice telephony services, and a focus on control of bottlenecks;
- focus on delivery of an **open service market on a European scale**;
- **maintenance of a balance** between the need to maintain the integrity and development of networks and the ability of existing and new suppliers to be competitive and innovative.
- consideration of **interconnection in terms of transit, access and equal access services**, for the provision of end to end services functionality and performances;
- specification of a **limited set of priority services**, additional services and optional capabilities;
- **recognition that interconnection arrangements may differ for different networks and member states** (competition model, interconnection regime and policy, service portfolio, costs and timetable may vary from one country to another).

15.3. End to End Interconnection Service Approach

RIOs should be sufficiently comprehensive to define a consistent interconnection service set of offerings. The proposed approach to planning and timetabling the implementation of interconnection services is as follows (based on both Directive deadlines and the technical analysis of feasibility presented in Part II of the final report).

We recommend RIOs to address interconnection services with an end to end service oriented approach

Module 1: Basic call/ customer care and billing services

- **Strategy**

  As a first priority a RIO should include the Module 1 services:
  - basic call connection,
  - call forwarding,
  - DTMF,
  - access to Directory Enquiries,
  - emergency services,
  - billing services.

  Availability of CLI (Calling Line Identification) information at the interconnection (to indicate subscriber's line identification) is recommended for the provision of a unique billing and CLI services. As far as CLI information may not be available on all networks and for all customers in the various Member States, some restrictions on the provision of CLI information/services could be considered by NRAs at the national level.

  The provision of AOC (Advice of Charge) services and unique billing is recommended. The obligation to provide it should be considered by NRAs at the national level.

- **Proposed Timetable**

  Full availability of the Module 1 service subset defined above: start 1998

  CLI migration path to define in each MS, based on national network/switches evolution

  Same migration path for AOC as CLI

  Unique billing: 2 years after full coverage of CLI availability.

Module 2: ISDN/GSM supplementary services

- **Strategy**

  At the European level it should be a second priority for each RIO to include the following subset of Module 2 services:
  - end to end EURO-ISDN supplementary services between two fixed networks,
  - end to end GSM supplementary services between two mobile networks,
  - common ISDN/GSM supplementary services between a fixed and a mobile network

  Each NRA should define the list of services and the timetable for the provision of these services at each national level. The target is to allow a new entrant to offer the same level of end to end EURO-ISDN services that those provided by the incumbent on his own network.
- **Proposed Timetable**

  The schedule should be consistent with the provision of EURO-ISDN services and supplementary services by the incumbent

Module 3: Provision for advanced services

- **Strategy**

  The provision of advanced services between networks should be determined by specific commercial arrangements between TO/SPs at a national level:
  - VPN services,
  - IN advanced services (Freephone, Premium rate, Virtual calling Card, UPT).

  Access to Freephone services should be guaranteed in each Member State.
- **Proposed Timetable**

  800/900 number access and allocation: Start 1998

  Other services: subject to specific agreement and dependent on emergence of standards

Module 4: Carrier selection services

- **Strategy**

  The provision of CLI at the interconnection interfaces should be a first priority to allow authentication of each call and provide carrier selection.

  The way carrier selection services are implemented should be ruled by NRA at each national level. They should ensure competitive equality with a favour for pre-selection.
- **Proposed Timetable**

  Default long-distance carrier is determined by the local access provider with the possibility of the user over-riding that choice on a call by call basis (1998).

  Carrier pre-selection by the user with the possibility of a call by call over-ride should be implemented as soon as incumbents provide CLI 80% coverage (at the latest by 2000).

Number portability services should not delay the completion of the first phase RIOs. In a second step, with the implementation of local number portability services in each Member State, the technical components of RIOs should be enhanced to:

- take into account the possible impacts on interconnection interfaces and routing capabilities of national implementations for local number portability,
- define on which user areas and which corresponding POIs local number portability is supported,
- define possible service regressions that could occur from the implementation of local number portability in the network.

15.4. Technical Components of RIOs

In addition to the proposed modules of interconnect services, RIOs also need to refine these to present a full contractual service offering. The publication of RIOs should represent all the information required to plan a new telecommunications service network. We recommend the following structure, as a minimum set of priority technical components to be included in RIOs.

Interconnection services offered

In order to provide end user Module 1 end to end services, the minimum set of Interconnect services should be as follows:

- **Interconnect implementation service**
  - POI sizing and configuration,
  - Network Accommodation/Routing,
  - Network facilities to POI,
  - Interconnection link.
- **Access services**
  - Network conditioning,
  - Customer billing information,
- **Conveyance services**
  - Local PSTN / ISDN calls,
  - National PSTN / ISDN calls,
  - International PSTN / ISDN calls,
- **Ancillary Services**
  - Billing services / customer billing,
  - Access to directory enquiries,
  - Emergency services,
- **Module 1 end user services:**
  - basic call connection,
  - call forwarding,
  - DTMF,
  - DDI.

Availability of CLI is a first priority to enable unique billing and carrier selection services. But its provision should guarantee user data protection and number presentation restrictions when asked by a user.

CLI provision and conditions

The RIO should define conditions under which a PTO will convey CLI to another operator for billing, call routing, caller display, carrier selection purposes. This should include the possible restrictions on the provision of CLI services (CLIP/CLIR/MCID) including number presentation.

This policy must be in accordance with the EC Data Protection Directive[7].

[7]Common Position N°57/96 with a view to adopting Directive 96//EC of the European Parliament and of the Council concerning the processing of personal data and the protection of privacy in the telecommunications sector.

As a second priority the following services should be addressed in RIOs when possible.

Supplementary services

The RIO should define conditions under which a PTO will provide

- **Access to special advanced services (800, 900 services...)/module 3 services**
- **ISDN supplementary services to be provided through interconnection/module 2 services,**
- **Additional ancillary services**
  - Directory services,
  - Information services,
  - Operator services,
  - Data traffic recording.

Points of interconnection

Points of Interconnection (POIs) represent the boundaries of responsibility between TOs. POI location and choice is closely related to interconnect charges. A full description of the services offered at each POI should be provided. A database of the calling zone or exchange area boundaries should be provided where the tariffs are based upon zone, or exchange area boundaries and where the digitised file exists.

They should be made available at the various network architecture levels:

- Double and Single Tandem / Transit switch levels,
- Local switch level,
- International switch level.

The provision of POIs should be submitted to evolutionary arrangements and evolve from few points to numerous access service areas. A plan for making POIs available will need to be approved by the NRA.

Interconnection architecture and models

The aim is to provide information on the interconnection architecture and routing structures in order to allow a new entrant to plan a new telecommunications service network.

It may be useful as a guide or example for the definition of call handling sequences to provide suggestions on Conceptual models for interconnection., but should not be viewed as restrictive in any way. TOs should be free to create their own interconnection models.

Call handling procedures

There should be some information provided in terms of how calls are handled..

- Calls should be handled as far as possible by the TO to which the caller is connected to or which be has been selected by the caller. The POI should be provided as near as practicable to the called party.
- With explicit selection, calls should be interconnected as near as possible to the caller's location. POI should be provided as near as practicable to the caller.

The originating operator should be able to route its call to the furthest technically accessible and legally possible point, thus incurring charges only for the unbundled part of the fixed network. When this is not possible or denied, and there is no other way to route the call to that particular point of interconnection, this portion of the call should not lead to supplementary charges.

Traffic routing capabilities

The RIO should make available details on the network to help other TOs to decide where to interconnect, and to define traffic routes, levels of interconnect resilience and security he wants to order.

Network Technical Interfaces / Standards

Signalling standards are part of the basic POI agreement and need to be specified in detail. Because of national contexts and time to migration towards ISUP standards for incumbents, POI standards could be based on the national TUP for a transitory period. Detailed technical specifications of the signalling systems at the POI should be provided.

POI interfaces should be based as soon as possible on ETSI standards:

- ETSI standards / D.2048S for structured leased lines,
- Access network V5 interfaces for the access to the transmission part of a public voice network at the local loop level,
- ISUP V1 and V2 standards for the interconnection of fixed networks,
- ETS 300 303, based on ISUP V1 or ETS 300-646-1, based on ISUP V2 for GSM to ISDN interconnection.

Migration paths and timetables from national TUP to ISUP, associated supplementary services and corresponding POI should be approved by the NRA as compliant with the RIO.

Where PTO networks remain based on the national signalling systems, gateway functions with ISUP standards should be achieved by the PTO at least for the offered module 1 services.

Carrier Selection provision

This should ensure the provision of Module 4 set of interconnect services

The RIO should define conditions under which a PTO ensure the provision of CLI at the interconnection interfaces to allow authentication of each call in order to guarantee that carrier selection is achieved without entering a pin code to avoid additional authentication procedures.

The PTO should define in which conditions the selected carrier information/identification is available at the interconnection.

The PTO should define which user areas and which corresponding POI are providing carrier selection services and which mode (per-default, pre-selection, prefix...) is used. An associated migration plan for the evolution of carrier selection modes should be provided.

Interconnection Testing

Both TOs need confidence that the two exchanges can interwork correctly and will ensure essential requirements without affecting the existing networks and services. The level of tests to achieve this should be specified according to the guidelines in ITU-T recommendations Q780. The incumbent should make available a list of switches and the corresponding services and facilities which have successfully been interconnected to allow a reduced level of testing wherever possible.

In addition the incumbent should provide additional test suites such as the EURESCOM test suites for ISDN services in order to prepare functional end-to-end service interoperability.

Quality of Service

Quality of Service (QoS) should be unambiguously defined and specified. Recommended network quality of services parameters and recommended criteria could be the following:

- **QoS for voice telephony services**
  - ITU - T performance standards
  - Quality of service/Call performances ITU-T E.820, E.830
  - Network availability ITU-T E.845, E.846
  - Quality of speech ITU-T P.48
- **QoS for Interconnection links**
  - ETSI D.2048 S performance requirements
- **QoS for service provision / Network conditioning**
  - Interconnect Service delivery maximum delay
  - Average failure rate
  - Number of interventions
  - Service access availability
  - Call set up time / transfer duration
  - Rate of successful calls.

16. Interconnection Agreements

The first issue for a new entrant is to get the relevant information about interconnection to be in a position to plan a new telecommunications network. In order to ensure effective operation and development of interconnection, an interconnection agreement needs to cover more that a RIO. An interconnection agreement will deal with contractual and operational aspects, and may define business practices to enable flexible arrangements and interconnection evolution.

16.1. Lessons from existing Interconnection Agreements

Individual NRAs and TOs/SPs have well developed ideas about the nature and content of interconnection agreements which it would be unwise not to take advantage of. Even more significantly, the supply industry as a whole is contributing to its own view of 'best practice', through the European Interconnection Forum (EIF).

The EIF framework interconnect agreement provides a pragmatic, consensus view from the TO community on the structure, contents and goals of an Interconnection Agreement. Therefore it may be appropriate that NRAs/incumbents use the following documents as a basis for developing interconnection agreements:

- the EIF framework interconnect agreement,
- existing active interconnection agreements to be used as the basis for contractual and operational aspects; specifically we believe that the interconnection agreements produced by BT, which are publicly available, provide a good starting point for these aspects.

A detailed analysis if interconnection agreements and EIF work are provided in the appendix 1 document.

16.2. Operational Components

Continued infrastructure development and evolution of network end-to-end service availability and quality will lead to a high degree of interdependence between two interconnected TOs. It will be necessary therefore for TOs to ensure a co-operative process for interconnection's technical planning, operational information exchange, network management and for customer billing.

Thus an interconnection agreement needs to address the following issues:

Co-ordination for network functional consistency/integrity

Testing of equipment development software and upgrades for network functional consistency should be covered in the co-ordination process. The TOs should define procedures for the co-ordinated testing of exchanges/protocols/service features at the POI.

Co-ordination for network development/planning

In many cases new-entrants objectives may depend upon the provision of POIs, routing capabilities and interconnect services offered by the incumbent. It is crucial to develop procedures at each national level to allow competitors to flag potential networking requirements with the incumbent avoiding disclosure of sensitive information.

TOs should advise other TOs when major network changes and software changes are to be implemented. The co-ordination process will ensure that TOs are aware of planned changes and potential problems arising from such changes.

An interconnect routing plan recording how calls are routed from one operator network to any part of another's should be settled and arranged between both parties.

Co-ordination for dimensioning of interconnection

It will be necessary for the interconnected TOs to establish ordering/provisioning arrangements which are sufficiently flexible to allow the dimensioning of POIs. Interconnection rules and allowances for alternative routing schemes will be covered in this co-ordination process.

Co-ordination for billing

The TOs will need to determine the information content, format and accuracy of call charge records that need to be exchanged. A co-ordination process will define mechanisms for the recording processing and sharing of call data between interconnected TOs.

For call tracing requirements information to be transferred in the form of a call charges record should include the carrier selection digits dialled by the customer and/or the customer's carrier pre-selection mark.

Co-ordination for network operations management

Network operations management has a role in the handling of traffic and meeting performances. It has also a vital role in reducing the impacts of unforeseen network disturbances. Co-operative contingency plans are required to ensure that disturbances in one TO's network do not cause unacceptable degradation of service in another TO's network. In addition, agreed inter-TO responses must be clearly defined to ensure immediate co-operation for service restoration. Procedures in the event of natural disasters could also be established.

Co-ordination for network fault analysis

A process for co-ordinating the network fault analysis activities for interconnected calls is required. End to end quality of service issues with clear undertakings for the sharing of responsibilities for blocking probability, fault diagnosis and clearance will be part of the process. Fault localisation in case of customer complaint will be also be part of the process.

Co-ordination for quality of service

This may include quality of service assurances for implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering.

Co-ordination for directory enquiry support

This may include arrangements for exchange of databases, and data protection issues that follow from that - dial up access to databases; transparent call transfer of directory enquiry calls; etc.

In the longer term this may require the establishment and operation of a central directory enquiries bureau, possibly separate from the operators' network and subscriber management functions, and possibly integrated with the management of a national numbering/portability database.

16.3. Contractual Components

The principles for negotiating interconnection arrangements should cover all the necessary contractual aspects to enable a prospective interconnecting TO to plan its interconnection reliably. We recommend that an interconnect agreement should cover the following issues:

Establishing interconnection:
- Nomination of contact points for further information
- Process for requesting interconnection
- Time to achieve interconnection
- Numbering management

System assurance:
- Prior conformance testing and standards assurance
- System protection and safety requirements
- System changes, routine testing and maintenance
- Approved attachments and customer equipment rooms

Operational security:
- System security/system integrity provisions
- Disaster recovery planning

Operating the service interconnection:
- Nominated individuals with operational responsibilities
- Routing principles
- Traffic delivery, forecasts and capacity
- Exchange of network design and configuration information
- Exchange of subscriber, numbering and billing information
- Payment terms and mechanisms

Ensuring end to end service quality:
- Provision, restoration times
- Network availability
- Network quality indicating the incumbent's network is equally successful in connecting other operator's calls
- Data management amendments to implement equally

Confidentiality:
- Each party information confidential
- Need to keep information from retail arm.
- Data Protection in respect of customer details
- Provision of information to regulator if needed

General provisions:
- Subcontracts
- Governing law
- IPR

Procedures for dealing with problems:
- Dispute resolution
- Breach, suspension and termination
- Limitation of liability
- Force majeure

17. GUIDELINES FOR NRAS AND TOS IN PREPARING RIOS AND IMPLEMENTING INTERCONNECTION

17.1. NRAs the Need for an Interconnection Issues Focus

The NRA must ensure that RIOs are based on the national regulatory framework on interconnection. This framework should include:

- principles upon which interconnection negotiations are based for all TOs and for dominant players,
- a mandatory negotiation timetable,
- powers to impose an interconnection agreement if negotiations fail by dates specified in the timetable,
- mechanisms for dispute mediation during negotiations.

Specific conditions for dominant players may include:

- the publication of an interconnection catalogue (mandated as the RIO);
- the level of unbundling - allowing access at local and the transit switching levels,
- the interconnection charging principles and the cost accounting method for establishing and justifying interconnect tariffs.

As far as the management into being of interconnection services is considered, the NRA is directly responsible for implementing national policy, which will take into account the relevant European policy. NRAs will have to:

- approve the RIO taking into account issues peculiar to the country and individual interconnection policy,
- provide guidance to TOs on issues such as interconnect conditions, service implementation and operational control.

The first issue for a new entrant is to get the relevant information on interconnection. The publication of the RIO should represent all the information required to plan a new telecommunications service network.

It is essential that NRAs ensure that the RIO covers interconnection services including precise technical specifications, operational requirements the connecting TO is expected to provide, time to implement new interconnections, costs, and points of contact for clarification and further information.

As far as RIO technicalities are concerned, the NRA must be well informed of the impact of technical decisions taken in RIOs on the ability of TOs to achieve effective interconnections.

Specifically, the NRA will need to develop a consistent policy on Equal Access, Portability, Numbering and POI architecture:

- **to support equal access services and ensure availability of CLI and its geographic coverage;**
- **to support carrier selection and local number portability implementations both by the incumbent and where appropriate by new entrants;**
- **to specify how numbers are allocated to new entrants, and portability of numbers ensured, and what the mechanisms to achieve this are (eg a central numbering database);**
- **to analyse whether a network-independent architecture may be adopted in the long run for the location of POI.**

17.2. Interconnect Service Implementation

To guarantee a service oriented approach, it is important that NRAs monitor the technical and operational process of interconnection. It is essential that TOs with the support of the NRAs develop business practices on interconnection.

In addition TOs will need to agree on operational guidelines for jointly monitoring interconnection It may be appropriate that NRAs support TOs in the development of this co-ordination process for ensuring the following tasks:

- management of the interworking between networks/services,
- establishment, operation, maintenance, administration charging and billing of end-to-end services,
- customer identification and billing services,
- network integrity and service performances,
- compliance with agreed quality of service standards,
- monitoring of all TOs' QoS as provided to end-users,
- developing business practises in respect of network performance.

In order to facilitate service implementation and operational control, guidance and support from NRAs is recommended for the development of business practices between TOs on the following aspects :

- **definition of a code of practice for the provision of calling party and customer billing information at the interconnection,**
- **definition of adequate procedures for ensuring end to end call traceability through interconnection**
- **achievement of precise rules for the coordinated introduction of new supplementary services that impact interconnection interfaces,**
- **development of an effective testing regime building on and developing the experience of public TOs in interconnecting with new TOs.**
- **guidance for the implementation of carrier selection and number portability services and their impacts on interconnection.**
- **coordination process in respect with network performance and QoS**

In achieving this the NRA will of course rely to a large extent on support from TOs, user groups etc. Clearly it is a matter for individual NRAs to determine what requirements they have for advisory groups at the national level but there should be mechanisms for:

- ensuring that service providers and equipment suppliers have an opportunity to contribute towards the RIO and national regulatory framework;
- supporting the development of new interconnection services, number portability and carrier selection;
- advising on the development and monitoring of the RIO, e.g. the introduction of new categories of interconnection.

We recommend that NRA to support industry fora. They should organise as a minimum:

- **a service advisory group – a forum of end-users and user associations, together with service/product representatives of TOs/SPs, who would set the agenda for the development of interconnection services, and in particular would be a forum to raise issues of TO/SP inter working (e.g. how strong the need for number portability is).**
- **a systems advisory group – a forum of technical representatives of TOs/SPs together with manufacturers representatives who would support the development of the systems comprising the national network, and in particular the development and monitoring of the NRA's Reference Interconnection Offer. c**

18. INTERCONNECTION FURTHER ISSUES

The majority of this report concerns the interconnection between operators and/or service providers which are:

- delivering services on non-IN circuit-switched systems;
- interconnected at OSI layers 1 (physical) to 3 (network) or above;
- in many cases, offering services on a mutual basis.

The conclusion is that in these cases, a peer-to-peer NNI based on SS7 (with appropriate profiles) and suitable operational arrangements is achievable, and the thrust of the recommendations are in the area of ensuring accessibility of information, harmonisation of standards, and ensuring that the ONP principles are respected in practice.

Therefore the proposed RIO aims at providing principles and guidelines to NRAs for the provision of voice telephony services, and for technical and operational interconnection arrangements between TOs. The major focus of the RIO is on public switched services: a service provided over a network which is capable of routing signals and messages from one subscriber line to any other subscriber line in a network.

However the current emphasis of the framework placed only on "voice telephony services" may lead to a one-sided interconnection framework that does not support the development of global competition and limits the scope of competition in service provision.

There are a number of cases in which the connection has a different character, in particular those involving 'non-traditional' operator networks. While it may not be possible to predict the full range of circumstances in which interconnection may be requested, it is essential that:

- the organisational and administrative mechanisms proposed for agreeing and regulating interconnections;
- the actions identified to achieving these mechanisms;

are tested against all the known current and likely future needs.

Thus RIO in the future should consider:

- the case of a service provider, who typically wishes to have a network-level interconnection for the provision of voice VPN services and the provision of combined fixed and mobile voice services,
- the case of interconnections between operators running IN-based networks,
- the case of wireless local loop networks.

Interconnection to wireless local loop networks may impact on end to end quality of service because they may introduce additional call establishment delay and voice signal characteristics.

For the future we recommend to extend the scope of RIOs to the interconnection with wireless local loops.

Two other cases deserve specific attention, both because of their likelihood of occurrence and because they raise specific issues:

- interconnection at the transmission level (layer 2 or possibly only layer 1) without high-layer interconnection;
- the approach to services based on new modes of carrying public voice traffic – specifically those carrying voice over packet-switched networks such as the Internet.

18.1. Voice VPN Service Providers

Distinction between "voice telephony service providers" and other types of voice services (such as VPN) may make sense in terms of the status defined by a licence granted to each telecommunications service provider. In the market, however, no substantial difference between services provided by TOs/SPs and VPN service providers may be observed in terms of the nature of the services provided to end-users. New market entrants (TOs and SPs) in liberalised markets typically begin their business by providing services to large corporate customers, rather than to address individual households from the beginning of market entry. VPN service is a typical example of a service addressed to large corporations.

Therefore the relevancy of interconnection rules being developed at the EC level for VPN service providers should be analysed:

- Interconnection rules that classify telecommunications service providers in terms of types of licences may create discrimination against those service providers that cannot benefit from the rules, such as VPN service providers.
- In the service markets where various types of telecommunications service providers compete with each other providing more or less the same services, creation of disadvantage to certain types of service providers in the regulatory framework may be harmful for the sound development of a fair playing field in the telecommunications markets.

The regulatory issues which underline with voice VPN or combined fixed plus mobile services are as follows:

- what are the conditions for ensuring non discriminatory access for VPN providers,
- what is the regulatory framework for the operation of combined fixed and mobile voice services,
- to what extent such services should be part of a Reference Interconnection Offer.

For the future we recommend to:

- **extend the scope of RIOs for the provision of combined fixed plus mobile voice services,**
- **to review the regulatory requirements for the provision of voice VPN services.**

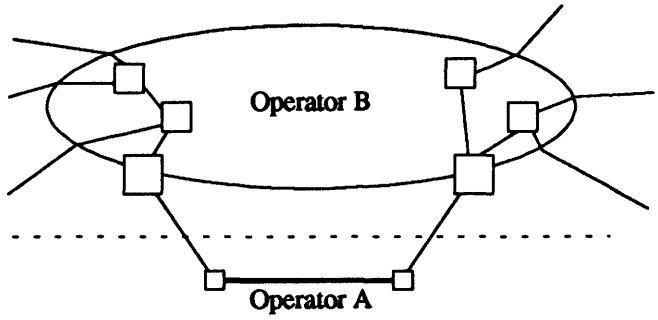
18.2. Transmission Level Interconnection

The scenario envisaged here is where an operator offers connection at below the network level to other operators. The interface then contains no higher-level information relating to the call, such as routing information.

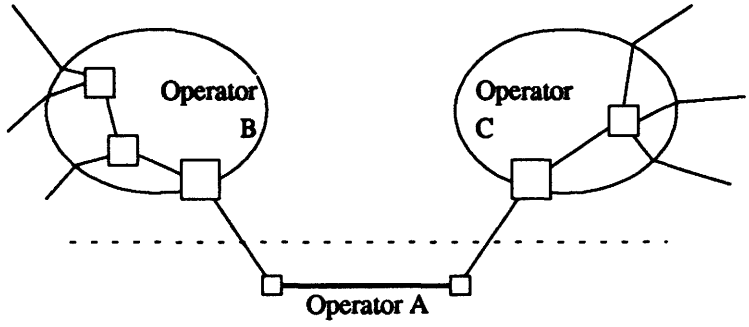
This kind of interconnection – 'transmission level interconnection' – could potentially be implemented in a number of ways (multiple single 64kbit/s channels, 'bulk' leased line, dark or lit fibre). However the connection issues are the same in each case, although obviously the more low-level the service provided, the fewer technical aspects which will need to be standardised in the Interconnection Agreement.

Specific new issues arise with transmission level interconnection from a consideration of the two main operational models (see Figure 6):

- (Model 1) operator A provides a service which interconnects two of operator B's switching nodes;
- (Model 2) operator A provides a service which interconnects one of operator B's switching nodes with one of operator C's switching nodes.



(a) Model 1 — transmission operator providing link services to single network operator



(b) Model 2 — transmission operator providing link services between two network operators

Figure 6: Transmission level interconnection: operational models

Model 1 is a simple case of Operator B renting a link from Operator A, and the issue is only one of the extent to which there is regulatory involvement in ensuring non-discriminatory conditions etc. Model 2 is a more complex case, but may be critical in opening up the European telecommunications market, for example by enabling operators in non-contiguous Member States to arrange bilateral agreements.

Model 1:

The model of one operator providing link services to a second is relatively straightforward. The operators will need, just as in the case of network layer interconnection, to agree:

- technical standards at the relevant layers (e.g. G.703), including quality of service/ performance standards;
- operational practice;
- interconnect charges.

The only difference is that what is logically a single interconnection is implemented at two physical points rather than one.

Model 2:

This model is contractually more complex than Model 1. The 'standard' model of interconnection agreement (i.e. A and B have one bilateral IA, A and C have a separate IA) is not sensible, because of the need for the two ends of the link service to be technically and operationally aligned. Three alternatives may be suggested (see Figure 7 below):

- a trilateral IA involving all three parties. The potential problem with this is that differing goals and developing tensions among the parties will result in an inability to agree on the implementation of evolution of the link;
- B and C formally establishing a Joint Link Management Organisation, composed of relevant officers of both B and C. This results in a Model 1 interconnection between operator A and the Joint Link body. This may be seen as a way of implementing a trilateral IA in practice;
- either B or C taking full responsibility for transport across A's network. In this case one of the network operators – say B – arranges a point of ownership on the far side of A's network – probably a manageable interface unit such as an SDH repeater. This results in a Model 1 interconnection between A and B, with a 'normal' (network level) interconnection between B and C.

The choice among these is a matter for contractual negotiation among the parties involved.

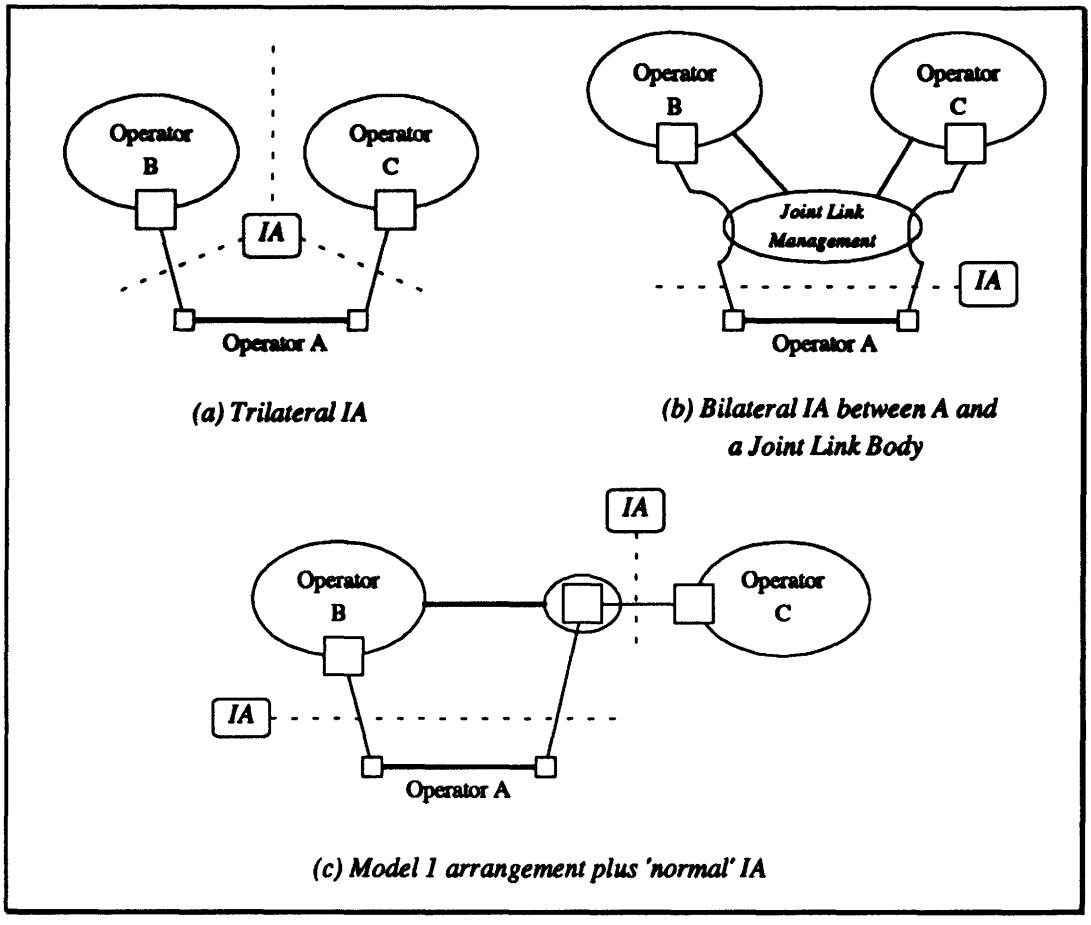


Figure 7: Model 2 interconnection agreements – options

Whichever solution the operators choose to adopt, the mechanisms proposed are, we believe, sufficient to effect the requirements of the Interconnection Directive and other ONP requirements in a practical way. The mechanism is based on:

- A having an Interconnection Catalogue which includes transmission services, offered in accordance with its NRA's regulatory control;
- B and C agreeing on how they wish to approach the interconnection, based on the openly published pricing of A's offering;
- B and C arranging the network-level interconnection between themselves in the normal way, based on *their* NRAs' regulatory control.

The sole regulatory issue which remains is to what extent such services should be part of a Reference Interconnection Offer.

We are firmly of the opinion that transmission level interconnection services which parallel retail services – including leased-line links – should be part of the RIO. Other services, such as dark fibre links, need not be part of the RIO. This is supported by a reading of the Interconnection Directive which interprets "telecommunications network" in an inclusive way, but it may be less contentious to leave this to individual NRAs for a definitive ruling.

We recommend to include in RIOs interconnection at transmission level.

18.3. Services based on Packet-Switched Networks

A more difficult problem is the one associated with packet-mode networks and the extent to which they deliver voice: specifically, the issue of Internet voice telephony. Although this is both far from being a mainstream service, it is important that this issue should not be avoided despite (or because of) it slightly political nature[8].

First it must be emphasised that no Internet Service Provider (ISP) may legally offer public switched voice communications without a TO licence. Further no ISP, even if he has an individual licence, may pass a voice communication on to another ISP for routing unless the second ISP *also* has a TO licence. In practice this is very difficult to enforce, since ISPs are not practically capable of knowing the contents of the traffic their users are presenting the network with.

Secondly it is unquestioned that Internet telephony provides currently, and will provide for the foreseeable future, a quality of service that is far inferior to the circuit-switched network services[9].

In one sense the problem *specifically for this study* is a straightforward one. Internet telephony is not likely to connect with 'normal' switched telephony networks. Such a connection requires a specific gateway at least at the voice codec level, translating packetised voice (e.g. CELP over IP) to PCM. But then the whole point of Internet telephony —that it is cheap over long distances despite being of poor quality— is negated. There is thus *prima facie* no incentive for such a connection.

Nevertheless the issue of interconnection of switched voice networks does arise, and in an interesting way. The logic may be argued as follows:

- it is not practical for ISPs to bar their networks against voice traffic, particularly given that the voice may be originated and be terminated outside the EU;
- it must therefore be assumed that ISPs are switching voice traffic, albeit unknowingly;
- ISPs are therefore bound by the provisions of the ONP Directives relating to voice telephony;
- therefore ISPs need TO licences – which NRAs may draft with relevant regulatory conditions;

---

[8] *The arguments for voice over the Internet are well known, and basically say that:*
- *it is not sensible to prevent the use of the Internet for something whch (i) will be a minority use for the foreseeable future; (ii) could enhance the uptake of multimedia service in Europe and thus enhance EU competitiveness; and (iii) does not actually represent much of a threat to established TOs because of the quality gap.*
- *if and when IP becomes a competitive mechanism for transporting voice, it becomes natural for TOs to adopt it, rather than preventing its adoption. Thus the effect of the current position is, in part, to prevent TOs researching novel (IP-based) voice transport techniques, which may lead to an even larger loss of competitiveness in the longer term.*

The arguments against refer to the need to maintain the ONP essential principles, specifically:
- *network security and data protection (for which the current Internet has a well-founded poor reputation, but largely in areas which are easily addressed);*
- *network integrity, in the sense of the availability and sustainability of a given end-to-end link and the services associated with it (which is a real problem).*

[9] *Note that ISDN is also, technically, a content unspecific digital service, albeit a circuit-switched one. In principle an unlicensed operator could offer "data-only ISDN services". However the natural use of ISDN for voice makes this a very dubious argument. The difference between voice over ISDN and voice over IP is a matter of practicality, not of principle.*

- in particular, the interconnections of ISPs (among a whole range of other attributes) are subject to the provisions of the Interconnection Directive as implemented in the European Interconnection Initiative.

Since the voice that is carried over IP is not evident to the network (except at any interconnection with the PSTN/ISDN), the concept of a service-oriented regulatory framework is difficult to sustain, particularly if the Internet traffic is seen very much as a customer selected low-quality service separate from the PSTN. Nevertheless the potential arises for NRAs to impose standards (including quality of service conditions and operational support standards) on ISP connections, on the basis of the Interconnection Directive.

Of course, in the absence of a clear direction for Internet voice regulation all this is speculative.

We recommend NRAs to develop a common view on the applicability of RIOs to Internet telephony, in the same way as it should address issues of defining and regulating voice service providers.

19. Coordinated Action at the European Level

19.1. The Need for European Action

The implementation of the Interconnection Directive, and more specifically of the technical initiative proposed by this study's, **will depend on the activities of many 'stakeholders'** in European telecommunications, including:

- the EC, ECTRA (European Committee on Telecommunications Regulatory Affairs), ETSI (European Telecommunications Standard Institute) and the EIF (European Interconnection Forum) at the European level,
- NRAs, TOs and Users at the national level

The previous sections have shown how the development of interconnection services is being prompted by Community legislation, and how this is impacting on the practical operation of the European telecommunications markets. While the deadlines for action are clear in the Directives – and now quite close! – it is clear that there is a great range of preparedness among both national regulators and operators.

The basic problem is that it is not clear to stakeholders what specific activities are required. There is a gap, in other words, between the policy framework set up by the Interconnection Directive and the ability of (say) a prospective new operator to know what he can do, how he must go about it, and what it will cost him.

Bridging this gap effectively will require significant effort from a number of organisations. Moreover, **it is not realistic for individual groups to seek local solutions** – partly because of the increasing internationalisation of telecommunications activities, and partly because of the short time available to achieve the necessary harmonisation.

The context for developing interconnections in Europe raises a number of issues:

- the increasing need to conduct telecommunications as an international activity, not only among EU Member States;
- the variations in experience among different NRAs, and the potential for transfer of experiences among them;
- the variations in experience among different TOs (particularly incumbents) in offering interconnection services, and the potential for transfer of experience among them;
- the need for standardisation at the European level (i.e. through ETSI);
- the need for guidance to manufacturers to be brought into alignment across Europe, in order to reduce R&D costs;
- the fact that the legislation has been defined, in some detail, at the European level, so that the focus of it covers interests of all Member States.

Some of this is already being addressed, specifically the EIF's development on a 'consensus' framework Interconnection Agreement. However at present the purpose of this, and the way it links to other activities (such as Member States' RIOs), is not currently being addressed. Unless this is rectified the implementation of actual network interconnections in Europe will be slowed, the legal deadline of 1998 notwithstanding.

There is thus an urgent need to provide coordination and guidance, at the European level, for the activities required to bring about effective telecommunications interconnections. The study proposes as a possible long term scenario a European Interconnection Initiative (EII) to undertake this necessary coordination and guidance.

19.2. Overview of the European Interconnection Initiative

The EII would be an initiative to coordinate a set of disparate and separate projects across the EU. Because of this the EII would need:

- to provide central support: a **mechanism for ensuring cordination of actions** among stakeholders, advice to NRAs, guidance to standards makers etc.;
- to **enable skills transfer**: a mechanism for documenting and publishing the consensus and experiences of relevant stakeholder groups.

The EII is a possible mechanism by which the implementation of the Interconnection Directive could be co-ordinated at the European level. More specifically, the EII may consist of the following elements:

- **coordination structure** that provides suitable fora for all relevant stakeholders – centred on a committee of NRAs as a European-level coordination body, but with components operating in Member States;
- **monitoring activities**: reporting of Member States' and TOs' plans and activities, progress reporting to policy makers and others;
- **projects for NRAs, TOs, ETSI** and possibly others to undertake, with specific technical goals, activities, and timetable.

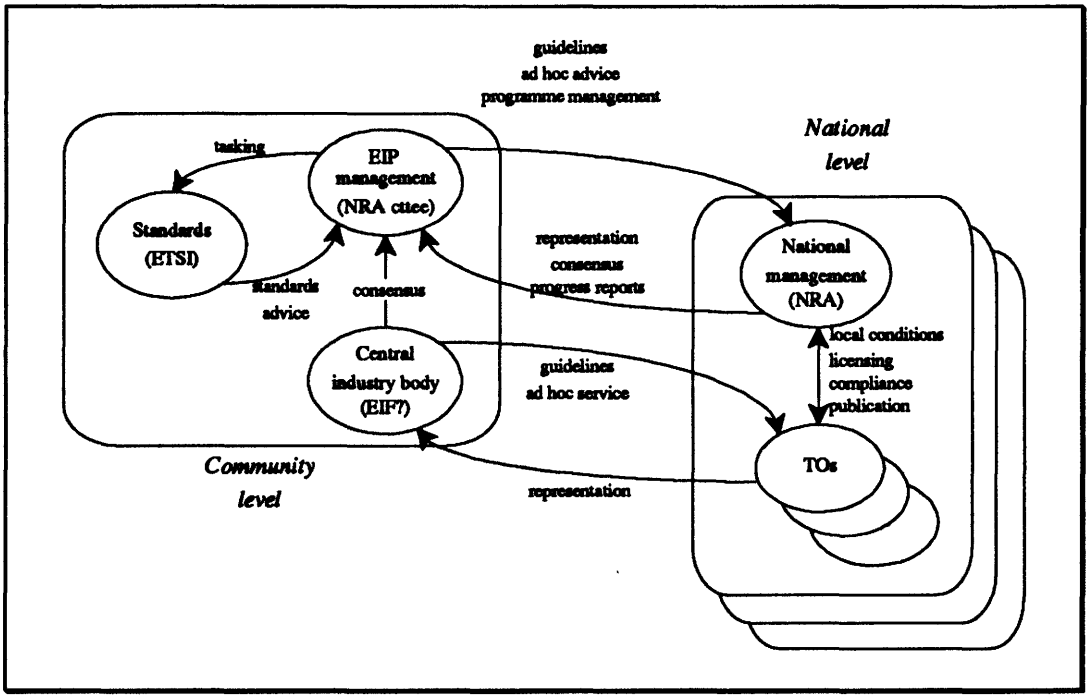


Figure 8: Schematic of proposed EII management structure

The aim of the EII would be to produce results in the following areas:

- an operational and technical strategy for implementation of interconnection services;
- a programme plan at European and (via Member States) national levels;

- a framework for the content and structure of RIOs;
- (via Member States) individual RIOs;
- priorities for standardisation;
- published guidelines for NRAs and TOs on how to prepare for and implement a telecommunications market rich in interconnections.

In addition the EII might provide:

- progress reports to the stakeholder community;
- *ad hoc* advice on specific aspects of implementation.

In order to coordinate and advise efficiently it will take as major inputs:

- relevant Community legislation, specifically the ONP Directives and particularly the Interconnection Directive (which defines the goals and some of the policy mechanisms the EII must address);
- stated policy and aims of NRAs, individually and collectively (which defines the direction and speed of specific instruments, e.g. on relative priorities of Universal Freephone and equal access services);
- the developments of the EIF (the current work provides a practically-based, consensus view from the TO community on the structure, contents and goals of an Interconnection Agreement; in future the EIF might contribute other inputs – guidelines on service costing, etc.);
- the current ETSI portfolio of technical and operational standards (which gives a range of technical mechanisms for implementing specific regulatory goals).

Figure 9 indicates the role of the EII schematically, together with its chief inputs and anticipated impacts.

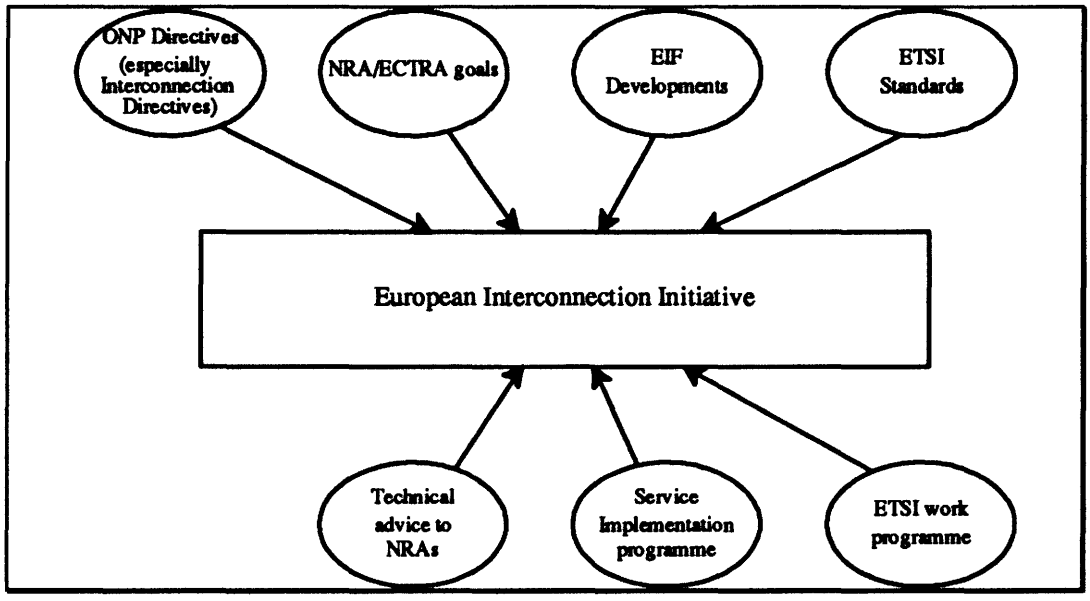


Figure 9: Schematic of proposed EII inputs and outputs

19.3. EII Objectives

The definition, coordination and implementation of an Interconnection Initiative at the European level aims at providing principles and guidelines to NRAs for the provision of services, and for technical and operational interconnection arrangements.

It is considered as critical that incumbents do not impose unreasonable technical and operational requirements on their competitors when establishing interconnection and that there will be compatibility and interoperability between interconnected networks.

The key mechanisms are:

- implementation via programmes run by NRAs;
- provision of guidelines to adapt and to endorse by NRAs;
- provision of opportunities for NRAs, TOs (of all kinds) and users to exchange skills and experience on a Europe-wide basis;
- exploitation of relevant industry interest and activities (e.g. through EIF work);
- promotion of standardised technical interfaces based on ETSI standards;
- ensuring co-operation between interconnected TOs in network development, operation and end to end service delivery;
- ensuring industry-wide participation in interconnect decisions where appropriate.

19.4. EII Principles: Rights and Obligations

Licences give 'rights' and impose 'obligations' on TOs/SPs. Ideally these will be harmonised across Europe, but there are bound to be local differences of policy, focus or interpretation. Licence conditions are expected to be something like the following:

- all licensed operators/SPs have rights of customer access, service provision, carriage, interconnection at NNI etc.; in return, all licensed operators/SPs have obligations to provide both customer and interconnection services;
- the nature of NNIs and the process of achieving them is under regulatory control;
- there are 'special' conditions which may be imposed on some licence holders—universal service obligation, a price cap formula, service limitation (e.g. prohibition from broadcasting services). A licence holder with such special conditions may be granted some *quid pro quo* – Government grant, ADCs, etc.
- derogations may be granted to some classes of licence holder (e.g. new entrants, perhaps all SPs).

19.5. EII Principles: Industry Contributions

Individual NRAs and TOs/SPs have well developed ideas about the nature and content of interconnection agreements which it would be foolish not to take advantage of. Even more significantly, the supply industry as a whole is contributing to its own view of 'best practice', through the European Interconnection Forum (EIF).

It is proposed that this valuable work is exploited by aligning, in the first instance, the structure of the EII with the EIF work. Because they have different purposes they will not fully overlap, and it is expected that:

- the EIF document addresses some matters of technicality, and which are duly excluded from the EII;
- the EII addresses some matters of management and policy that are beyond the remit of the EIF, and which are duly excluded from their document;
- there are areas in which the EII provides general guidance only which the EIF needs to (or chooses to) refine.

As time passes the goal is to make the EIF document effectively act as the technical working-out of the EII. By a similar process the RIOs (as mandated by the Interconnection Directive) will become regulatory workings-out of the Framework, based on national circumstances.

19.6. EII Principles: Operations

The fundamental basis of the management of interconnection services is, as with all industry policy, an agreed structure of operations. Within the European context the authority structure is based on compliance with:

- ***harmonisation* and *competition policy*, at the European level (and under which principle the ONP Framework and other Directives are in force);**
- ***subsidiarity*, the freedom of Member States to act freely in other areas.**

The industry model (see Figure 10) on which the proposed structure is based is the following (which is implicit in the ONP programme):

- TOs and SPs are (or will soon be) private sector organisations, operating competitively but under licence, to offer services to users;
- direct, detailed regulation of individual TO activities is at national level, although the possibility of a non-national direct regulation (e.g. to streamline the regulation of TOs which operate internationally) is not ruled out;
- (national) regulators represent the strategic interests of users by ensuring anti-competitive practices are minimised, by issuing and monitoring compliance with nationally defined licences;
- the European 'tier', through the EC, has a role in monitoring the harmonisation of developments to ensure the best development of telecommunications services on a Europe-wide basis, and steering the development of European legislation and regulation (e.g. to react to changes in technology).

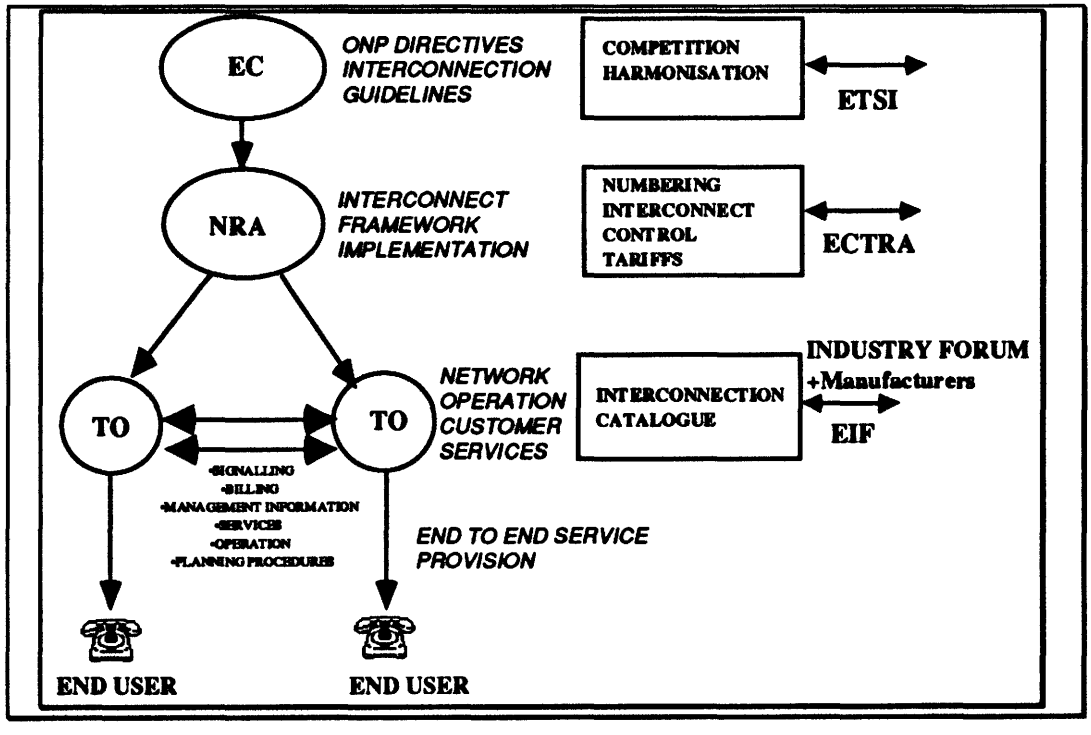


Figure 10: Industry Structure

The ONP Directives already allocate certain responsibilities; for instance numbering administration is clearly identified as the responsibility of the NRA.

19.7. Management of the EII

The EII, and the work at national level (and below), would itself require effort to manage. The proposed approach is indicated in Figure 11.

The main elements of this management structure are:

- **at the European level, the EII promotes mechanism for the interpretation and implementation of the ONP Directives.** The Framework is associated with (elements of) the latest version of the EIF consensus, current ETSI standards, etc.
- **at national level, each Member State owns adapts and maintains a public national policy on interconnection practice, and sponsors the production of the Reference Interconnection Offer**, probably with or via the incumbent TO. The RIO may be developed by TOs into Interconnection Catalogues. Completion of Interconnection Agreements is a bilateral activity between licensed TOs/SPs. Users feed their views into regulators via a suitable advisory group.
- **at each level there is a responsibility for developing policy, developing a suitable implementation plan, providing 'upwards' feedback, compliance monitoring** etc.

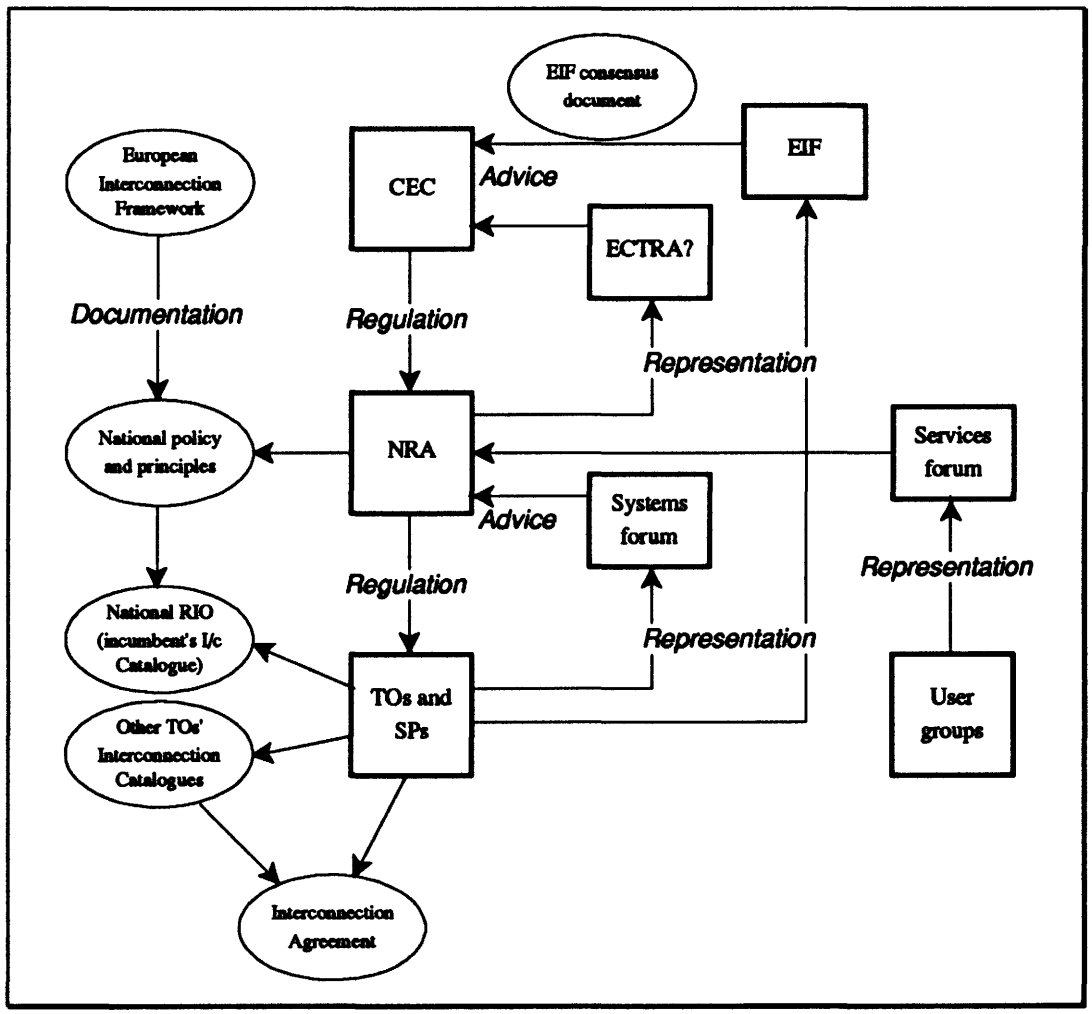


Figure 11: Schema of ideal Framework management structure

19.8. EII Management Resources

The key questions at the European level are:

- what body should manage the EII on a day to day basis (i.e. acts as change control authority)?
- what body should maintain the plan?
- what body should monitor compliance?

Clearly it would take significant effort to manage the Framework. Much of this will come from NRAs etc. in the normal course of their activities. However the coherent development and maintenance of the European tiers is new.

The solution proposed is for a *suitable forum of NRA representatives* to undertake day to day management. However there should also be a Europe-level regulatory voice on this management body – either the EC itself or the ETO.

EII management is not believed to require the establishment of a new management organisation, with the attendant bureaucracy. There should be sufficient flexibility in existing structures for the EII to be managed via, say, a Working Group of ECTRA or of the ONP Committee.

As a non-legislative body the rules for voting etc. do not need to be rigid. The aim would be, as with the EIF, for a consensus to be achieved.

An alternative option is that *the EC directly manages the Framework.* This is not a preferred solution, for two reasons (partly practical and partly political):

- it adds an extra layer of regulation which runs the risk of being less in touch with actual operators, networks and users than NRA secondees;
- it runs the risk of failing to convince individual NRAs, thus slowing down the process of Framework adoption, relative to the option in which NRAs themselves are closely involved in defining the Framework.

For those reasons, it is proposed that:

- **The EII be defined, tracked and developed by a Steering Committee** (possibly through ECTRA). Ideally this committee would have a mixture of types of regulatory officers - legal/contractual, service/user-oriented, licensing/compliance and technical.
- **At national level, there should be an Interconnections Directorate in each NRA,** which is responsible for undertaking the day-to-day liaison with national TOs in the area of interconnections and interconnection services, and which is also responsible for developing the national-level EII deliverables.

Furthermore, it would be advantageous if NRAs' EII representatives used the EII as a forum to pool their experiences with drafting the national-level documents.

19.9. EII outputs

The deliverable deliverables of the EII Initiative of projects could be the following:

At the European level:

- EII Coordination Plan: documented organisation structure and operations;
- Interconnection Service Plan: definition and associated timetables of interconnect service offerings;
- RIO Framework: a framework at the European level to guide the content and structure of Member States' RIOs;
- EII Guidance: guidelines for NRAs and TOs on how to prepare for and implement telecommunications interconnections;
- EII Standardisation Plan: a programme of work for ETSI.

At the national level:

- National Interconnection Coordination Plan: establishes the committees and forums to be used within the Member State;
- National Interconnection Service Plan: timetables of implementation of specific interconnection services nationally;
-

20.1. Regulation of Technical Aspects

As well as interconnection charges, technical and operational aspects of interconnection represent a major component of interconnection conditions which may lead to bottlenecks and discriminatory conditions especially on the following aspects:

- the availability of a detailed Reference Interconnection Offer in consistency with ONP provisions and new entrants requirements,
- the availability of standardised interconnection interfaces rich in interconnection services,
- linked to interconnect charges, the availability of POI located both at transit switch and local switch levels,
- a set of clearly defined coordination procedures for the monitoring and the management of interconnection.

In addition to the proposed set of interconnection services, and RIO's technical components, the study aims at providing guidelines to NRAs/TOs for the provision of voice telephony services, and for practical implementation of interconnection arrangements between TOs.

In order to implement interconnection with a service oriented approach, and to deal with practical engineering arrangements, the analytical process used in the study has led to the identification of additional tools needed to be set up at a European level. These tools will help to complete actions at the national level.

Those tools and actions take as major inputs:

- the relevant Community legislation, specifically the ONP Directives and particularly the **Interconnection Directive;**
- the **stated interconnection policy and aims of NRAs**, individually and collectively;
- the current **developments of the EIF;**
- the current **ETSI portfolio** of technical and operational standards.

At the European level, we recommend that the following tools should be available:

- **The proposed Interconnection Standardisation Plan within a programme of work for ETSI.**
- **The proposed Interconnection Service Approach: with the definition and associated timetables of interconnect service offerings;**
- **The proposed check list for RIOs;**
- **The proposed guidelines for NRAs and TOs on how to prepare for the RIO and to implement telecommunications interconnection agreements.**

At the national level, we recommend NRAs and TOs to use those tools for the completion of the following regulatory actions:

- **Production of an Interconnection Service Plan: timetables of implementation of specific interconnection services nationally;**
- **Production of the National Reference Interconnection Offer;**
- **Publication by NRAs of guidelines on their approach to imposing principles and obligations on interconnection or and on how to prepare for and implement interconnections.**

In addition to regulatory actions, we recommend NRAs and TOs to complete the following operational actions:

- **Publication on the NRAs Web of specific Interconnection Information presenting national interconnection regulation, and RIOs**
- **Achievement of business practices between TOs with the support from NRAs**
  - **for the introduction of new supplementary services between interconnected networks,**
  - **for the provision of calling party and customer billing information at the interconnection,**
  - **to ensure call traceability at the interconnection,**
  - **to develop an effective testing regime,**
  - **to develop the experience of public TOs in interconnecting with new TOs,**
  - **to develop co-ordination processes in respect of network performance management and Quality of Service.**
- **Development with the support from NRAs of forums representing the supplier industry (all TOs) and user community who would agree to the agenda for the development of national services, and in particular for number portability and carrier selection.**

20.2. Standardisation Plan

Standardisation activities are required in both non-IN and IN interconnections. However the approach must be very different between the two cases. The following proposes a suggested list of contents for a Standardisation Plan; however this will clearly need to be refined by both NRAs (to set service priorities) and ETSI (to propose a timetable based on feasibility and market readiness).

20.2.1. Non-IN Standards

A common partial standard is required defining the lower-level functionality of ISUP to enable the networks to interwork. This lower-level functionality should be in place within a reasonable time frame - perhaps two years.

Existing standards that should be promoted, and used as the basis for extension work, include:

- access network V5 interfaces for the access to the transmission part of a public voice network at the local loop level,
- ISUP V1 and V2 standards for the interconnection of fixed networks,

- ETS 300 303, based on ISUP V1 or ETS 300-646-1, based on ISUP V2 for GSM to ISDN interconnection.

In addition to present ISUP standardisation work, ETSI should develop technical frameworks and implementation guidelines related to:

- call handling, charging and billing procedures, covering at least:
  - provision of real time AOC (Advice Of Charge) services for basic call and supplementary services across the interconnection interface;
  - signalling and procedures to support call tracing, including an Originating Network Identifier;
  - charging and settlement procedures in order to provide unique billing and reliable AOC information to the users;
  - procedures to ensure the confidence in the calling party number received by a TO at a NNI;
  - provision of additional information elements to calling party number in order to provide a customer billing address.
- methods for defining a national TO identification code, and the encoding in Transit Network Selection Information Elements for the provision of carrier selection services:
  - description of the method to define a national TO identification;
  - the national TO identification code should preferably include an identification of the country that issued the identification code;
  - definition of pan-European TO identification codes including an identity code specifying Europe.
- implementation of local number portability using non-IN solutions ;
- implementation and management of a reference data base for non geographic numbers;
- management of interconnection interfaces covering:
  - fault management, procedures for tracking network faults, management of information delivered to interconnected TO;
  - performance/quality of service at the interconnection interface (probability of traffic congestion, provision of alternate paths, continuity of service in the event of link/node failures),
  - end-to-end performance and quality of service (transmission quality, call path integrity, network congestion, call performance, network availability),

20.2.2. IN interconnection standards

At present IN interconnections are not well supported by standards. Standardisation work on IN and network management standards is required to allow effective management of single-operator networks, and multi-operator (national, European) networks, particularly for VPN networks and services.

ETSI should be tasked to develop a standard framework and work plan based on the model used for GSM for:

- service implementation, management and call handling;
- charging, accounting and apportionment procedures.

20.3. Long Term Scenario

The study proposes as a possible long term scenario a European Interconnection Initiative (EII) to undertake coordination and guidance to bring about effective telecommunications interconnections.

It may be appropriate for the stakeholders to develop the EII as a possible mechanism for the interpretation and practical implementation of the EU legislation on interconnection.

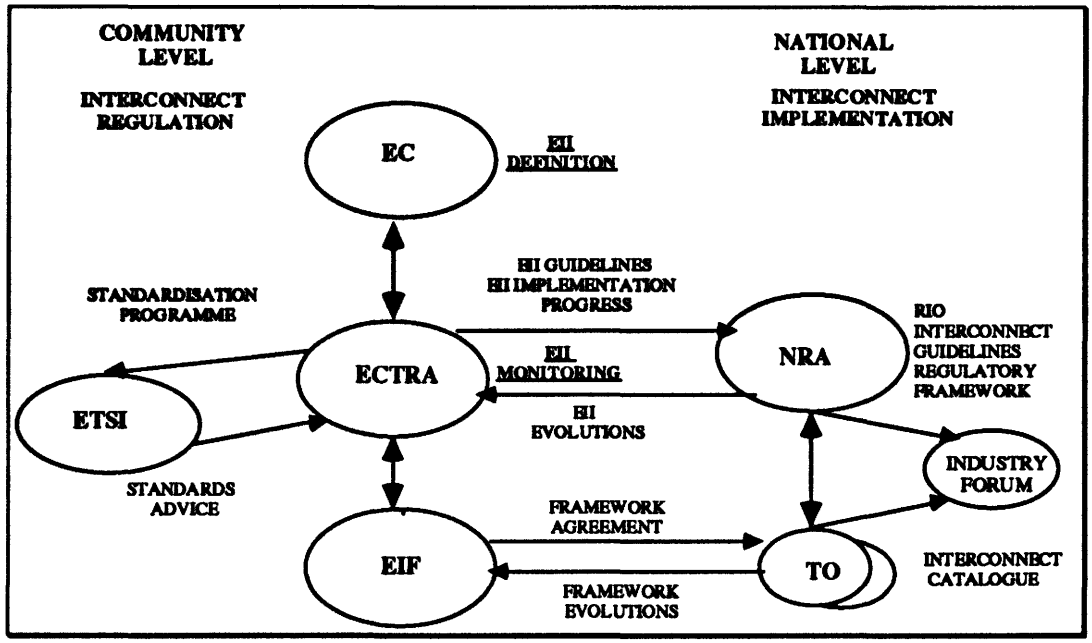


Figure 12: EII action chart

The following actions have been identified:

- **to create a monitoring structure at the European level** that provides suitable fora for NRAs as a European-level co-ordination body to:
  - monitor compliance of the TOs' plans and activities in Member States,
  - respond to problems experienced when completing and evolving RIOs,
  - monitor ETSI standardisation plan to set service priorities and to propose a timetable based on feasibility and market readiness,
- **to create an observatory for interconnection QoS and network integrity issues** and take the responsibility for the gathering and publishing of country experiences related to network integrity problems and solutions achieved,
- **to finalise, in association with the elements of the latest version of the EIF consensus, a reference interconnect agreement** for the proposed sets of interconnect services and to refine the interconnect reference agreement taking into account impacts of carrier selection and local number portability service implementations.

21. List of Acronyms

A

AOC	Advice of Charge
ART	Autorité de régulation des Télécommunications: the name of the French NRA since 1 Jan 1997. Previously DGPT.
AUSTEL	Australian Telecommunications authority (the NRA in Australia)

B

BMPT	the NRA in Germany

C

CC	Country Code
CCBS	Call Completion to Busy Subscriber
CF	Call Forwarding
CLASS	Common Local Area Signalling Services
CLI	Calling Line Identification
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CW	Call Waiting

D

DDI	Direct Dialling In
DECT	Digital European Cordless Telecommunications
DGPT	Direction Générale des Postes et Télécommunications: the French NRA (from 1 Jan 1997, its name is ART)
DGTEL	the NRA in Spain
DTMF	Dual Tone Multiple Frequency

E

ECTRA	European Committee on Telecommunications Regulatory Affairs
EIF	European Interconnection Forum
EII	European Interconnection Initiative (as defined per this document)
ETO	European Telecommunications Office
ETNS	European Telephony Numbering Space
ETS	European Telecommunications Standard (standards established according to the procedures of the ETSI)
ETSI	European Telecommunications Standard Institute

F

FCC	Federal Communications Commission (the NRA in the US)

G

GSM	Global System for Mobile communications

I

ICP	the NRA in Portugal
IN	Intelligent Network
INAP	Intelligent Network Application Part
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISP	Intermediate Service Part (related to SS7 architecture)
ISUP Vx	ISDN User Part version "x"
ITU-T	International Telecommunications Union - Telecommunications sector

L

LEC	Local Exchange Carrier (in the US)

M

MCID	Malicious Call IDentification
MoU	Memorandum of Understanding
MSA	Metropolitan Statistical Area

N

NIIF	Network Interconnect Industry Forum (in Australia)
NNI	Network to Network Interface
NRA	National Regulatory Authority
NTP	Network Termination Point

O

OFTEL	Office of Telecommunications (the NRA in the UK)
ONP	Open Network Provision (concept defined in Council Directive 90/387/EEC)
OSI	Open Systems Interconnection

P

PCS	Personal Communications Services
PLMN	Public Land Mobile Network
PNO	Public Network Operator
POI	Point Of Interconnection
POTS	Plain Old Telephone Services
PSTN	Public Switched telephone Network
PTO	Public Telecommunications Operator
PTS	Post & Telestyrelsen (the NRA in Sweden)

Q

QoS	Quality of Service

R

RCF	Remote Call Forwarding
RIO	Reference Interconnection Offer

S

SCCP	Signalling Connection Control Part
SCEF	Service Creation Environment Function
SCF	Service Control Function
SDF	Service Data Function
SP	Service Provider
SRF	Specialised Resources Functions
SSF	Service Switching Function
SS7	Signalling System number seven

T

TAC	Telecommunications Administration Centre (the NRA in Finland)
TCAP	Transaction Capabilities Application Part
TO	Telecommunications Operator
TP	Terminal Portability
TUP	Telephone User Part
TUP+	Telephone User Part "Plus"

U

UNI	User to Network Interface
UPT	Universal Personal Telecommunications
UUS1/2/3	User-to-User Service 1/2/3

V

VPN	Virtual Private Network

12, rue Delerue
92120 MONTROUGE
FRANCE
Tel: (33) (1) 42 53 89 97
Fax: (33) (1) 46 54 05 27

EQUAL ACCESS & INTERCONNECTION

Study on the issues related to Fair and Equal Access and the provision of harmonised offerings for Interconnection to Public Telecommunications Networks and Services in the context of Open Network Provision conducted by ARCOME & SMITH System on behalf of EC DG XIII

EXECUTIVE SUMMARY

ARCOME SA Suzanne Debaille

SMITH System Engineering Mark Cartwright

Version 3.0
Reference: SD/105/97
21 March 1997

Table of Contents

---

1. Background to the study

This document has been prepared by Arcome SA (France) and Smith System Engineering Ltd (UK) for the European Commission. It represents the final report of a study for the DGXIII on "Issues related to fair and Equal Access and the provision of harmonised offerings for interconnection to public networks and services in the context of Open Network Provision (ONP)".

The aim of the study has been to provide a practical and operational set of recommendations for the implementation of European Directives on the interconnection of telecommunications networks.

As the interconnection regulatory framework requires Telecommunications Operators (TOs) to publish an Interconnection Reference Offer, a major concern of the study has been to help regulators and operators to identify what offerings should be included in their Reference Interconnect Offers (RIOs).

The study is limited in principle to voice telephony services (as defined in the Voice Telephony Directive). However, reflections on Intelligent Networks (IN), Virtual Private Networks (VPN) and Bandwidth services are included in the light of comments from industry players, country experiences and technical analysis.

This Executive Summary provides an overview of the study's main conclusions.

The main text of the report provides additional detail on our findings and analysis, and on the proposed way ahead. Detailed country surveys and experiences on interconnection, and detailed analysis of technical issues, have been separately bound into two appendices.

This report is based on information gathered and analysed using the following three-phase method:

- **Phase 1: Information gathering.** Survey of experiences of interconnection and equal access in key national networks; reviews of existing interconnection frameworks and agreements; validation workshop to the provider, user and regulator communities (12 June 1996).
- **Phase 2: Technical analysis.** Analysis of user needs for equal access and interconnection services and scope of necessary framework; analysis of technical impacts on interconnection; analysis of standards position; analysis of manufacturers viewpoint, definition of a technical strategy and standardisation programme.
- **Phase 3: Strategy proposal.** Analysis of organisational and operational aspects related to interconnection implementation and management; definition of the major components of a Reference Interconnection Offer (RIO), development of guidelines and recommendations for both National Regulatory Authorities (NRAs) and TOs; outline of a European Interconnection Initiative (EII) to implement the strategy.

1. Context

1.1. The Regulatory Background

For interconnection and equal access issues, the core of the European regulatory framework is contained in the ONP Interconnection Directive which is currently in development [Common position adopted by the council with a view to adopting Directive 96/.../EC of the European Parliament and of the Council on interconnection in telecommunications with regard to ensuring universal service and interoperability through application of the principles of open network provision (ONP) (OJ C220, 29.7.96) . Joint Text approved by the Conciliation Committee on 20 March 1997.] . and the 'Article 90' Directive 96/19/EC (art 4a) for the introduction of full competition in telecommunications services [Commission Directive (96/19/EC) amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications market (OJ L 74, 22.3.96)] . The latter mandates the publication by the incumbent of terms and conditions for interconnection (called RIO : Reference Interconnection Offer) by mid-1997. The mandatory publication of interconnection terms and conditions also includes tariffs.

Detailed presentation of the European regulatory background is presented in part I, section 2 of the final report.

1.2. The Need for a Technical/Operational Interconnection Framework in Europe

On 1 January 1998, public voice telephony networks and telecommunications infrastructures will be liberalised in Europe to enable full competition within the telecommunications market. Two major issues are associated with the implementation of full competition in public voice telephony networks and services:

- **Equal Access - Carrier Selection**: the mechanisms by which a customer has a fair choice of network service providers, including those to which he is not connected directly;
- **Network Interconnection**: the mechanisms by which independently managed telecommunications networks connect to one another to provide an efficiently interoperable service to users.

In order to cope with the practicalities of interconnection and carrier selection, a comprehensive technical/operational framework will need to be in place in the different Member States to provide guidance in order to allow multiple operators to interconnect and to operate in the same geographical areas. In addition, the effective management of technicalities and the involvement of national regulatory authorities in network interconnection will be a significant factor in the implementation of the process.

1.3. The Need for Co-ordination

The implementation of the Interconnection Directive will depend on the activities of many `stakeholders' in European telecommunications. However, there is an extra step to be taken at present between the policy framework set up by the Interconnection Directive and the ability of:

- an incumbent Telecommunication Operator (TO) to know what he is mandated to provide;
- a National Regulatory Authority (NRA) to judge what represents a reasonable proposal by the national TOs;
- a prospective new operator to know what service he will be able to obtain, how he must go about getting them, and what it will cost him.

Because of the variations in experience among different TOs (particularly incumbents) in offering interconnection services, and the potential for transfer of experience among them, implementing regulatory policy into interconnection practicalities may require co-ordination at the European level.

1.4. Lessons from Interconnection Experiences

Current interconnection experiences show the tools available at the regulatory level are not sufficient to tackle technical and operational issues of interconnection.

In the different countries visited during the country survey, which was completed from January to July 1996, interconnection was recognised as crucial for the existence of competition and the availability of a wide choice of telecommunications services for the end users. New entrants considered that interconnection to an incumbent TO's allows an access to essential facilities and has to be viewed with both angles:

- the provision of any to any communications,

- the capability for customers to get access to any provider's services, usually known as indirect Access.

However competition models chosen by individual countries have led to different interconnection policies :

- some countries like the UK have put emphasis on infrastructure competition,
- while other countries like US have put emphasis on service competition, the resale of existing infrastructure especially in the access network, and Equal Access like Finland and Australia.

In the different countries which were analysed, the role of the NRA varied considerably for interconnection preparation and within the negotiation process. But it was recognised that:

- **the regulator has a vital role to play in interconnect negotiations** by ensuring that agreements achieved economic efficiency, and by promoting fair competition,
- **independence, effective powers and sufficient experience** are needed for a regulator to develop an interconnection policy.

It was also recognised that as long as the incumbent TO remains the dominant player, interconnection has to be negotiated between the parties under standard terms and conditions (Reference Interconnect offer) which has to be approved by the NRA. Under those conditions, RIO interconnection components should be sufficiently unbundled to allow interconnection at the most technically feasible points of a network.

In addition to interconnection charges, technical and operational aspects of interconnection represent a major component of interconnection conditions which may lead to bottlenecks and discriminatory conditions The following requirements were highlighted from the country surveys:

- the availability of a detailed Reference Interconnection Offer (RIO) in consistency with ONP provisions and new entrants requirements,
- the availability of standardised interconnection interfaces rich in interconnection services,
- the availability of POI (Point Of Interterconnection) located both at transit switch and local switch levels, linked to interconnect charges,
- the availability of a set of clearly defined co-ordination procedures for the monitoring the planning and the management of interconnection.

These requirements also emerged during an interim workshop organised in Brussels in June 1996. The workshop was attended by more than 100 participants from the industry and was the occasion of fruitful discussions around interconnection key issues. More than 20 written comments from TOs, NRAs and manufacturers were received over the July-August 1996 period. In the opinion of the workshop attendees, a technical/operational interconnection framework was necessary in addition to the regulatory framework proposed by the EC Interconnection Directive and should be written at a European level.

A detailed analysis of the country surveys and the workshop outputs are presented in Appendix I document, and summarised in part I, sections 3 and 5 of the final report.

1.5. Proposed Approach

Based on this context, the study recommends a way ahead consisting of six elements:

- **definition of interconnection set of services offerings** and technical guidance for their implementation (summarised in Section 2 of this Executive Summary);
- **definition of a standardisation programme** for ETSI (summarised in Section 3);
- **guidance** to help regulators and operators develop a common understanding **of what an RIO should contain** (summarised in Section 4);
- **guidance** on operational and contractual aspects of **an Interconnection Agreement** (summarised in Section 5)
- **guidance to help regulators and operators migrate** operations towards an open interconnection services environment (summarised in Section 6);
- **overall scenarios** which aim both to **support the implementation and operation of the RIO, and to co-ordinate its development over the longer term** (summarised in Section 8).

2. Interconnection Set of Offerings

2.1. Service Orientation

Until now the primary role for interconnection has been the achievement of transparency of call management, end-to-end across a number of PTO (Public Telecommunications Operators) domains. In the future, a service oriented approach is proposed to ensure that interconnection regulation is tied to user requirements.

User requirements may be classified following 5 modules of services which need to be addressed at a pan-European level between interconnected TO networks.

Module 1, 2 and 3 services correspond to end-user services which can be provided through interconnected networks. The provision of those services should be addressed in a RIO.

Module 4 and 5 services correspond to special service requirements arising from a competitive environment. The way these services are implemented may impact on interconnection interfaces. Those technical impacts should be mentioned in a RIO.

Module #	Title	Services
Module 1	Basic call/ customer care and billing services	Basic call connection CLI services (CLIP, CLIR, MCID) Access to Directory Enquiries Emergency services Billing services (AOC, provision of itemised and unique billing)
Module 2	ISDN/GSM supplementary services	End to end ISDN supplementary services between two fixed networks End to end GSM supplementary services between two mobile networks Common ISDN/GSM supplementary services between a fixed and a mobile network
Module 3	advanced services	VPN services IN advanced services (Freephone, Premium rate, Virtual calling Card, UPT)
Module 4	carrier selection services	Per default Carrier Selection call by call Dialling Parity or Carrier Pre-selection
Module 5	number portability	Local geographic number portability GSM number portability 800 number portability Non geographic number portability

Service Modules

2.2. Provision of Interconnection Services

Module 1, Module 2 and Module 4 interconnection services can be provided by using non-IN network interconnection techniques and standards. Except for local number portability, Module 3 and Module 5 interconnection services require IN interconnection solutions because these types of services rely fundamentally on the exchange of applications layer information.

The interconnection of `basic' (non-IN) networks - primarily PSTN but also ISDN, GSM does not present a significant technical problem. The standards status and the experience of nations and TOs with interconnection agreements provides a sound basis for achieving and regulating the interconnection of such networks. But newer service offerings - specifically those that may be based on IN capabilities - are more challenging.

Therefore module 1 and 4 services may be easily classified as a primary class of services to be provided through interconnected networks while only an advisory approach and more flexible arrangements should be considered for module 2, and 3 services.

However for the implementation of Module 1 services relevant information from the incumbent need to be available to the other TOs. Technical solutions for carrier selection at user interface (Module 4 services) have very little impact on the interconnection interfaces. The mandatory technical condition is the provision of reliable calling line identification, and charging information at the interconnection interfaces.

As far as supplementary services (Module 2 services) are concerned, the provision of end to end ISDN/GSM supplementary services between interconnected networks should be aligned with the PTOs implementation phases of EURO-ISDN services/GSM services.

The completion of Module 3 services is based on the implementation of Intelligent Network architectures and databases. Even if the interconnection for the provision basic call and voice supplementary service is the first issue between competitive operators, the interconnection of services based on IN will be a major issue in the near future. Therefore, it is recommended to complete interconnection standards and solutions for IN as soon as possible.

Number portability (Module 5 services) also represents a strong service requirement for consumers. It could be implemented in a number of ways, which may differ in time to implement, short term efficiency, long term efficiency and long term flexibility. Local number portability which is the most important portability service to ensure competition may be achieved by using non-IN means.

A detailed technical analysis for implementing those services is provided in Appendix II and in Part II, sections 7 to 12, of the final report.

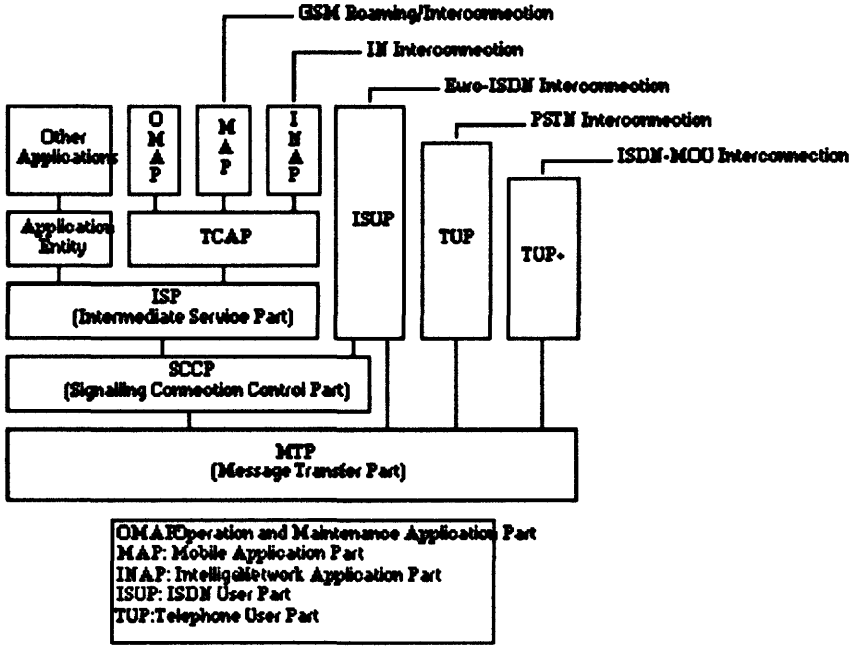
3. Technical Standards

3.1. Standards Status

SS7 (Signalling System N°7) is now widely used in European and North American public networks although the national coverage of SS7 may vary from one country to another. SS7 standards aim at defining signalling procedures and architectures in circuit switched networks: PSTN, ISDN, GSM and IN.

As far as SS7 protocol architecture is structured according to OSI layered model, different SS7 layers (user part) may be concerned for the interconnection between two networks (see figure below) and may be considered in an interconnection agreement to provide the service modules..

Telephony User Part (TUP) which defines the formats and signalling procedures to be used for PSTN calls and ISUP for ISDN/GSM basic calls and supplementary services, have been designed first at an international boundary between two public voice networks. In principle these standards are appropriate for the interconnections of different TO networks in the same country for the provision of fixed or mobile voice telephony services.



Current SS7 layered model

In Europe, ETSI has transposed ITU-T recommendations to ETSI standards in order to define adaptations to European countries. ETSI standards process is perceived to work effectively: a common standard defining the lower-level functionality of ISUP for PSTN, ISDN and GSM signalling networks is available to enable voice fixed and mobile networks to inter-operate. But some additional refinements on service implementation between interconnected networks are necessary to be completed.

In addition to present ISUP standardisation work in ETSI, we recommend ETSI to achieve implementation guidelines related to:

- call charging and billing procedures, reliability of customer information between interconnected networks,
- methods for defining a national TO identification code, and the encoding in Transit Network Selection Information Elements for the provision of carrier selection identification,
- the management of interconnection interfaces,
- implementation of local number portability using non-IN solutions.

Most European countries are migrating towards ISUP (version V1 or V2) to support their EURO-ISDN offerings. In addition, the latest ETSI interconnection standards are based on ISUP. Therefore, it appears that ISUP is the best candidate for the interconnection interface of signalling systems between two voice TO networks.

In order to ensure the consistency of end to end supplementary services PTOs should provide, in a reasonable time scale, ISUP compliant interfaces at POI, and ensure if necessary the interworking capabilities between ISUP and their national protocol, by providing the mapping [Protocol converter functions] specifications for end to end service provision to the new entrants.

In order to avoid discriminatory conditions for the new entrants and to promote ISDN/GSM supplementary services, the interconnection interface has to be as complete as necessary to achieve at least the continuity of all end to end services offered by the incumbent.

Interconnection interface should allow the provision of end to end ISDN/GSM supplementary services between two networks in alignment with the incumbent TO's implementation phases of EURO-ISDN services/GSM services.

3.2. Interconnection Testing

The development of an effective interconnection testing regime is vitally important as are the development of network management standards.

For non-IN networks, interconnection is already taking place successfully and testing does not represent a major barrier as long as the PTO provides testing capabilities and specifications to new entrants. With interconnection based on ISUP standards and the SS7 associated mode establishing basic voice services and ISDN supplementary services, network integrity risk is limited to the dysfunction of interconnected equipment.

Interconnection testing combined with network management have so far prevented from a breach in network integrity. However IN interconnection and the provision of non-circuit related services (such as Call Completion services) will require enhanced testing levels and constantly reviewed controls.

In order to ensure network integrity, we recommend incumbent TOs to set up a test service including testing capabilities and test specifications for new entrants applying for interconnection.

For the introduction of new supplementary services at the interconnection between two TO networks we recommend to promote the EURESCOM approach and test suites to test end to end service interoperability.

In addition to national testing procedures, a follow up of network integrity issues needs to be completed at the European level: by creating an observatory for QoS and network integrity issues at the interconnection.

3.3. Development of a Tool Box for IN Network Interconnection

A more responsive approach to IN standardisation is needed for higher layers that allows (for instance) new signalling message types to be developed, agreed upon and implemented on a short time scale, but within a co-ordinated and public plan.

To consolidate IN interconnection standards, we recommend ETSI to work according with the following approach:

- concentrate on a very limited number of advanced services which need to be addressed on a pan-European basis such as Freephone or provided in each Member State such as Number Portability,
- provide for these advanced services a common service definition,
- define for each service the interworking procedures and a unique interconnection interface,
- use the same approach as achieved for the definition and the standardisation of roaming services between GSM networks,
- complete a technical framework for charging, accounting and apportionment procedures and interactions on signalling systems in the provision of these IN services,
- provide guidance for the implementation and management of a reference data base for non-geographic numbers and portability services.

3.4. ETSI focus on Interconnection

Until now, ETSI standardisation work has been based on public telecommunications services provided by a single public

network.

The scope and the involved parties in the ETSI standardisation work related to interconnection should be extended:

• **it may be appropriate for ETSI to facilitate the involvement of new entrants in the standardisation process** by promoting interconnection standards and work programmes. We recommend ETSI to create a new horizontal project related to interconnection. To ensure alignment with competitive environment, inputs to this project could be provided by achieving an ETSI Interconnection Panel involving new TOs.

• **ETSI should refocus on interconnection standards** by introducing new principles in the development of standards for an interconnected environment. For example: the standardisation work for a new service or a new UNI should include the corresponding enhancements and standards at the NNI,

• **NRAs should get involved in ETSI process for service definition** in order to ensure that proposed solutions and standards allow the non-discriminatory provision of a service by the competitive TOs,

• In order to get stable standards in a reasonable time frame, **ETSI should avoid to define too many types of interconnection interfaces.** In particular, special access should use existing standardised NNI and UNI interfaces.

• **ETSI should start work items regarding enhancements of existing SS7 standards to network security/integrity** and include these aspects in all the future documents and standards. These mechanisms of security and protection in the signalling networks could benefit from those that have been defined by the Internet Community with the concept of firewalls.

4. Reference Interconnection Offers (RIO)

4.1. RIO Requirements

The Interconnection Directive mandates all NRAs in EU Member States to ensure a Reference Interconnection Offer (RIO) is produced by TOs with significant market power. This represents a national list of interconnection services - by user type where justified - and associated terms and conditions (including tariffs).

The two major aspects which RIOs should aim at implementing are:

- to support service competition: availability of customer choice and carrier selection services;
- to support interoperability of interconnection services: transparent seamless connectivity between users.

It is expected that in most cases RIOs will be prepared by incumbents and approved by NRAs. The incumbent's Interconnection Catalogue will initially be synonymous with the RIO.

In addition to service and price lists, a RIO should carefully define the requirements and conditions to ensure that:

- two networks can interwork effectively and efficiently,
- services to end users are met,
- facilities offered and interconnection provisions are available in a given timescale,
- CLI information or customer billing information (ie name and address) is provided to facilitate billing services and carrier selection services,
- no network is able to disrupt another party's services,

- mechanisms for liaison and contact are specified to allow interconnection planning, maintenance, and evolution.

4.2. RIO Principles

In answering the suitability of the RIO prepared by a TO, the key principles should be the following:

- **an end user service focus** for public voice telephony services, and a focus on control of bottlenecks;
- focus on delivery of an **open service market on a European scale**;
- **maintenance of a balance** between the need to maintain the integrity and development of networks and the ability of existing and new suppliers to be competitive and innovative.
- consideration of **interconnection in terms of transit, access and equal access services**, for the provision of end to end services functionality and performances;
- specification of a **limited set of priority services**, additional services and optional capabilities;
- **recognition that interconnection arrangements may differ for different networks and Member States** (competition model, interconnection regime and policy, service portfolio, costs and timetable may vary from one country to another).

4.3. End to End Interconnection Service Approach

RIOs should be sufficiently comprehensive to define a consistent interconnection service set of offerings. The proposed approach to planning and timetabling the implementation of interconnection services is as follows (based on both Directive deadlines and the technical analysis of feasibility presented in Part II of the final report).

We recommend RIOs to address interconnection services with an end to end service oriented approach

Module 1: Basic call/ customer care and billing services

• Strategy

As a first priority a RIO should include the Module 1 services:

- basic call connection,
- call forwarding,
- DTMF,
- access to Directory Enquiries,
- emergency services,
- billing services.

Availability of CLI (Calling Line Identification) information at the interconnection (to indicate subscriber's line identification) is recommended for the provision of a unique billing and CLI services. As far as CLI information may not be available on all networks and for all customers in the various Member States, some restrictions on the provision of CLI information/services could be considered by NRAs at the national level.

The provision of AOC (Advice of Charge) services and unique billing is recommended. The obligation to provide it should be considered by NRAs at the national level.

• Proposed Timetable

Full availability of the Module 1 service subset defined above: start 1998

CLI migration path to define in each MS, based on national network/switches evolution

Same migration path for AOC as CLI

Unique billing: 2 years after full coverage of CLI availability.

Module 2: ISDN/GSM supplementary services

• Strategy

At the European level it should be a second priority for each RIO to include the following subset of Module 2 services:

- end to end EURO-ISDN supplementary services between two fixed networks,
- end to end GSM supplementary services between two mobile networks,
- common ISDN/GSM supplementary services between a fixed and a mobile network

Each NRA should define the list of services and the timetable for the provision of these services at each national level. The target is to allow a new entrant to offer the same level of end to end EURO-ISDN services that those provided by the incumbent on his own network.

• Proposed Timetable

The schedule should be consistent with the provision of EURO-ISDN services and supplementary services by the incumbent

Module 3: Provision for advanced services

• Strategy

The provision of advanced services between networks should be determined by specific commercial arrangements between TO/SPs at a national level:

- VPN services,
- IN advanced services (Freephone, Premium rate, Virtual calling Card, UPT).

Access to Freephone services should be guaranteed in each Member State.

• Proposed Timetable

800/900 number access and allocation: Start 1998

Other services: subject to specific agreement and dependent on emergence of standards

Module 4: Carrier selection services

• Strategy

The provision of CLI at the interconnection interfaces should be a first priority to allow authentication of each call and provide carrier selection.

The way carrier selection services are implemented should be ruled by NRA at a national level. They should ensure competitive equality with a favour for pre-selection.

• Proposed Timetable

Default long-distance carrier is determined by the local access provider with the possibility of the user over-riding that choice on a call by call basis (1998).

Carrier pre-selection by the user with the possibility of a call by call over-ride should be implemented as soon as incumbents provide CLI 80% coverage (at the latest by 2000).

Number portability services should not delay the completion of the first phase RIOs. In a second step, with the

implementation of local number portability services in each Member State, the technical components of RIOs should be enhanced to:

- take into account the possible impacts on interconnection interfaces and routing capabilities of national implementations for local number portability,
- define on which user areas and which corresponding POIs local number portability is supported,
- define possible service regressions that could occur from the implementation of local number portability in the network.

4.4. Technical Components of RIOs

In addition to the proposed modules of interconnect services, RIOs also need to refine these to present a full contractual service offering. The publication of RIOs should represent all the information required to plan a new telecommunications service network.

We recommend the following structure, as a minimum set of priority technical components to be included in RIOs.

Interconnection services offered

In order to provide end user Module 1 end to end services, the minimum set of Interconnect services should be as follows:

• Interconnect implementation service

- POI sizing and configuration,
- Network Accommodation/Routing,
- Network facilities to POI,
- Interconnection link.

• Access services

- Network conditioning,
- Customer billing information,

• Conveyance services

- Local PSTN / ISDN calls,
- National PSTN / ISDN calls,
- International PSTN / ISDN calls,

• Ancillary Services

- Billing services / customer billing,
- Access to directory enquiries,
- Emergency services,

• Module 1 end user services:

- basic call connection,
- call forwarding,
- DTMF,
- DDI.

Availability of CLI is a first priority to enable unique billing and carrier selection services. But its provision should guarantee user data protection and number presentation restrictions when asked by a user.

CLI provision and conditions

The RIO should define conditions under which a PTO will convey CLI to another operator for billing, call routing, caller display, carrier selection purposes. This should include the possible restrictions on the provision of CLI services (CLIP/CLIR/MCID) including number presentation.

This policy must be in accordance with the EC Data Protection Directive [Common Position N°57/96 with a view to adopting Directive 96//EC of the European Parliament and of the Council concerning the processing of personal data and the protection of privacy in the telecommunications sector.] .

As a second priority the following services should be addressed in RIOs when possible.

Supplementary services

The RIO should define conditions under which a PTO will provide

- Access to special advanced services (800, 900 services...)/module 3 services
- ISDN supplementary services to be provided through interconnection/module 2 services,
- Additional ancillary services
  - Directory services,
  - Information services,
  - Operator services,
  - Data traffic recording.

Points of interconnection

Points of Interconnection (POIs) represent the boundaries of responsibility between TOs. POI location and choice is closely related to interconnect charges. A full description of the services offered at each POI should be provided. A database of the calling zone or exchange area boundaries should be provided where the tariffs are based upon zone, or exchange area boundaries and where the digitised file exists.

They should be made available at the various network architecture levels:

- Double and Single Tandem / Transit switch levels,
- Local switch level,
- International switch level.

The provision of POIs should be submitted to evolutionary arrangements and evolve from few points to numerous access service areas. A plan for making POIs available will need to be approved by the NRA.

Interconnection architecture and models

The aim is to provide information on the interconnection architecture and routing structures in order to allow a new entrant to plan a new telecommunications service network.

It may be useful as a guide or example for the definition of call handling sequences to provide suggestions on Conceptual models for interconnection., but should not be viewed as restrictive in any way. TOs should be free to create their own interconnection models.

Call handling procedures

There should be some information provided in terms of how calls are handled..

- Calls should be handled as far as possible by the TO to which the caller is connected to or which be has been selected by the caller. The POI should be provided as near as practicable to the called party.
- With explicit selection, calls should be interconnected as near as possible to the caller's location. POI should be provided as near as practicable to the caller.

The originating operator should be able to route its call to the furthest technically accessible and legally possible point, thus incurring charges only for the unbundled part of the fixed network. When this is not possible or denied, and there is no other way to route the call to that particular point of interconnection, this portion of the call should not lead to supplementary charges.

Traffic routing capabilities

The catalogue should make available details on the network to help other TOs to decide where to interconnect, and to define traffic routes, levels of interconnect resilience and security he wants to order.

Network Technical Interfaces / Standards

Signalling standards are part of the basic POI agreement and need to be specified in detail. Because of national contexts and time to migration towards ISUP standards for incumbents, POI standards could be based on the national TUP for a transitory period. Detailed technical specifications of the signalling systems at the POI should be provided.

POI interfaces should be based as soon as possible on ETSI standards:

- ETSI standards / D.2048S for structured leased lines,
- Access network V5 interfaces for the access to the transmission part of a public voice network at the local loop level,
- ISUP V1 and V2 standards for the interconnection of fixed networks,
- ETS 300 303, based on ISUP V1 or ETS 300-646-1, based on ISUP V2 for GSM to ISDN interconnection.

Migration paths and timetables from national TUP to ISUP, associated supplementary services and corresponding POI should be approved by the NRA as compliant with the RIO.

Where PTO networks remain based on the national signalling systems, gateway functions with ISUP standards should be achieved by the PTO at least for the offered module 1 services.

Carrier Selection provision

This should ensure the provision of Module 4 set of interconnect services

The RIO should define conditions under which a PTO ensure the provision of CLI at the interconnection interfaces to allow authentication of each call in order to guarantee that carrier selection is achieved without entering a pin code to avoid additional authentication procedures.

The PTO should define in which conditions the selected carrier information/identification is available at the interconnection.

The PTO should define which user areas and which corresponding POI are providing carrier selection services and which mode (per-default, pre-selection, prefix...) is used. An associated migration plan for the evolution of carrier selection modes should be provided.

Interconnection Testing

Both TOs need confidence that the two exchanges can interwork correctly and will ensure essential requirements without affecting the existing networks and services. The level of tests to achieve this should be specified according to the guidelines in ITU-T recommendations Q780. The incumbent should make available a list of switches and the corresponding services and facilities which have successfully been interconnected to allow a reduced level of testing wherever possible.

In addition the incumbent should provide additional test suites such as the EURESCOM test suites for ISDN services in order to prepare functional end-to-end service interoperability.

Quality of Service

Quality of Service (QoS) should be unambiguously defined and specified. Recommended network quality of services parameters and recommended criteria could be the following:

- **QoS for voice telephony services**
  - ITU - T performance standards
  - Quality of service/Call performances ITU-T E.820, E.830
  - Network availability ITU-T E.845, E.846
  - Quality of speech ITU-T P.48
- **QoS for Interconnection links**
  - ETSI D.2048 S performance requirements
- **QoS for service provision / Network conditioning**
  - Interconnect Service delivery maximum delay
  - Average failure rate
  - Number of interventions
  - Service access availability
  - Call set up time / transfer duration
  - Rate of successful calls.

A detailed description of RIOs contents is provided in Part III, section 15, of the final report.

5. Interconnection Agreements

The first issue for a new entrant is to get the relevant information about interconnection to be in a position to plan a new telecommunications network. In order to ensure effective operation and development of interconnection, an interconnection agreement needs to cover more that a RIO. An interconnection agreement will deal with contractual and operational aspects, and may define business practices to enable flexible arrangements and interconnection evolution.

5.1. Lessons from existing Interconnection Agreements

Individual NRAs and TOs/SPs have well developed ideas about the nature and content of interconnection agreements which it would be unwise not to take advantage of. Even more significantly, the supply industry as a whole is contributing to its own view of `best practice', through the European Interconnection Forum (EIF).

In Europe, the EIF is a group of organisations interested in and concerned with telecommunication interconnection. The EIF is in a close association with the ONP-CCP Consultation and Coordination Platform. The EIF is working on a Framework Interconnect Agreement in order to assist negotiations by drawing on experience from current interconnection agreements and to make available common solutions to interested parties.

The EIF framework interconnect agreement provides a pragmatic, consensus view from the TO community on the structure, contents and goals of an Interconnection Agreement. Therefore it may be appropriate that NRAs/incumbents use the following documents as a basis for developing interconnection agreements:

- the EIF framework interconnect agreement,
- existing active interconnection agreements to be used as the basis for contractual and operational aspects; specifically we believe that the interconnection agreements produced by BT, which are publicly available, provide a good starting point for these aspects.

A detailed analysis if interconnection agreements and EIF work are provided in the appendix 1 document and in part I, section 4 of the final report document.

5.2. Operational Components

Continued infrastructure development and evolution of network end-to-end service availability and quality will lead to a high degree of interdependence between two interconnected TOs. It will be necessary therefore for TOs to ensure a co-operative process for interconnection's technical planning, operational information exchange, network management and for customer billing.

Thus an interconnection agreement needs to address the following issues:

Co-ordination for network functional consistency/integrity

Testing of equipment development software and upgrades for network functional consistency should be covered in the co-ordination process. The TOs should define procedures for the co-ordinated testing of exchanges/protocols/service features at the POI.

Co-ordination for network development/planning

In many cases new-entrants objectives may depend upon the provision of POIs, routing capabilities and interconnect services offered by the incumbent. It is mandatory to develop procedures at each national level to allow competitors to flag potential networking requirements with the incumbent avoiding disclosure of sensitive information.

TOs should advise other TOs when major network changes and software changes are to be implemented. The co-ordination process will ensure that TOs are aware of planned changes and potential problems arising from such changes.

An interconnect routing plan recording how calls are routed from one operator network to any part of another's should be settled and arranged between both parties.

Co-ordination for dimensioning of interconnection

It will be necessary for the interconnected TOs to establish ordering/provisioning arrangements which are sufficiently flexible to allow the dimensioning of POIs. Interconnection rules and allowances for alternative routing schemes will be covered in this co-ordination process.

Co-ordination for billing

The TOs will need to determine the information content, format and accuracy of call charge records that need to be exchanged. A co-ordination process will define mechanisms for the recording processing and sharing of call data between interconnected TOs.

For call tracing requirements information to be transferred in the form of a call charges record should include the carrier selection digits dialled by the customer and/or the customer's carrier pre-selection mark.

Co-ordination for network operations management

Network operations management has a role in the handling of traffic and meeting performances. It has also a vital role in reducing the impacts of unforeseen network disturbances. Co-operative contingency plans are required to ensure that disturbances in one TO's network do not cause unacceptable degradation of service in another TO's network. In addition, agreed inter-TO responses must be clearly defined to ensure immediate co-operation for service restoration. Procedures in the event of natural disasters could also be established.

Co-ordination for network fault analysis

A process for co-ordinating the network fault analysis activities for interconnected calls is required. End to end quality of service issues with clear undertakings for the sharing of responsibilities for blocking probability, fault diagnosis and clearance will be part of the process. Fault localisation in case of customer complaint will be also be part of the process.

Co-ordination for quality of service

This may include quality of service assurances for implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering.

Co-ordination for directory enquiry support

This may include arrangements for exchange of databases, and data protection issues that follow from that - dial up access to databases; transparent call transfer of directory enquiry calls; etc.

In the longer term this may require the establishment and operation of a central directory enquiries bureau, possibly separate from the operators' network and subscriber management functions, and possibly integrated with the management of a national numbering/portability database.

5.3. Contractual Components

The principles for negotiating interconnection arrangements should cover all the necessary contractual aspects to enable a prospective interconnecting TO to plan its interconnection reliably. We recommend that an interconnect agreement should cover the following issues:

Establishing interconnection:

- Nomination of contact points for further information
- Process for requesting interconnection
- Time to achieve interconnection
- Numbering management

System assurance:

- Prior conformance testing and standards assurance
- System protection and safety requirements
- System changes, routine testing and maintenance
- Approved attachments and customer equipment rooms

Operational security:

- System security/system integrity provisions
- Disaster recovery planning

Operating the service interconnection:

- Nominated individuals with operational responsibilities
- Routing principles
- Traffic delivery, forecasts and capacity
- Exchange of network design and configuration information
- Exchange of subscriber, numbering and billing information
- Payment terms and mechanisms

Ensuring end to end service quality:

- Provision, restoration times
- Network availability
- Network quality indicating the incumbent's network is equally successful in connecting other operator's calls
- Data management amendments to implement equally

Confidentiality:

- Each party information confidential
- Need to keep information from retail arm.
- Data Protection in respect of customer details
- Provision of information to regulator if needed

General provisions:

- Subcontracts
- Governing law
- IPR

Procedures for dealing with problems:

- Dispute resolution
- Breach, suspension and termination
- Limitation of liability
- Force majeure

6. Guidelines for NRAs and TOs in preparing RIOs and

implementing Interconnection

6.1. TOs: the Need for Readiness Projects

An interconnection environment will impose new requirements on a TO's planning:

- operators will be required to develop and offer a new set of `interconnection services' as a condition of their licence;
- operators will be required to provide and support these services to a new set of customers (peer TOs);
- the other services that TOs offer may be affected by the need to develop them with interconnection offerings in mind.

The activities required for this are not very different in principle from those required to provide `retail' telecommunications services on request from a customer; however the practice may be different, as:

- interconnection services are more complex than UNI services;
- the configuration and management of interconnection services requires more joint work between a TO and his `customer' than is typical of UNI services;
- it is much more likely that there will be regulatory scrutiny of the individual contract and operational arrangement.

In order to provide and support interconnection TOs will need to reorganise and dedicate specific resources (money, staff time etc.) for interconnection planning and implementation.

It is most likely that each incumbent TO will launch (if it does not already have one) an `Interconnection Readiness Project Team'. This project team should:

- liaise with the NRA to establish requirements;
- develop and obtain approval for a change plan;
- liaise with network planners and developers to develop a time/cost plan for relevant network changes;
- liaise with systems planners and developers to develop a time/cost plan for relevant system changes;
- work with the NRA towards the launch of an Interconnection Catalogue, as the RIO;
- plan subsequent stages of RIO development.

6.2. NRAs: the Need for an Interconnection Issues Focus

As far as the management into being of interconnection services is considered, the NRA is directly responsible for implementing national policy, which will take into account the relevant European policy.

Since interconnection regulation is likely to be a significant role of NRAs over the coming few years, **it may be appropriate for each NRA to have a dedicated Interconnection Team. In order to fulfil the requirements of the Interconnection Directive, the policy departments in Member States should ensure that their NRAs are given authority in these areas.**

The Interconnection Directive mandates NRAs to ensure a Reference Interconnection Offer (RIO) is produced. To achieve this the NRA needs that both to follow and influence development of EU-wide activities, and to ensure that it has a sound understanding of specific TO architectures and operations.

It is essential that the NRAs take an active part in authorising the RIO from the point of view of:

- **completeness**: is the NRA satisfied that the TO is offering all NNI services it should, given the nature of the TO and the nature of the UNI services it is licensed to provide?
- **fairness**: is the NRA satisfied that the NNI services are being offered on a fair basis (as indicated by the ONP Directives – in terms of pricing, geography etc.)?

NRAs will have to

- approve the RIO taking into account issues peculiar to the country and individual interconnection policy,
- and provide guidance to TOs on issues such as interconnect conditions, service implementation and operational control.

It is essential that NRAs ensure that the RIO covers interconnection services including precise technical specifications, operational requirements the connecting TO is expected to provide, time to implement new interconnections, costs, and points of contact for clarification and further information.

6.3. Interconnect Service Implementation

As far as RIO technicalities are concerned, the NRA must be well informed of the impact of technical decisions taken in RIOs on the ability of TOs to achieve effective interconnections.

Specifically, the NRA will need to develop a consistent policy on Equal Access, Portability, Numbering and POI architecture:

- to support equal access services and ensure availability of CLI and its geographic coverage;
- to support carrier selection and local number portability implementations both by the incumbent and new entrant where apprpriate;
- to specify how numbers are allocated to new entrants, and portability of numbers ensured, and what the mechanisms to achieve this are (eg a central numbering database);
- to analyse whether a network-independent architecture may be adopted for the location of POI.

In achieving this the NRA will of course rely to a large extent on support from TOs, user groups, advisory groups at the national level.

We recommend that NRAs support industry fora. They should organise as a minimum:

- **a service advisory group** – a forum of end-users and user associations, together with service/product representatives of TOs/SPs, who would set the agenda for the development of national services, and in particular would be a forum to raise issues of TO/SP inter working.
- **a systems advisory group** – a forum of technical representatives of TOs/SPs together with manufacturers representatives who would support the development of the systems comprising the national network, and in particular the development and monitoring of the Reference Interconnection Offer, carrier selection and number portability services.

To guarantee a service oriented approach, it is important that NRAs monitor the technical and operational process of interconnection. It may be appropriate that TOs with the support of the NRAs develop business practices on interconnection.

In order to facilitate service implementation and operational control, guidance and support from NRAs is recommended for the development of business practices between TOs on the following aspects :

- definition of a code of practice for the provision of calling party and customer billing information at the interconnection,
- definition of adequate procedures for ensuring end to end call traceability through interconnection
- achievement of precise rules for the coordinated introduction of new supplementary services that impact interconnection interfaces,
- development of an effective testing regime building on and developing the experience of public TOs in interconnecting with new TOs.
- guidance for the implementation of carrier selection and number portability services and their impacts on interconnection.
- coordination process in respect with network performance and QoS

A detailed description of operational issues of interconnection and guidelines are provided in Part III, sections 14 and 17, of the final report.

7. Interconnection Further Issues

The majority of the study deals with the interconnection between operators and/or service providers which are:

- delivering services on non-IN circuit-switched systems;
- interconnected at OSI layers 1 (physical) to 3 (network) or above;
- in many cases, offering services on a mutual basis.

The major focus of RIOs is on public switched services: a service provided over a network which is capable of routing signals and messages from one subscriber line to any other subscriber line in a network.

However the current emphasis placed only on "voice telephony services" may lead to a one-sided interconnection framework that does not support the development of global competition and limits the scope of competition in service provision.

There are a number of cases in which the connection has a different character, in particular those involving `non-traditional' operator networks. Thus RIOs in the future should consider:

- the case of a service provider, who typically wishes to have a network-level interconnection for the provision of voice VPN services and the provision of combined fixed and mobile voice services,
- the case of interconnections between operators running IN-based networks,
- the case of wireless local loop networks.

The regulatory issues which underline with voice VPN or combined fixed plus mobile services are as follows:

- what are the conditions for ensuring non discriminatory access for VPN providers,
- what is the regulatory framework for the operation of combined fixed and mobile voice services,
- to what extent such services should be part of a Reference Interconnection Offer.

For the future we recommend to:
- extend the scope of RIOs for the provision of combined fixed plus mobile voice services,
- to review the regulatory requirements for the provision of voice VPN services.

Interconnection to wireless local loop networks may impact on end to end quality of service because they may introduce additional call establishment delay and voice signal characteristics.

For the future we recommend to extend the scope of RIOs to the interconnection with wireless local loops.

Two other cases deserve specific attention, both because of their likelihood of occurrence and because they raise specific issues:

- interconnection at the transmission level (layer 2 or possibly only layer 1) without high-layer interconnection;
- the approach to services based on new modes of carrying public voice traffic – specifically those carrying voice over packet-switched networks such as the Internet.

Transmission level interconnection services are straightforward to harmonise technically, though they require a more complex management approach. We believe that these should be fully included in a RIO. This interpretation is by supported the Interconnection Directive, which interprets "telecommunications network" in an inclusive way, but it may be less contentious to leave this to individual NRAs for a definitive ruling.

We recommend to include in RIOs interconnection at transmission level.

A more difficult problem is where packet-mode networks are used to deliver voice services - specifically, the issue of Internet voice telephony. It is essential that a common view is to be developed on the applicability of the proposed harmonisation mechanisms to Internet telephony.

We recommend NRAs to develop a common view on the applicability of RIOs to Internet telephony, in the same way as it should address issues of defining and regulating voice service providers.

8. Conclusions

8.1. Regulation of Technical Aspects

In addition to the proposed set of interconnection services, and RIO's components, the study aims at providing guidelines to NRAs/TOs for the provision of voice telephony services, and for practical implementation of interconnection arrangements between TOs.

In order to implement interconnection with a service oriented approach, and to deal with practical engineering arrangements, the analytical process used in the study has led to the identification of additional tools needed to be set up at a European level. These tools will help to complete actions at the national level.

Those tools and actions take as major inputs:

- the relevant Community legislation, specifically the ONP Directives and particularly the **Interconnection Directive**;
- the **stated interconnection policy and aims of NRAs**, individually and collectively;
- the current **developments of the EIF**;
- the current **ETSI portfolio** of technical and operational standards.

At the European level, we recommend that the following tools should be available:

- The proposed Interconnection Standardisation Plan within a programme of work for ETSI.
- The proposed Interconnection Service Approach: with the definition and associated timetables of interconnect service offerings;
- The proposed check list for RIOs;
- The proposed guidelines for NRAs and TOs on how to prepare for the RIO and to implement telecommunications interconnection agreements.

At the national level, we recommend NRAs and TOs to use those tools for the completion of the following regulatory actions:

- Production of a National Interconnection Service Plan: timetables of implementation of specific interconnection services nationally;
- Production of the National Reference Interconnection Offer;
- Publication by NRAs of guidelines on their approach to imposing principles and obligations related to interconnection.

In addition to regulatory actions, we recommend NRAs and TOs to complete the following operational actions:

- **Publication** on the NRAs Web of specific Interconnection Information presenting national interconnection regulation, and RIOs
- **Achievement of business practices between TOs with the support from NRAs**
  - for the introduction of new supplementary services between interconnected networks,
  - for the provision of calling party and customer billing information at the interconnection,
  - to ensure call traceability at the interconnection,
  - to develop an effective testing regime,
  - to develop the experience of public TOs in interconnecting with new TOs,.
  - to develop co-ordination processes in respect of network performance management and Quality of Service.
- **Development with the support from NRAs of forums** representing the supplier industry (all TOs) and user community who would agree to the agenda for the development of national services, and in particular for number portability and carrier selection.

8.2. The Need for Coordination

The implementation of the Interconnection Directive will depend on the activities of many `stakeholders' in European including:

- the EC, ECTRA (European Committee on Telecommunications Regulatory Affairs), ETSI (European Telecommunications Standard Institute) and the EIF (European Interconnection Forum) at the European level,
- NRAs, TOs, SPs and Users at the national level.

The study has highlighted how the development of interconnection services is being prompted by Community legislation, and how this is impacting on the practical operation of the European telecommunications markets.

Each Member State will no doubt develop its own arrangements within the framework of the EU Directives, but there is a need to learn about the realisations and experiences from other countries.

The context for developing interconnections in Europe raises a number of issues:

- the increasing need to conduct telecommunications as an international activity, not only among EU Member States;
- the differences in experience among different NRAs, and the potential for transfer of experiences among them;
- the need for standardisation at the European level (i.e. through ETSI);
- the need for guidance to manufacturers to be brought into alignment across Europe, in order to reduce R&D costs;
- the fact that the legislation has been defined, in some detail, at the European level, so that the focus of it covers interests of all Member States.

Moreover, it will not be realistic for individual groups to seek local solutions – partly because of the increasing internationalisation of telecommunications activities, and partly because of the short time available to achieve the necessary harmonisation.

In the future, there is need to provide co-ordination and guidance, at the European level, for the activities required to bring about effective telecommunications interconnections:

- by providing a mechanism **to ensure harmonisation of actions** among stakeholders, advice to NRAs, guidance to standards makers etc.;
- by **enabling skills transfer** through mechanisms for documenting and publishing the consensus and experiences of relevant stakeholder groups.

8.3. Long Term Scenario

The study proposes as a possible long term scenario a **European Interconnection Initiative (EII)** to undertake this necessary coordination and guidance.

More specifically, the EII may consist of the following elements:

- **coordination structure** that provides suitable fora for all relevant stakeholders – centred on a committee of NRAs as a European-level coordination body, but with components operating in Member States;
- **monitoring activities**: reporting of Member States' and TOs' plans and activities, progress reporting to policy makers and others;
- **projects for NRAs, TOs, ETSI** and possibly others to undertake, with specific technical goals, activities, and timetable.

The EII is a possible mechanism by which the implementation of the Interconnection Directive could be co-ordinated at the European level.

The main elements of this proposed monitoring structure are as follows:

- at the European level, the EII promotes mechanisms for the interpretation and implementation of the ONP Directives. The Framework is associated with (elements of) the latest version of the EIF consensus, current ETSI standards, etc.
- at the national level, each Member State owns, adapts and maintains a public national policy on interconnection practice, and refines the national Reference Interconnection Offer, probably with or via the incumbent TO.
- at each level there is a responsibility for developing policy, and a suitable implementation plan, providing `upwards' feedback, skill transfer.

It may be appropriate for the stakeholders to develop the EII as a mechanism for the monitoring of practical implementation of the EU legislation on interconnection. The following actions have been identified:

- to create a monitoring structure at the European level that provides suitable fora for NRAs as a European-level co-ordination body to:
  - monitor compliance of the TOs' plans and activities in Member States,
  - respond to problems experienced when completing and evolving RIOs,
  - monitor ETSI standardisation plan to set service priorities and to propose a timetable based on feasibility and market readiness,
- to create an observatory for interconnection QoS and network integrity issues and take the responsibility for the gathering and publishing of country experiences related to network integrity problems and solutions achieved,
- to finalise, in association with the elements of the latest version of the EIF consensus, a reference interconnect agreement for the sets of interconnect services and to refine the interconnect reference agreement taking into account impacts of carrier selection and local number portability service implementations.

Proposed principles, monitoring structure and detailed contents of the EII are presented in Part III, section 19, of the final report.

9. List of Acronyms

A

AOC Advice of Charge

C

CLI Calling Line Identification

CLIP Calling Line Identification Presentation

CLIR Calling Line Identification Restriction

D

DDI Direct Dialling In

DTMF Dual Tone Multiple Frequency

E

ECTRA European Committee on Telecommunications Regulatory Affairs

EIF European Interconnection Forum

EII European Interconnection Initiative (as defined per this document)

ETSI European Telecommunications Standard Institute

G

GSM Global System for Mobile communications

I

IN Intelligent Network

INAP Intelligent Network Application Part

ISDN Integrated Services Digital Network

ISP Internet Service Provider

ISUP Vx ISDN User Part version "x"

ITU-T International Telecommunications Union - Telecommunications sector

M

MCID Malicious Call IDentification

N

NNI Network to Network Interface

NRA National Regulatory Authority

O

ONP Open Network Provision (concept defined in Council Directive 90/387/EEC)

OSI Open Systems Interconnection

P

POI Point Of Interconnection

PSTN Public Switched telephone Network

PTO Public Telecommunications Operator

Q

QoS Quality of Service

R

RIO Reference Interconnection Offer

S

SCCP Signalling Connection Control Part

SS7 Signalling System number seven

SP Service Provider

T

TCAP Transaction Capabilities Application Part

TO Telecommunications Operator

TP Terminal Portability

TUP Telephone User Part

TUP+ Telephone User Part "Plus"

U

UNI User to Network Interface

UPT Universal Personal Telecommunications

V

VPN Virtual Private Network

Last modification: April 15, 1997

ARCOME sa

ARCHITECTURE DE COMMUNICATION POUR LES ENTREPRISES

12, rue Delerue

92120 MONTROUGE FRANCE

Tel: (33) (1) 42 53 89 97 Fax: (33) (1) 46 54 05 27

EC/DGXIII

EQUAL ACCESS
&
INTERCONNECTION

Appendix 1
Country Surveys and Interconnection Frameworks

For ARCOME	For SMITH Engineering Systems	For NERA
Isabelle Chapis Suzanne Debaille François Paulus	Mark Cartwright Simon Dunkley	Nigel Attenborough Claudio Pollack

Version 1.1
Reference: SD/55/97
17 January 1997

Table of Contents

A. Country Summaries

B.

C. Analysis of some Interconnect Experiences

Interconnection Agreements are not available in the public domain, except to a limited extent in the UK, and Sweden. It is only possible therefore to analyse interconnection agreements from these countries. From the UK, it has been possible to review several interconnection agreements between BT and other interconnecting parties; from Sweden is has only been possible to review a general Interconnection Agreement for interconnection of mobile operators. AUSTEL in Australia has achieved an interconnection technical and operational framework and completed several conceptual models defining interconnection and Equal Access services. This information is analysed and constitute inputs in the proposed framework.

C.1. BT Interconnect Agreement

Interconnection Agreements between BT, the incumbent PNO in the UK, and several long-distance carrier service providers have been reviewed. The content of the agreements is broadly similar, but the format has varied until recently, when a standard format was adopted, modified for each operator by the addition of Schedules (additional sections) at the end of each agreement.

The description that follows is a summary of the Interconnect Agreement between BT and Torch Communications Ltd (IA282), and is dated 27 January 1996. The content of the agreement is however, representative of all of the BT agreements

(IA282), and is dated 27 January 1996. The content of the agreement is however, representative of all of the BT agreements that have been reviewed.

C.1.1. Structure of the Document

The document comprises the following sections:

- Main.doc.
- Specifications.
- Annex A BT Standard interconnect agreement: Technical operations.
- Annex B BT Standard interconnect agreement: Billing and payment.
- Annex C Schedules.
- Interconnect link charges.

The contents of each section are as follows:

Main.doc

This is the generic document to which extra schedules are attached to specify the particular requirements of the interconnecting PNO. The section comprises a glossary of terms, and a main block which includes detailed information such as formally defining terms and conditions of the contract, referencing standards, definition of framework for charges and addresses issues such as confidentiality and IPR. This part of the agreement contains little technical information. The headings of each of the sections are included in appendix A.

Specifications

This section of the document provides a comprehensive list of all technical standards and specifications to which the Interconnection Agreement binds both parties. These include standards from ITU-T, ETSI and the British Standards organisation. Extra technical information is included where the scope of the interconnection is outside that of these standards, for example to define the precise cable to be used at interconnection points, or arrangements for maintaining synchronisation at the interconnection point and procedures for when the synchronisation signal is lost.

The standards include definitions of the:

- electrical and physical interfaces;
- C7 signalling interface;
- transmission interface for PDH and SDH.

Annex A: BT Standard interconnect agreement: Technical operations

This section specifies in detail the planning and operational details of operation of services between the respective PNOs' networks. This includes sections on *inter alia*:

- network information;
- routing principles;
- numbering;
- performance standards;
- services.

Examples of the detail that is contained in the sections are:

- Network Information: requires that both parties exchange information concerning alterations to the network configurations, changes to numbering structures and availability of capacity.
- Routing principles:
  - details of how calls are routed through the operators' networks, including the type of line used (e.g. digital Vs analogue);
  - dimensioning of capacity;
  - how indirect calls are handled;
  - etc.
- Traffic forecast: requires that "each party shall use reasonable endeavours" to provide traffic forecast information to the other party.
- Capacity profiles and advance capacity orders: requires that capacity orders, time scales and testing be notified to the other party.
- Numbering: specifies details of how digits are to be exchanged between networks, and how blocks of numbers are allocated.
- Switch testing: describes the way in which switches are tested by BT.
- Services: lists details of services offered by BT and the interconnecting party including, *inter alia*:
- operator services;
- blind or disabled services;

- exchange of CLI information;
- emergency call routing and signalling.

Annex B BT Standard interconnect agreement: Billing and payment

Describes the recording and exchange of billing information, and the conditions of invoicing and payment between the interconnecting parties.

Computerised billing information exchange is described (using BT's INCA billing system) and any similar system that the interconnecting party may have. Time scales are specified for the exchange of this information, preparation of subsequent invoices and payment.

Costs for accessing and using BT's system are fixed. Cost for BT to use the interconnecting party's services are negotiated and details of these charges are contained in BT's Carrier Price List/Carrier Price List document. A summary of the structure of this list is contained in appendix D.

Infrastructure charges made *by BT* include:

- interconnection links
- leased lines
- multiplexor services (for SDH and PDH)

(For all items above - connection and rental charges.)

Charges made *by BT and the interconnecting party* for telephony services include cost of calls in pence per minute from the billed, to or via the billing party's network (for basic telephony or ISDN services). For each call, information recorded includes interconnect link identifier, the date and time of the call and the chargeable call duration.

Annex C Schedules

This section describes interconnection issues that are specific to, or optional additions to, the standard BT Interconnect Agreement. For the agreement analysed this includes details of customer-sited interconnection arrangements and in-span [In-span interconnection is where interconnection is made at a point other than one of the interconnecting party's premises eg at an existing BT cable or a BT building.] interconnection arrangements.

C.1.2. Analysis of the BT Interconnection Agreement

This section analyses the content of the Interconnection Agreement and compares it to that would be required for a more general Europe-wide agreement.

The agreement is a comprehensive description of the legal and technical aspects of interconnection required for regulation of the interconnection agreed between BT and Torch. As a framework for a comprehensive and flexible general agreement, the terms of interconnection are comprehensive, though do not cover all possible issues that may be required to be addressed.

Location of Interconnection Points

Interconnection is possible either by making the physical connection at the interconnecting party's premises or at another point (at a BT site or to a BT cable) - this is known as In-span interconnection[1]. Interconnection can be made at several points within the network, including local exchanges which are general less than a few kilometres from any point that at which an interconnecting party may need to make a connection to its network.

Access to the local loop is not detailed in this agreement, though BT does have arrangements for connection for fibre optic cable operators. Related issues therefore are not addressed in this agreement such as physical connection to the local loop, arrangements for Equal Access and funding of such facilities.

Technical Specifications

A comprehensive set of technical standards are referenced, and where more detail specific to BT's system is required, this is given within the text of the Interconnection Agreement.

Costs, Billing and Invoicing

Costs are included in the BT Carrier price list document. A detailed section on billing, invoicing and exchange of information is included within the agreement.

Legal Aspects

The *main.doc* section of the Interconnection Agreement sets out the legal basis of the interconnection agreement in some

detail including details on liability and dispute resolution.

Numbering Issues

A procedure for number ordering and flow of numbering information between the parties is laid out as part of the Interconnection Agreement. BT allows access to its numbering database.

No reference is made to any form of number portability between networks; a significant issue for a future deregulated network. Similarly, no reference is explicitly made to the implementation of intelligent network technology and its inter working across the interconnection.

Maintenance

No provisions for maintenance are made, the onus being on each party to ensure that its system is safe and does not cause damage to the other party's equipment. Each party is committed to provide a specified quality of service.

Quality of Service

Quality of individual *services* provided as part of the interconnection are detailed in the associated schedules.

Quality of service of other aspects such as implementation, servicing and management of interconnection links; and administration and implementation of data management processes, e.g. number ordering, are not covered, which is a significant weakness.

Services to be provided

The level of interconnection is limited to multiples of 2Mbit/s bundles. Connection points can be made at:

- BT tandem exchanges
- BT local exchanges
- BT international switching centres

The Interconnection Agreement includes the provision of basic telephony services, but BT's Carrier price list includes ISDN services. SDH and PDH facilities are available. BT also makes a variety of auxiliary services available such as operator assistance and directory enquiries.

CLI

CLI is required to be passed between the two parties where feasible, and to third parties. The agreement binds the parties to any new regulatory and legal legislation that may come into force. It also refers to compliance with a draft `Code of practice for network operators in relation to Calling Line Identification display services and other related services'.

Testing

Detailed procedures for the testing of interconnecting hardware are given. Procedures for the testing of BT-provided capacity are also given.

Network Management

Parties are bound to exchange network management information. No provisions are made for management of the joint network as a whole. Strategic planning of future network modifications is not addressed. The limited scope of the agreement in respect of management is likely to be problematic in the context of a future network of networks.

C.2. TELIA Interconnect Agreement

Telia's Model Interconnect Agreement for interconnection to mobile telephone operators' networks has been reviewed for comparison with the BT-based agreements. Interconnection agreements with other fixed service operators are not available in the public domain in Sweden. A document describing the services that Telia offers interconnecting operators was available however, and provides useful background information.

C.2.1. A description of Telia interconnection services

Telia offers interconnecting PNOs a termination service, an access service and a transit service. The termination service allows customers of the interconnecting PNO to call to points within Telia's network; the access service allows customers of the interconnecting PNO to be called from Telia's network; and the transit service allows customers of the interconnecting PNO to call third-party customers via Telia's network.

Telia's network is divided into 13 segments. An Operator may gain access to the network at one or two points in any

particular segment known as Points of Interconnection (POIs). Connections are made in units of 2Mbit/s PCM lines.

Charges are made for making a connection to a POI, rental of the POI, connection of each 2Mbit/s line and rental of each 2Mbit/s line, and penalties are levied if minimum traffic flows are not achieved Telia also offers interconnection via standardised SDH optical fibre links into Telia's SDH multiplexers

C.2.2. Telia Standard Interconnect Agreement

The document comprises the following sections:

- Main agreement.
- Appendices.

Main agreement

The main agreement contains the legal outline of the document and contains little technical information. It is broken up into 19 sections including such topics as definition of the service, charging issues, points of interconnection, numbering implementation, liability and dispute resolution. A summary of the sections is shown in appendix B.

Appendices

Nine appendices are attached to the document, treating some of the issues addressed in the main document in some detail and introducing the necessary technical detail, mostly by reference to CCITT specifications. Description of the content of each appendix is contained in appendix C.

C.2.3. Cost of services

The agreement includes some detail on the cost structure for interconnection between the two parties.

Infrastructure charges made *by Telia* include:

- interconnection links;
- leased lines.

(For all items above - connection and rental charges. Note: multiplexer services are not explicitly offered.)

Charges made *by Telia* for telephony services include cost of calls in pence per minute from the billed, to or via the billing party's network.

The interconnecting party may chose from two tariffs, one being a flat rate tariff over the 24-hour period, and the other offering peak and off-peak rates.

Additional penalty tariffs are levied by Telia in the event of the interconnecting party failing to generate a predefined traffic level set by Telia.

Charges made *by the interconnecting party* for telephony services are referred to in the main body of the document, but the annex purporting to lists these details was not included in the document and it is assumed that this is negotiated on an individual basis.

C.2.4. Analysis of the Telia Interconnection Agreement

This section analyses the content of the Interconnection Agreement and compares it to that that would be required for a more general Europe-wide agreement.

The agreement is a comprehensive description of the legal and technical aspects of interconnection required for the offer that Telia make to interconnection PNOs. As a framework for a comprehensive and flexible general agreement, the terms of interconnection are limited.

Location of Interconnection Points

Geographically, the POIs are far apart, requiring the interconnecting PNO to lay or lease lines to potentially inconvenient locations.

Interconnection is limited to the regional POIs, and no arrangements are made for the interconnecting party to gain direct access to Telia's international switching centres.

Technical Specifications

Little technical information is included in this generic Interconnection Agreement and reference is made to parties agreeing technical standards for specific agreements. The only standard that is referenced is one specific to GSM interconnection.

The agreement appears to be outdated and it may be that agreements between parties in Sweden now include reference to more standard specifications.

Costs, Billing and Invoicing

Details of costs for interconnection and on-going rental charges are included in the document. Procedures for exchange of billing information and invoicing are given, but in little detail. The exchange of information appears to be in hard copy (i.e. printed on paper) format.

The costs of modifications to the network "shall be met by the party requesting the measure, except where agreed otherwise" is an imprecise statement having potentially far-reaching consequences for the future development of the network.

Legal Aspects

As for the BT document, these aspects are covered in some detail.

Numbering Issues

Few details of numbering allocation, management and information exchange between the companies are given, except for reference to implementation of numbering capacity made by the NRA.

Telia does not appear to make its numbering database available to the interconnecting party. As the European network migrates to a more open system, access to individuals numbering databases would appear to be desirable, and progress to a common database may be considered, perhaps administrated by an independent numbering agency.

No reference is made to any form of number portability between networks; a significant issue for a future deregulated network. Similarly, no reference is explicitly made to the implementation of intelligent network technology and its inter working across the interconnection.

Maintenance

No reference to maintenance provisions are made.

Quality of Service

No reference is made to the expected quality of service offered by either party (except that numbering capacity will be implemented within three months). This may include agreements on the standard of telephony services; implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering. This is a significant omission.

Services to be provided

The level of interconnection is limited to multiples of 2Mbit/s bundles at the regional interconnection points. Access to local exchanges and the local loop is not available. Related issues therefore are not addressed such as physical connection to the local loop, arrangements for Equal Access and funding of the such facilities.

Telia appears to make data services such as X25 available as well as basic telephony and ISDN.

CLI

CLI is required to be passed between the two parties where feasible, but restrictions on the passing of information to a third party are imposed, leading to suspension of the transferral should this be abused. Transmission of CLI information abroad is forbidden. This policy would make the universal handling of CLI across the network of networks problematic and incomplete if repeated in similar Interconnection Agreements across Europe.

Testing

No reference is made to the testing of hardware to be used in interconnect to Telia's network to maintain network integrity, but hardware is to conform to specified national standards.

Network Management

Network management and the transfer of information between the two parties is covered only briefly by high-level policy statements. This is likely to be a significant issue to be addressed in a multi-operator environment. Strategic planning of future network modifications is also not addressed.

C.2.5. Summary

The two documents that have been reviewed for this study are intended to reflect existing interconnection arrangements between BT, Telia and their respective interconnecting partners. The BT document is more detailed and though containing omissions from what would be expected for a future interconnect agreement, is the more comprehensive of the two.

The documents are, however, a good basis as a generic interconnect agreement, but by their nature are lacking required detailed information in the following areas:

- Network management

The agreements require only that network management information be exchanged between the two parties. No provisions are made for the interconnection or integration of management functions. No strategy is laid out for the development of the networks.

- Numbering issues

Arrangements for a possible independent numbering authority, and issues of number portability and Equal Access are not addressed.

- CLI data exchange

The exporting of data to third party operators and the conveyance of CLI data is restricted under the agreements.

- Quality of service

Detailed quality of service requirements other than basic technical requirements of telephony services are lacking. These may include quality of service assurances for implementation, servicing and management of interconnection links; and administration and implementation of data management processes e.g. number ordering. This is a significant omission.

- Future services

Understandably for a contemporary agreement, future services such as ATM and broadband ISDN are not described.

C.3. AUSTEL Interconnection Framework

C.3.1. AUSTEL Approach

Since 91, Austel has been very highly involved in preparing Interconnection/ Equal access arrangements and regulations . The Austel approach has been the following:

- Definition of the cope of interconnection: provision of facilities to competing networks and service providers in order to achieve transparent/seamless connectivity between telecommunications users.
- Definition of interconnection/ Equal Access principles:
  - Ability of telecommunications users to call other customers irrespective of the TO network they are connected to (Any to any communication / connectivity).
  - Availability of customer choice, and Minimum customer inconvenience.
  - Provision of access services between TOs and provision of a single customer bill per call.
- Definition of a minimum set of interconnection requirements:
  - Interconnection between networks.
  - Access to facilities and ancillary services.

These requirements involve considering access and interconnection as follows:

- Interconnection is considered as the physical connection of two networks to allow full interoperability for the provision of any to any capability for customers of all networks.
- Access services relates to the access of functionality for the purpose of service provision (e.g. billing systems, databases, carrier pre-selection).

To sustain this approach and to facilitate interconnection arrangements Austel completed an interconnection services model and a technical/operational framework in mid 91. As the issues has become more complex since this start up date, Austel through a progressive industry involvement (NIIF: Network Interconnect Industry Forum) undertook to develop a new interconnection model in 94. This new model has been used to consider a number of case studies and is now under revision for the post 97 telecommunications regime leading to full telecommunications liberalisation.

C.3.2. AUSTEL Interconnection Scenarios 1991

From the definition of a minimum set of interconnection requirements Austel has defined two interconnection models and

scenarios (see Figure 1):

Figure 1: 1991 Austel interconnection conceptual models

Access Interconnection

This corresponds to indirect access to a long distance network through another local loop TO by giving the capability for customers to select alternative TO.

The TO controlling the local access has to provide an access service to interconnecting TO.

Symmetrical interconnection

This corresponds to interconnection between two networks where each network delivers end to end services to its own customers.

This was considered for the interconnection between:

- Mobile / fixed networks,
- Fixed TOs having their own local loop.

With this model three types of access service are considered:

- Symmetrical interconnection,
- Access interconnection,
- Equal access service (corresponding to access interconnection in addition to TO preselection).

C.3.3. AUSTEL Interconnection framework – 1991

On the basis of this conceptual model, Austel completed a technical/ operational interconnection framework (Documented Austel Interconnection Framework 1991) presenting the principles and operational arrangements for the technical aspects of network and service interconnection. It covers:

- fixed to fixed, fixed to mobile, mobile to mobile interconnection,
- access and symmetrical interconnections,
- access to ancillary/ operational support systems,
- end to end service quality and performance,
- co-ordination of technical planning, development and operations,
- access to additional facilities and services (billing, directory, operator services).

The framework defines 4 major building blocks to an interconnection agreement:

- Provision of POI (Point Of Interconnection) between the TOs,
- Specification of end to end service standards,
- Network co-ordination process to define respective roles of TOs for traffic handling support functions,
- Provision of end user services.

POI / Gateway Exchanges

The gateway exchanges at the POI handle the carriage of traffic across the interconnection paths and provide the following functions:

- Handle traffic across the interconnection routes according to customer preference,
- Provide facilities / statistics for service quality supervision,
- Network traffic management,
- Network protection,
- Service assistance.

End to End Services Standards

End to end service standards encompass standards for transmission quality, and standards for signalling interfaces:

- Voice telephony signalling standards,
- Transmission quality,
- Call path integrity,

- Network congestion procedures.

Network co-ordination / forum

Network co-ordination encompasses network management, planning and development procedures to ensure that the roles of each TO with respect to traffic carriage and support functions are clearly defined:

- Customer and network operations,
- Network management,
- Network planning and development,
- Network functions consistency,
- POI dimensioning,
- Crisis situations / disaster,
- Fault handling.

End User Services

The framework considers end user services and supplementary services to provide between interconnected networks:

- Basic and supplementary telephone services: local / long distance / international,
- Mobile services + inter working between GSM / ISDN-PSTN services,
- ISDN Services,
- Operator assisted services,
- Billing services,
- Directory enquiries,
- IN services (Calling card, VPN, Free phone services).

C.3.4. New Interconnection Model -1994

In 1994 AUSTEL defined a new Interconnection Model. This Model attempted to facilitate mediation during negotiations and involved the industry consultation through the NIIF. This model (Documented in "Interconnection Model: Multi-Service Delivery Environment", March 1995) identifies 3 groups of services:

- Fixed network calls to geographic numbers where the location of the called party is fixed and may be deduced by the dialled number. Calls involving preselection or selection by carrier's code are included in this group.
- Special service calls which utilise IN which are not mobile calls and where the location cannot be deduced by the dialled number.
- Calls made to mobile numbers where the network can be recognised but the location of the party is unknown.

For these groups of services, a set of specific rules were introduced where the exact relationships between the TO involved in service delivery can be spelt out and clearly separated (see Figure 2 below).

Figure 2: 1995 Austel interconnection conceptual models

In addition to this model Austel introduced the concept of Service Deliverer instead of carrier or TO, with the following types of service delivery:

- Originating or Terminating Access Service Deliverer,
- Transit Service Deliverer.

Arising from the work on new interconnection model it was proposed to establish the NIIF industry forum in mid 95 in order to ensure consistent inter working between TOs and to provide the relevant specifications for new or enhanced interfaces.

The NIIF activities are focused on technical and operational issues associated with interconnection/Equal Access for Service Deliverers (TOs and SP) including outputs for the definition of a Code of Practise. In the post 97 arrangements this code of practise will be approved by the ACCC (Australian Competition Consumer Commission) which will be responsible for interconnection regulation.

C.3.5. Interconnect Services offered

At the moment there is no published standard catalogue of interconnection services. The services considered to competing TOs in the technical framework are the following:

- Basic PSTN
- Originating access

- Terminating access
- Access to Directory Enquiries
- Access from public pay phones
- CLI for originating access/pre-selection calls
- Freephone services ("1800")
- Information services ("1900" and "055")
- Emergency services ("000")
- Directory assistance
- Customer billing information with CLI
- Network conditioning

CLI and billing identification of the customer for pre selection and billing purposes are required to be passed between the two networks where feasible. Post 97 it will refer to compliance with a `Code of practice for network operators in relation to Calling Line Identification display services and billing name and address information's'

D. EIF Framework Interconnect Agreement

D.1. Introduction

This document is intended to assist negotiations by drawing on experience from current interconnection agreements. It is to be viewed in the light of current EU regulations and national law and regulation at any given point in time. The document provides suggestions and examples, without prejudice to existing regulatory provisions and is not intended to be a substitute for regulatory obligations. Furthermore, the document is conceived as a `living document' to be adapted to the changing realities in interconnection. Hence, suggestions and examples are not to be regarded as exhaustive.

The document is drafted under the assumption that interconnection takes place with non discrimination and reciprocity of treatment.

The document is structured as a typical interconnect agreement, identifying key items that should be discussed in an interconnect agreement. For each section a description is given of the issues to be addressed and some guidelines are given as to the contact provisions.

The document discusses switched voice traffic interconnection. However similar principles apply to non-voice connection, e.g., packet switched services, and non-switched voice or data connections. This document does not address prices and access obligations.

D.2. Definitions

Non-Discrimination: The treatment by an Operator of all interconnect operators and its own business on a basis of equivalence of economic, quality of service and other relevant terms and conditions.

Point of Interconnect: The physical point where the Operators systems are connected.

The following are two possible network interconnect structures:

Physical Network: The actual network used by an Operator for the conveyance and switching of calls.

System Independent Structure:
A reference network independent from the "internal network" evolution which provides the same interface specifications and functionalities and access to all telephone numbers at each POI, despite disparities of technology.

D.3. Points of interconnect (POI) and Interconnect Links

This section defines the conditions for the actual connection of one network to another network. The connection takes place at a Point of Interconnect (POI). The issues that need to be addressed are:

– At what network levels a POI may be provided in each operators network (local, intermediate, etc.). This may refer to a physical network or a system independent structure defined for the purpose of interconnection. Interconnect prices based on a system independent structure will reflect the costs of the physical network.

- The location of a POI in relation to the nodes/premises of the two operators. At what physical locations POIs are offered at a particular point in time (street addresses).
- Each Operator shall offer a reasonable number of locations for POI.
- Interconnect links, e.g. types of transmission links, transmission speeds, ownership of multiplexing and de-multiplexing equipment, arrangements for physical redundancy and alternative routing, national signalling standards (including national changes to SS7) and whether the traffic routes are to be one-way or two-way.

- The lead times for providing a POI (from ordering to node-to-node testing) and interconnect links.
- Where the local law or license condition requires, or where the operators mutually agree, the mechanism for ordering and testing interconnection links furnished by either operator.

D.3.1. Network level

Interconnection shall be available at the following levels:

- interconnect at intermediate/tandem/transit level
- interconnect at terminating/local level
- interconnect at international level

The POIs may be associated with the physical network of an operator as the network is designed at a particular point in time. Alternatively, the POIs may be associated with a System Independent Structure, such that access to the relevant services may be achieved without detrimental effect.

D.3.2. Location

A POI may be located at the site of one of the operators or at another chosen location (e.g. midpoint between the operators). The POI is the boundary between the respective Operator Systems. Each party owns the part of the interconnect list on its side of the POI. The figures presented below are not intended to be an exhaustive list of possible POI arrangements.

D.3.3. POI at Operator Site

One of the operators is responsible for providing interconnect links from their site to the other operator's site where the POI is established (see Figure 3 below). There may be POIs at either operators' sites.

Figure 3: POI at operator's site

D.3.4. POI at another location

Both operators jointly provide the interconnect links. The POI may be located at any point, e.g. midpoint between the sites of the two operators or outside the premises of either party (see Figure 4 below).

Figure 4: POI at another location

D.3.5. Extension Circuits

This is an additional interconnect link that extends the interconnect from the Point of Interconnect to additional Operator B switch at a site remote from the initial switch. This facility uses the Operator B transmission plant to provide the access and is likely to be appropriate for interconnection with physical networks.

D.3.6. Interconnect links

Interconnect links will be established between the parties to provide the means by which calls and signalling can be passed between the two networks. The transmission capacity may be provided by or for one or both interconnecting operators. Consider the following:

- Physical transmission media, e.g. optical, electrical or radio.
- Bandwidth - 2Mbit/s as detailed above, 64 Kbit/s or higher order where needed. (Multiple 2Mbit/s transmission circuits can be multiplexed, and brought into an Operator's switching centre at a higher level, such as 140Mbit/s, then de-multiplexed into individual 2Mbit/s streams.) The interconnection agreement should define the ownership of such de-multiplexing equipment through proper designation of the precise location of the POI.
- Planning and design of the interconnect link.
- Both-way (two-way) or uni-directional (one-way) traffic routes.
- Alarms.
- SDH/PDH technology (using open standards where possible).
- Resilience (redundancy and diverse routing) -Path protection, separation, diversity and rings architectures should be considered. Division of traffic among multiple connection points, with the ability to overflow should one or more points of connective be lost should also be considered.

- Synchronisation to ensure proper digital synchronisation.
- Arrangements to permit access by one operator of equipment physically located on the premises of the second operator, and related issues of which operator supplies electrical power (AC primary power or DC power with battery backup).

D.3.7. Implementation time

Consider the following:

- Contractual time scales should be detailed.
- Contractual and non-contractual time scales should be clearly defined.
- Time scales may be dependent on the capacity ordered and the amount of planning associated.
- Additional capacity on existing routes may be provided quicker than capacity on new routes.
- Reasonable flexibility in capacity ordering should be permitted in the early stages of planning a new interconnection links.

It is common and desirable for an operator to provide periodic forecasts of circuit requirements for interconnect links. Joint planning is necessary to ensure acceptable schedules and quality.

D.4. Services

D.4.1. Guidelines

Interconnect call services are provided in order to allow any-to-any communication, whereby customers of one operator can call customers of another operator. Interconnect services may also be provided in order to allow customers connected to one operator's network to access services offered by another operator, possibly in competition with the first operator. Furthermore, some interconnect services may be provided by an operator on a fully competitive basis as alternatives to other ways of meeting a demand (the services should include ISDN and subsets thereof, or data services such as X.75).

The following is not an exhaustive list. However for each service, principles for charging and call handover should be defined.

D.4.2. Data Management Amendments

Access to the each other's telephone numbers will be achieved by implementing data management amendments in the networks. This is necessary for access to both geographic and non-geographic numbers.

Each Operator will be obliged to enable access to the numbers of other operators, by implementing data amendments in their network. Adequate testing should be conducted to verify that access has actually been enabled.

D.4.3. Conveyance

Operator B will terminate in their network, any calls passed from Operator A customers, where the terminating number belongs to Operator B. The calls may originate in Operator A's network, or in another country with connections to Operator A. Operator B charges Operator A for the termination service.

Figure 5: Conveyance

D.4.4. International Conveyance

Operator B will convey across their network, any calls passed from Operator A customers, where the terminating number belongs to an international operator having a correspondent agreement with Operator B. Operator B charges Operator A for the termination service.

Figure 6: International Conveyance

D.4.5. Special Telephony Services

Operator B will terminate in their network, any calls passed from Operator A customers, where the terminating number

belongs to an Operator B Service Provider. The calls may originate in Operator A's network, or in another country with connections to Operator A. Calls may be freephone, local, national and premium rate calls, with services from both interconnecting parties.

Figure 7: Special Telephony Services

D.4.6. National Transit

Operator A passes a call to Operator B, for termination in the network of Operator C. The calls are terminated in a network other than Operator B's.

Figure 8: National Transit

D.4.7. Access Services

Indirect Access

For indirect access, a directly connected customer of Operator B would use a specific short code to access Operator A. Operator B will implement data amendments into their network so that whenever the code is dialled, it will be recognised and the call forwarded immediately to the Operator A network, via the point of interconnect. Operator A will pay Operator B for the originating part of the call.

Two variations of this product can be implemented. The first - using `A' number presentation (or Calling Line Identification), where the caller can instantly be identified as an Operator A customer, and the call validated. The other type relies on two stage call set up, where the caller will be required to enter a Personal Identification Number, which will be validated by the Operator A.

Equal Access

Where equal access is used, all calls via either Operator are prefixed each with a different access code of the same number of digits. This code is used to indicate the chosen Operator. The Operator serving the calling customer will route the call based upon the access code used by the calling party. Each operators will have a different access code in this scenario. Where there is pre selection of the access code shall be made available in a non discriminatory manner.

Figure 9: Equal Access

Access to Local Loop

Where an Operator is unable or unwilling to provide either an indirect access or equal access service it shall allow it's competitor to interconnect directly with the distribution frame terminating the local loop, to permit conveyance of calls between the customer and the other Operator.

D.4.8. Other Services

The following services will be available to all Operators.

Operator Assistance Service

The call will be passed over to the operator assistance provider at a number of specified connection points. Service will not discriminate between customers of different Operators.

Directory Enquiry Service

The call will be passed over to the Directory Enquiry provider at a number of specified connection points. Service will not discriminate between customers of different Operators.

Emergency Service

Customers of all operators can pass their customers' emergency services calls to the Emergency Service provider. They will handle, and pass across to the correct authorities.

Number Information Systems and Services

The numbers of all operators must be allowed in a Number Information System (NIS) Database. It is the source of phone books and directory assistance information. All operators should be allowed access to this database. The NIS Database is preferentially implemented as a single database available to all Operators, but may also be implemented as multiple independent databases, one or more for each Operator, with a common data linkage and query capability. Appropriate contractual mechanisms should be established concerning updating the NIS Database, the basis for charging for database transactions and preserving the privacy of data concerning subscriber information.

Phonebooks and Directory Listings

- Operators buy directories from the providing operator, for distribution to their customers. Nothing in the interconnection agreement shall be read to require an Operator to have a printed directory.
- It should be possible for customers of one operator to have a listing in another operator's directory

Calling Card/Charge Card Facilities

This will enable all operators to provide their customers with access to another operators' charge card platform to enable calls to be made and charged to the Calling card/charge card.

Number Portability

To enable customers of one operator, to change over to another operator without altering the phone number for their telephone.

D.4.9. Intelligent Network Interconnection

This section deals with the interconnection of advanced network services such as cashless calling, call forwarding and other related value-added services. To offer such services to customers of other operators, the interconnecting operator may provide signalling, database access and call control capabilities. Operators that provide end-user access may seek to use another operator's intelligent network service to supplement it's own voice facilities, where access to services cannot be obtained over the PSTN.

D.5. Charges and Payments for Interconnect Links and Services

This section shall define the charging principles applicable interconnection links and services. Principles should be defined for sharing costs for facilities used by both parties, e.g. Interconnect links used for both way traffic. Where charges are cost based as required by regulation, then all charges raised should be on the same costing principles and cost allocation basis.

This may include items such as:

- Payment for the elements of interconnect links relating to a POI.
- Chargeable network elements (network segments, and/or distance).
- Fixed cost elements.
- Per call charge or other charge method, e.g. flat charge.
- Chargeable call elements, e.g. conversation time, successful calls.
- Time of day, time of week variations.
- Mechanisms for reviewing and changing interconnect prices.
- Where appropriate universal service contributions.
- Where charges for call conveyance are distance-based, the geographical reference point for call origin must be defined.
- Payment should commence with the receipt of the Answer signal, and terminate with receipt of the Release signal.
- Prices on a geographical averaged basis.

D.6. Billing

This section shall define the principles and procedures for collecting billing information and settling invoices between the parties. All billing systems should be auditable and tested to verify their accuracy. This will include defining:

D.6.1. Recording of billing information

- Who is responsible for recording billing information for different traffic types.
- What information is to be recorded, e.g. call duration, called number/calling number, date and time, trunk route,

special services used.

D.6.2. Exchange of billing information

- What information to be exchanged and by whom.
- When it shall be sent.
- Mechanism of exchange, e.g. data tape, direct electronic transfer, etc. and associated data format.
- Structure of billing information, e.g. split by POI and services.

D.6.3. Invoicing and payment procedures

- Who invoices whom.
- Structure and content of invoice.
- When an invoice is to be sent.
- Method of calculating invoices if billing information is unavailable.
- Payment conditions including late payment provisions.

D.6.4. Recording of billing information

- The format and content of the billing information should be agreed prior to service, e.g. information for each individual call, or in bulk format.
- Both parties should have the mechanism for recording billing information, to enable checks to be made. The data presented should tie in with the agreed method of pricing (e.g. with chargeable call duration recorded).
- Needs to account for times where one call covers two different charge rate periods.
- Call accounting should be detailed for each individual POI.
- Agree procedures to recognise potential difficulties with specific services, e.g. transfer charge calls.

D.6.5. Exchange of billing information

- Need to reconcile records of accounts and agree on invoicing channels.
- Agree upon the physical media for interchange of data and the data protocol.
- Dates for exchange should be pre-defined on regular basis.
- Need contingency plan for circumstances where one or the other billing system fails.

D.6.6. Invoicing and payment procedures

- Payment periods must be defined, with time scales for payments.
- Deal with procedures for payment of transfer charges calls including provision for the prevention of fraud.
- Interest payments in cases of default or disputes.
- Procedures for refunds if applicable.
- Dispute/escalation procedures.
- Bad debt procedures. Normally, each Operator is responsible for collecting from its customers and absorbs any bad debts of its customers.
- Rights to terminate interconnection service in the event of a billing dispute should not normally exist.

D.7. Numbering

Numbering should be administered by an independent agency.

- Common use of geographic codes, allocated in blocks to all operators.
- Common use of key non-geographical codes, e.g. freephone.
- Short access codes for indirect/equal access.
- Allocation of signalling point codes where appropriate.

D.8. Network Modification

This section shall define the obligation and principles for making changes in one operator's system caused by the implementation of another operator's numbers. An example is the implementation of functions to handle access codes and subscriber/service numbers associated with an interconnecting operator.

D.9. CLI

This section shall define conditions under which an operator will convey CLI to another operator requesting CLI. This may include:

- The purposes for which the CLI may be used by the receiving operator e.g. billing, call routing, display and

validation
- Possible restrictions on the use of CLI including e.g. number presentation
- Free use of CLI for signalling and billing purposes

D.10. Quality of Service

This section shall define the Quality of Service parameters that the parties shall meet, the way to measure the actual performance and the consequences of not meeting the agreed figures.

Quality of Service provision should be included in the agreement, stating a minimum standard service that is applied to the operators. This should be subject to strict contractual terms and conditions, with effective tools demonstrably in place to confidentially monitor the commitments. Interconnect traffic should not be discriminated in relation to other comparable traffic in the network of an operator and alternative routing should be available in the event of equipment failures in either party's networks or failure of a particular interconnect link.

D.10.1. QoS for Telephony

Calls passed across a POI shall be conveyed in the receiving network in the same routing and quality of service as calls originating within that network. Measuring percentage of successful relevant calls for ingress and egress traffic. Calls are defined as being unsuccessful if they fail due to network problems such as congestion. Where call failure is due to customer behaviour such as engaged numbers, they will not be considered unsuccessful. In cases of network failure, procedures for alternative route should be agreed and utilised.

D.10.2. QoS for Interconnect Links

May be specified in Interconnect Agreement or in other agreement (e.g. Leased Line contract) depending on the way the links are arranged. May include requirements on implementation times and restoration times.

The measure chosen should include an average measure with an index that takes into account the times in cases which are significantly better or worse than the average.

D.10.3. QoS for Data Management Amendments

Target times for implementation of number orders and similar. Measured from the date of receipt of valid order to service provision, consistent with the terms of the Interconnect agreement.

D.11. Interface Standards and Technical Requirements

This section shall define the technical standards or specifications that each party shall comply with.

The interfaces are:

- Electrical and physical interface
- Transmission interface
- Signalling interface (SS no. 7)
- The relevant technical standards defining the interface, e.g., G.703, G.704 and G.706 for 2 Mb/s circuits, I-EIS 300226, G.652, G.653 and EN 187.000 for fibre optic cable, etc.

Access to national variations in SS 7, and an obligation to work with all Operators to verify proper signalling. Adequate advance notice of changes would be necessary.

The standards and specifications shall be applied in the order of precedence set out in the relevant regulations, as follows:

1.) ETSI Recommendations
2.) ITU-T Recommendations
3.) National standards/specifications

D.12. Network Design

This section shall describe, or make reference to, relevant network structures of the interconnecting operators and define principles for call routing. It may be based the physical network or a system independent structure, depending on the principles applied for POI provision. The routing principles shall cover routing in normal as well abnormal situations (e.g. network failure).

This section shall also define principles for interconnecting SS no. 7 links/network.

D.12.1. Architecture

Operators shall exchange information about it's network to the extent necessary to perform network planning and planning of POIs.

This includes a full listing of the switches and associated number ranges where physical network interconnection is used. Where a System Independent Structure is used the addresses of POIs shall be made available. In both cases, the information shall include information on the technical interface and where appropriate the switching technology (i.e. digital or analogue), signalling system etc.

D.12.2. Call Routing

Normal call routing shall be such that calls passed from another Operator are conveyed in the same routing as other traffic within the network. The parties shall define the rules for routing traffic in normal and abnormal situations including dealing with overflow, congestion and network management.

D.12.3. Information

Where charges for service are based upon zones or exchange boundaries the parties shall exchange the relevant data without charge.

D.13. Network Planning

This section shall define principles for the continuous planning process that must take place between the interconnecting parties. The planning process should include:

- New POIs
- Changes to the transmission capacity at each POI during an appropriate planning period.
- Detailed rules for call routing (principles defined in section 11).
- Changes to the signalling network
- New numbering blocks

The process should define timing requirements and information exchange requirements.

The parties must forecast the amount of traffic expected over all interconnect links. Based on those forecasts and the QoS requirements, the capacity for the different routes shall be planned. Capacity orders placed will be contractually binding on both parties, though some flexibility should be built in, during the early days of an interconnect.

Contingency arrangements will also be established in cases of network failure. First and second choice routing will be agreed including the provision of redundancy between the relevant switch connections. Methods of network management (such as call gapping) will be agreed.

Provisioning time scales should be included. This should include the time scales for installation and testing, see also Section 13. The full technical provisioning process should be jointly project managed and monitored.

D.14. Installation, Operation and Maintenance

This section shall define procedures for installation and testing in conjunction with the initial interconnect, as well as in conjunction with upgrading interconnect facilities, e.g. new POI, new services and new number blocks.

This section shall also define the principles for the continuous operation of the interconnection, including network/traffic supervision, fault/disturbance reporting and fault recovery actions.

The main provisions should be stated in the agreement and supported working documents. The common approach agreed prior to service opening should be based upon providing and maintaining the services at the required quality of service. This should include rules for testing, fault reporting and clearance by both parties.

D.15. System Protection and Safety

This section shall define the obligations each party has to protect each others network and measures to prevent endangering people.

D.16. System Alteration

This section shall define the principles for dealing with changes in the system of one operator, that may have an impact on the system of the other operator. Issues that may need to be specified are:

- Advance notice times
- How to deal with costs for alterations in the network of the other operator

This would apply in two general circumstances:

1.) Changes to physical network, e.g. switch closure or re-location.
2.) Upgrade of electrical/signalling specification.

Each party shall notify the other of any significant changes made in the network that may affect the conveyance of calls. The changing party should pay the costs of the other operator where their alterations cause the other party to change its system to continue to convey calls. Exceptions to this would be in the case where the change is agreed or where the alteration is part of a planned upgrade programme.

D.17. Provision of Information

This section shall define rules for providing information on the existing network e.g. network structure and interfaces. Information should be provided on planned changes to the network structure or hierarchy, as well as planned changes to transmission and signalling systems that may impact other operators.

All information shall be subject to confidentiality and general principles of co-operation. Any information required to implement a service should be provided under strict time scales.

D.18. New Services

This should apply to both parties, as it is relevant to all new obligatory interconnect services, regardless of initiator. Examples are new call conveyance products such as Premium Rate or Local Rate calls. It covers the process of implementing a new service where full commercial agreement may not yet have been reached.

It must state an obligation for co-operation, and to enter into good faith negotiations. These negotiations should result in the incorporation of an additional product into the interconnect agreement.

The process should be relatively simple, with easy to use pro formats for notification of new numbers/services. Time scales and milestones should be agreed, for commercial and technical implementation. Within these time scales, if agreement is not reached, temporary prices should be applied, to prevent unnecessary delay to the launch of new services. These prices will be retrospectively adjusted when the price is finally agreed or determined.

D.19. General Contract Provisions

D.19.1. Duration

- Contract should provide for a reasonable duration of contact with scope to re negotiate at regular intervals by way of review to reflect changes in plans, portfolio and regulation.

D.19.2. Review

- Process of setting up re negotiation of defined issues e.g. changes in law or regulation
- Minimum time for complete re negotiation
- Specified time periods for obligation to modify agreement.
- Review notices
- Date of changes coming into effect.
- Option where parties agree to use arbitration to resolve disputes.

D.19.3. Determination

- Defines fall back if review not agreed in time scales.
- National regulator acts as expert in resolving issues sent to him. If not possible then need some equivalent independent arbitration.
- Define criteria for determination e.g. licences

D.19.4. Confidentiality

- Keep other party's information confidential
- Need to keep information from retail arm.
- Data Protection in respect of customer details
- Provision of information to regulator if needed

D.19.5. Intellectual Property Rights

- Control use of each others trademarks
- Prevent IPR being used to control standards
- Need `open' interfaces

D.19.6. Liability

- Not damage each others systems
- Limitation of liability - direct loss
- Threshold below which claims will not be made

D.19.7. Disputes

- Simple process to resolve disputes
- Escalation procedures, then refer to arbitration, the regulator or the courts
- Need contact points to be defined

D.19.8. Additional Provisions

- Force Majeure
- Assignment
- Contract variation
- Breach of contract
- Termination
- Law

E. Main Outputs from the June 96 Workshop

E.1. General Comments

The issues presented in the workshop have sufficiently covered the current concerns of the various players and NRAs. There was a general request for a clarification on the direction of the regulatory framework (focus on infrastructures versus focus on services) proposed by Interconnection Directive in order to better evaluate the technical recommendations and framework to be proposed in the study.

In particular, a major question arose: do we want to open the telecommunications market by encouraging investment in new infrastructure or by opening the dominant network to new entrants who provide new services without owning their own network?

The industry participants thought that a clear idea of the policy objectives was necessary to prepare a technical interconnection framework.

Main comments were related to the following points:

- framework policy objectives should be to facilitate interconnect to the PSTN for new entrants. Incumbent PTO and especially the local loop represent a "bottleneck" which prevents competitors from fair and equal access to the telecommunications market,
- mobile network interconnection should be ruled under a special framework,
- status and rights/obligations to interconnect for TOs and SP need to be clarified,
- while an "any-to-any" interconnection principle is necessary to ensure complete interconnectivity, other mandatory interconnection obligations should be on the PTOs such as unbundled access at any technically feasible point,
- an interconnection framework for Trans-European service provision will be necessary in the future,
- the technical/operational framework should be written at a European level by EIF, with endorsement from the EC,
- as far as general principles are established by the EC, EIF can be used to discuss interconnection practical implementation issues,
- numbering issues should not be addressed in the technical framework, these issues are already studied in the European numbering forum,
- a technical/operational framework at the European level is in addition and not in replacement of interconnect service catalogues to be provided by incumbents,
- VPN is an important issue which should be covered by the technical framework in the future.

Rights and Obligations

New entrants should have an affirmed right to interconnect to the public switched telephone network (PSTN). Such

interconnection should be transparent, cost-oriented, and non discriminatory as set forth in the Interconnection Directive Proposal. Certain obligations must be borne by the PTOs in order to ensure that emerging competitors are able to establish themselves in the telecommunications marketplace.

Dominant player regulation and its impact on interconnection obligations and rights

In order to determine whether there is significant market power in the context of telecommunications network interconnection, it is first necessary to determine which particular telecommunications market is to be examined. The acquisition of a license to install or operate a telecommunications network or to perform specialised telecommunications services does not imply that the licensee enjoys a position of dominance with respect to the provision of interconnection. The market for which the analysis of significant power relative to interconnection should be undertaken is not the overall telecommunications services market but rather the interconnection market.

Means to limit mediation process

It was recommended to include in the study a framework for Rules of Engagement among TOs, SPs and VPN service providers in order to limit mediation periods. The framework may be in a form of a template of agreed parameters between the TOs, SPs and VPN service providers for ordering interconnection. It is not to dictate internal business processes but to provide guidelines to assist those TOs, SPs and VPN service providers that have not experienced interconnections in this realm. Possible parameters may include at least the following: department identified for engagement, electrical interfaces, signalling interfaces, quality of service targets for interconnection, billing parameters and medium and fault management.

Cross-Border Interconnection

A list of the unbundled pieces to be offered for interconnection with a fixed network is mandated in the draft EU Directive, and is essential in bringing the monopolistic interconnection charges the PTOs currently offer. As well, for cross-border interconnection, a standard list of products would make the interconnection process more efficient.

E.2. Comments from Mobile Operators

It would be helpful to have a separate Framework for fixed/wireless interconnection: Difference between fixed and mobile is justified. Because it does not offer local exchange service as a substitute for that provided by the PTO networks and wireless should not be treated as a PTO nor constrained by local exchange obligations.

Interconnection for Service Providers to Wireless Networks

The EC Proposal's establishment of service providers' "rights" to interconnect may artificially protect less efficient competitors and create unnecessary regulatory costs and delays.

Interconnection among all Network Providers

Extending similar affirmative interconnection obligations to all network providers including the former PTO monopolies, as suggested in the Interconnection Proposal, is counterproductive to rapid development of a competitive market and inconsistent with the concept of proportionality. Competitive network providers do not represent a bottleneck to the provision of emerging services, and therefore should not be obligated to connect other providers to their networks. The key to interconnectivity is the public switched telephone network: as long as all networks have the opportunity to connect to the PSTN, interconnectivity will be achieved. Therefore, a different and more stringent set of interconnection obligations should be imposed on the PTOs.

Direct interconnection between two competitive networks to bypass the PTO will occur as dictated by market needs, in situations where the benefits outweigh the costs, in a manner which is far more efficient than that which could be promoted by regulation.

The US Model

1. The US model treats mobile separately from Local Exchange Carriers (LECs)

In the United States, Commercial Mobile Radio Service (CMRS) is recognised by federal policy makers as being distinct from local exchange service:

- CMRS is expressly excluded from the definition of local exchange carrier under the Communications Act of 1934, as amended. Congress has acknowledged that CMRS offerings are inherently interstate, and charged the FCC with primary responsibility to oversee rapid deployment of CMRS services.
- Congress has pre-empted state jurisdiction over intrastate CMRS rate and entry regulation to "foster the growth and development of mobile services that (are)... an integral part of the national telecommunications infrastructure."
- Under the 1996 Telecommunications Act (the first major reform of telecommunications law since the original Act was passed in 1934), CMRS continues to be recognised by Congress as a non-LEC service.

Regulatory restrictions that apply to LECs do not apply to CMRS:

- LECs must provide Interconnection at any technically feasible point, offer wholesale and retail rates and offer collocation.

Reseller Switch concept not approved:

- FCC did not adopt Proposal to require interconnection of reseller switch. The Commission tentatively concluded that switch-based interconnection requirements are "unnecessary" and "may impose costs on the Commission, the industry, and consumers."
- Service providers which do not own network facilities are not "interconnecting" but rather seeking market access through resale of network services,
- treating all mobile and LECs same for unbundling purposes allows resellers to piggyback on facilities-based carriers.

2. LEC-CMRS interconnection viewed separately in US, particularly to foster competition between the two:

- Congress has expressed the view that it "considers the right to interconnect an important one which the (Federal Communications) Commission shall seek to promote, since interconnection serves to enhance competition and advance a seamless national network."
- The FCC's task under Congressional directive is to ensure that all CMRS providers are able to obtain interconnection from LECs at reasonable rates.
- FCC issued a notice of Proposed Rulemaking for "bill and keep" pricing for interconnection to encourage wireless industry growth and competition.

3. Universal Service separately from interconnection

Universal service policy is being developed by the FCC separately from interconnection policy:

- costs of providing universal service are unrelated to the costs of interconnection
- general recognition that burdening mobile with universal service contribution would delay onset of competitive market
- cellular customers should not be required to pay an amount that bears no relationship to their actual usage of the local loop -- an amount which in US is far in excess of that collected from other LEC
- making full use of the competitive market is the best means of advancing the objectives of universal service -- through industry-wide competition, the consumer will have the greatest opportunity to select, at the lowest price, desired telecommunications services from a broad range of alternatives.

E.3. Approach to an European Interconnection Framework

Need for a Technical/Operational Framework at the European level

From the attendees a technical / operational Interconnection Framework is necessary, in addition to the Framework proposed by the EC Interconnection Directive. Without a specific framework, an incumbent public telecommunications operator (PTO) will easily control all aspects of fair competition by controlling the local loop. For example, the PTO will be able to restrict the entry of competing TOs, SPs and VPN service providers by setting unduly high technical and operational interconnect standards. The proposed Framework Directive by the European Commission (EC) is not specific enough to prevent anti-competitive practices.

The technical and numbering issues need to be adopted at the European-wide level in line with the EU policy in support of competition. If these issues were to be left at the national level, it is anticipated that half of the member States would not conform to the principles of the Interconnection Directives. Experiences in the implementation of Service Directives proved that more than half of the countries failed to meet the dead line to adjust national regulations to accommodate market entry of facility-based telecommunications service providers.

Position with EIF framework approach

From the attendees there would be merit to an approach under which an interconnection framework is proposed by an independent source, in addition to the *EIF Interconnection Guidelines*.

The EIF Guidelines were the result of negotiations between dominant PTTs and alternative operators. As a result, finding a common position on most issues was impossible. In developing the EIF Guidelines, finding a common position on the following issues was very difficult to achieve:

- alternative operators' ability to choose call routing or to see PTTs network architecture (thus the option for a "System Independent Structure")
- location of the point of interconnection: defining a specific POI location is important because of the division of responsibility for providing equipment, transmission and links. PTOs wanted the POI within the terminating equipment (DEF, MUX, LTE) whereas others wanted the POI located between both operators. It is to the advantage

of the PTO to have the POI within his competitor's switch, because it forces the competitor to purchase the PTOs terminating (multiplexing and/or de-multiplexing) equipment. The EIF Guidelines compromise was to draw a line on a diagram showing that the POI could be anywhere, inside or outside of the switch. To be fair, all choices should be available to those connecting with the PTO.

- Network modification costs: the PTOs should clearly state what kinds of additional charges they will to impose for network modification, and fully justify them.
- Implementation times: most PTOs have an order interval that is much longer than a mobile operator requires, and much longer than a mobile operator experiences with self-provided microwave links. (90-180 days is a common installation interval across Europe, whereas the average microwave installation period for mobile is 50-60 days). Any new framework should provide for damages to be paid to the competitive operator when a PTO fails to meet its installation objectives.
- Need for a good faith estimation process for capacity needs.

Writing and ownership of technical/operational framework

Most the attendees believe that the technical/operational framework should be written at a European level by EIF, with endorsement from the EC. Ownership by the EIF would be ideal, given their membership comprises all sectors of the telecommunications industry.

Ownership at the national level would unnecessarily focus interconnection policy too low and thereby decentralise the resolution of interconnection issues. This would work against one of the key objectives for the framework and the EU - harmonisation.

Industry forums would be useful in bringing together involved parties to resolve key issues. Forums should be conducted at the EU, rather than national level, and should be designed so as to avoid the challenges posed by industry competitors obstructing each other's initiatives for purely competitive reasons.

E.4. Comments on Technical and Numbering Issues

Draft Technical Framework major items covered.

Areas listed are well covered and the suggested solutions would meet our requirements, e.g., CLI, QoS, Interface Standards, Network Design and Installation/Operations and Maintenance.

Interconnection Conceptual Models

The differentiation of "symmetrical" versus access interconnection is not relevant to the scope of the analysis. A single model should be enough to represent the different roles played by the different agents. These roles represent the value provided for each party in order to complete the end to end service.

The proposed model is a "chain" of value.

1. - Call origination
2. - Customer billing
3. - Call termination
4. - Transit
5. - Customer care
6. - Information provision

In services with "calling party pays" services 1, 2 and 3 are provided by the same operator.

In services with "sharing cost" schemes 2 and 5 are provided partially by different agents.

Therefore it was proposed to substitute the term "symmetrical" by "unguided by calling party" and "access interconnection" by "guided by calling party".

Settling priorities on items to cover

1. **Interconnection Models: Advisory.** May be useful as a guide or example for the uninitiated, but should not be viewed as restrictive in any way. The companies should be free to create their own interconnection arrangements.
2. **Call handling procedures: Mandatory.** There should be some flexibility in terms of how calls are handled, although there some common standards should be adhered to in terms of call handling. The originating operator should be able to route its call to the furthest point that is technically and legally possible, thus requiring that is purchase only the unbundled part of the fixed network. When this is not possible or denied, and there is no other way to route the call to that particular point of interconnection, this (unbundled network component) portion of the call should be cost-based because it cannot be negotiated.
3. **Point of interconnection: Advisory.** Again, examples are instructive, but they should not be restrictive. A full discussion of the possible known combinations should be included.

4. **Collocation/facility sharing: Advisory.** This should be an alternative available for the two parties to discuss and agree upon.
5. **Interconnection services: Advisory/Mandatory**. Possible services should be spelled out. If there is a specific interconnection service that will always be provided, then this may have a mandatory requirement. However, most services will probably be considered optional, especially if there is competition in the marketplace.
6. **Access services: Mandatory.** A key point in any interconnection agreement is to provide access to the respective networks.
7. **Conveyance services: Mandatory**. Similar to "Access services" above.
8. **Voice basic services and all other services: Mandatory.** The services provided across the point of interconnection need to be specified so the appropriate billing can take place.
9. **POI standards: Advisory.** There may not be specific POI standards. These standards need to be addressed in the agreement so there is no misunderstanding regarding maintenance, quality, trouble shooting, etc.
10. **Signalling standards: Mandatory**. Signalling standards are part of the basic POI agreement and need to be specified.
11. **Quality and maintenance: Mandatory.** There should be no misunderstanding relative to quality, and penalties (if appropriate) associated with failure to deliver should be specified. Time frames for completion of orders may also be appropriate.
12. **Traffic/network management: Advisory**. This should not be a serious issue, but it may be appropriate to cover it in an agreement. A database of the digitised calling zone or exchange area boundaries should be provided where the tariffs are based upon zone or exchange area boundaries and where the digitised file exists.
13. **Geographic number portability: Mandatory.** The technical solutions for this process should be harmonised and/or developed at an ITU level.
14. **Non-geographic numbers management: advisory This** should not be part of an interconnection agreement. This is an administrative issue, and not part of an agreement between two carriers.
15. **Carrier selection: advisory** a favour for pre-selection, with an option to choose a different carrier by dialling a prefix.

Carrier Selection Issues

Easy access (prefix) would suit the level of competition in EU member States today. The US experience indicates that Easy access accelerates competition. In order for Equal Access (preselection) to work well, however, alternative service providers have to be already highly competing with an incumbent PTO. The market competition in Europe is yet to reach this level. It will be necessary to review the efficiency of the method of carrier selection as the level of competition grows in the future. The time may come when Equal Access becomes more appropriate than Easy access.

E.5. Specific Comments on VPN

VPN SP Right to Interconnect

Some TOs expressed the following viewpoint regarding Service Providers and VPN right to interconnection:

- VPN and IN services are simply additional services and should be treated as such
- there should not be an obligation for competitive operators to interconnect with SPs.

At the contrary from Service Providers like SITA and IBM there is a request that the interconnection rules being developed at the EC level should be made applicable to VPN service providers:

- Interconnection rules that classify telecommunications service providers in terms of types of licences will create discrimination against those service providers that can not benefit from the rules, such as VPN service providers.
- In the service markets where various types of telecommunications service providers compete with each other providing more or less the same services, creation of disadvantage to certain types of service providers in the regulatory framework will be harmful for the sound development of a fair playing field in the telecommunications markets.

VPN service providers need fair interconnection rules, as much as TOs and SPs do. VPN service providers should not have any disadvantage in relation to TOs/SPs in providing the same services as the ones provided by TOs/SPs, i.e., VPN services. Ability to interconnect a VPN with the Public Switched Telecommunications Network (PSTN) is necessary to provide customers with switched access to and from a VPN. This function is necessary to complement the VPN services to customers.

The importance of the role played by VPN service providers in the promotion of market competition should be recognised by policy-makers and that their interests should be included in all the policy debates on telecommunications regulatory issues. Fair treatment of VPN service providers will stimulate competition and ultimately generate great benefits to end-users. The current emphasis of the study placed only on "voice telephony service providers" fails to reflect the reality to lead to a one-sided interconnection framework that does not support the development of a fair playing field.

Interconnection Framework for VPN Providers

From Service Providers like SITA and IBM view point, the scope of the study should include specialised providers of VPN services: in the current focus of the study, interests of "voice telephony service" providers alone are included. These providers are defined, in the study, TOs and SPs, where the former own switched voice telephony network infrastructure and the latter, do not own the infrastructure. These players believe that the focus is too narrow to correctly reflect the reality of competition in service provision.

Distinction between "voice telephony service providers" and other types of voice services (such as VPN) may make sense in terms of the status defined by a licence granted to each telecommunications service provider. In the market, however, no substantial difference between services provided by TOs/SPs and VPN service providers may be observed in terms of the nature of the services provided to end-users. New market entrants (TOs and SPs) in liberalised markets typically begin their business by providing services to large corporate customers, rather than to address individual households from the beginning of market entry. VPN service is a typical example of a service addressed to large corporations. The profit margin from large corporations is larger than profits from individual households. In order to efficiently obtain a substantial share of the voice service market, TOs and SPs naturally focus their marketing efforts to a group of large customers. Even if TOs and SPs are authorised to provide voice telephony services to the public at large, the public is not their major focus.

In the long term, TOs and SPs may develop into full service providers addressing the public at large. At that time full competition in the markets will be achieved. It takes, however, a long time for full competition to emerge. For example, the UK has opened the market for competition in 1984. Since that time, regulations have been reformulated to support the competition. As a result, there are a number of TOs/SPs that are licensed to provide public telecommunications services over the fixed network. In fact among these TOs and SPs, only three are providing services to the public at large today ; BT, Mercury and Kingston Communications (HULL). All other TOs and SPs offer services to specific segments of customers, most of which are business users needing intra corporate communications.

In the UK market described above, TOs/SPs and VPN service providers are in direct competition with each other. Most TOs/SPs that are licensed to provide public telecommunications services over the fixed network provide VPN service. VPN is, however, provided by other types of telecommunications service providers under the class licence, not necessarily under the public telecommunications operator licence (PTO). This provides an empirical evidence that a difference in the licensing status does not make a substantial difference between TOs/SPs and VPN service providers in terms of the services provided by them.

Observing some countries' experiences where voice telephony services are liberalised, such as Australia, Canada, Japan and the US, we have learned that it takes ten or more years for efficient competition to take place. Even if a regulatory framework that facilitates competition among TOs/SPs is adopted, that does not automatically generate competition between them overnight.

TOs, SPs and VPN service providers will continue to compete with each other in many service markets for a number of years. VPN service providers thus play an important role in order to stimulate competition. In fact, the border between TOs/SPs and VPN service providers is blurring. TOs/SPs may provide value-added services serving a specific customer segment (such as large corporations). In practice in the markets, there is no meaningful distinction between services provided by TOs, SPs and VPN providers.

E.6. List of Contributing Companies

Below the list of companies which have sent their contributions from the workshop questionnaire:

- ACC
- AIRTEL
- AIRTOUCH
- CNPF
- DTI
- EIF
- LUCENT
- SIEMENS
- SITA
- UNISOURCE

Last modification: April 28, 1997

ARCOME sa

ARCHITECTURE DE COMMUNICATION POUR LES ENTREPRISES

12, rue Delerue

92120 MONTROUGE FRANCE

Tel: (33) (1) 42 53 89 97 Fax: (33) (1) 46 54 05 27

Undisplayed Graphic

EC/DG XIII

EQUAL ACCESS & INTERCONNECTION

Appendix 2
Technical Study

For ARCOME

Bassam Almoussa
Jacques Buisson
Suzanne Debaille
Joël Repiquet

For SMITH Engineering Systems

Mark Cartwright
Simon Dunkley

Version 2.1
Reference: SD/56/97
17 January 1997

Table of Contents

List of Figures

List of Tables

Table 7: Countries in the EU in which the respondees offer products 52

PART I. INTRODUCTION, APPROACH AND CONCLUSIONS

1. Introduction, Aims and Context of the Report

1.1. General

This document has been prepared by Arcome and Smith System Engineering for DGXIII under Contract 48330. The contract is for a study on "*issues related to fair and Equal Access and the provision of harmonised offerings for interconnection to public networks and services in the context of open network provision (ONP)*". This document is the technical report of the study.

1.2. Background and Context

On 1st January 1998, large parts of the European telecommunications networks will be deregulated to encourage competition within the market. In order to cope with the technical requirements of this major change, a comprehensive technical framework will need to be in place to allow multiple operators to operate in the same geographical areas.

Two major and related issues associated with this framework are:

o **Equal Access**: offering a customer a fair and equal mean to the choice of network service provider; and

o **Interconnection**: the mechanism by which independent networks connect to one another to form a homogeneous and efficiently functioning network from the point of view of the customer.

To support the development of such a framework, the CEC has funded an independent study. The study has:

- surveyed experience world–wide of interconnection and equal access issues in telecommunications networks,
- reviewed user needs for equal access and interconnection services,
- reviewed appropriate developments in standards,
- conducted a large workshop in Brussels to present initial ideas and gain feedback from the telecommunications provider, user and regulator communities,
- reviewed a wide range of specific technical issues that might be involved in the CEC framework.

The country surveys have been separately reported. This report covers the technical aspects of interconnection. Together with a report covering organisation and management aspects, these will form the main input to the final report of the study, which will recommend a `European Framework' for the regulation of interconnection and equal access.

1.3. Aim and Scope of this Report

This report surveys the options for technical regulation across a wide range of areas related to telecommunications interconnection and equal access, and draws conclusions about the directions that regulatory control and standardisation should take at a European level.

The report addresses:

- the requirements for interconnection and interworking which arise as a result of user service offerings and developments (e.g. call completion, number portability);
- available interfaces, level of services and capabilities;
- currently supported standards and additional standardisation work required for interconnection, covering all relevant NNI interfaces;
- alignment of these standards with existing TO technical solutions;
- operational aspects: technical constraints related to interoperability testing, network integrity, billing needs, data security etc.

In order to provide short term recommendations and define the building blocks of a technical and operational interconnection framework the main focus of this report is on `normal' current voice networks and services, based on local switching control PSTN, GSM, ISDN etc. which corresponds to the type of interconnection currently operated in deregulated countries,

However there will be an increasing trend towards the use of IN solutions and value-added public services (e.g. through the SS7 INAP), and these have also been included to ensure that the proposed Framework does not become obsolete too quickly. Therefore IN network interconnection is considered on the service aspects and the standardisation state of the art.

This is a discussion document prepared by Arcome and Smith for DGXIII. It will not be revised and reissued; however review comments will be taken into account in the final report.

1.4. Contents

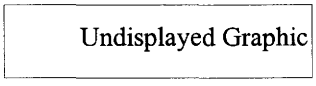


Figure 1: Technical report organisation

The report has been divided in four major parts:

- Part I deals with introduction, definitions, approach and conclusions:
  - Section 2 gives definitions and clarifications about network interfaces and network architectures in order to establish the basis for a common understanding to this analysis,
  - Section 3 describes the requirements of identified modules of end–user telecommunications services for TO interworking and outlines the approach taken to the analysis of technical options and the recommendations of the final report,
  - Section 4 summarises the conclusions of the technical analysis,
- Part II deals with the technical analysis of interconnection services to provide to end users:
  - Section 5 describes technical solutions for the interconnection to the access network and the issues surrounding the technical direction of interconnections among `normal' networks (PSTN, ISDN, GSM),
  - Section 6 describes the rather different set of issues surrounding `new' network types, including INs,
- Part III deals with the technical analysis of special requirements of services arising in a competitive environment:
  - Section 7 outlines the technical impacts of carrier selection procedures.
  - Section 8 describes the interconnection issues related to number portability.
- Part IV deals with technical information related to standards and manufacturers:
  - Section 9 gives a list of acronyms,
  - Section 10 contains additional information regarding the existing and developing standards provision,
  - Section 11 gives a the view of equipment manufacturers on technical alignment, developments and regulation.

1. Definitions

1.1. Types of Access to Public Network Operators

The ONP Voice Telephony Directive identifies three types of network access:

- **Access at "commonly-provided" network termination points**. This is the normal type of customer access. **It corresponds technically to a User to Network Interface**. Charges are based on published retail tariffs.
- **Special Network Access.** End users, service providers and telecommunications organisations when not providing voice telephony services, may require "Special Network Access" to the fixed public network at other points that the network termination point. Technically there may be little difference between interfaces available under Special Network Access and interfaces available under Interconnection. **It may correspond technically to a User to Network Interface or Network to Network Interface**.
- **Interconnection.** It concerns the interconnection between telecommunications providing fixed or mobile public telephone networks in the same Member States or in different Member States. **In most cases, it corresponds technically to Network to Network Interfaces**. Technical and commercial agreements for interconnection are a matter for agreement between the involved parties subject to intervention by the NRA.

- User to Network Interfaces (UNI) are related to the access point where TOs provide telecommunications networks and services to users. The ITU-T (I112) definition settles that a UNI is the interface between the terminal equipment and a network termination at which interface the access protocols apply. UNI are provided at the Network Termination Point (NTP) which represents the regulatory boundary. UNI are ruled under approval conditions for approved telecommunications equipment compliant with essential requirements.
- Network to Network Interfaces (NNI) are related to interfaces between national TO networks or between international TO networks, they correspond to interconnection between telecommunications network logical peers. The ITU-T (I112) definition settles that a NNI is the interface at a network node which is used to interconnect with another node. The Point of Interconnection (POI) represents the regulatory boundary that marks each TO for the successful handling of internetwork traffic. NNIs are ruled under essential requirements. One major characteristic of NNI is the symmetrical relationship they establish.
- The major NNI component considered in the report is the inter-provider exchange of information within the service control layer of a public voice network (ISDN, PSTN, GSM, IN). This corresponds to the interconnection of signalling system interexchange messages in the majority of current networks (PSTN/ISDNs) but needs to be interpreted more subtly for newer services (VAN and IN services, including VPNs).

1.2. Voice Public Networks Classification

As far as public networks increasingly employ sophisticated and powerful computing and control functions resources in the delivery of services, we propose to define two basic types of public voice networks implemented by TO. Technology for interconnection will be associated to each type:

- **Local processing: non IN or "current" public networks** such as PSTN and ISDN, where control functions and service management are provided locally and not separated from call handling functions in a switch. Non IN networks can provide numerous facilities such as MODULE services, ISDN supplementary services. Facilities such as 'call waiting' or 'short code dialling' may be provided without additional distributed network intelligence.
- **Remote processing: IN public networks** where service management and control functions are distributed and separated from the task of establishing a communication channel. IN term is used both to describe an architectural concept which aims to ease the introduction of new services, and to define "advanced services" such as freephone and VPN, but may also provide more easily existing services.

IN applications embrace both voice telephony services, advanced services, back office applications such as billing and routing management, by using function entities in addition to non IN networks call processing entities. For example, GSM networks use IN service control and management functions for the provision of roaming capabilities, in addition to a non IN network for the call completion and the provision of supplementary services such as CLI, call forwarding (PLMN part). Figure 2 indicates the difference between the two kinds of service architecture.

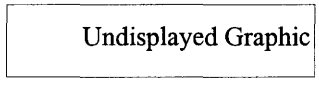


Figure 2: Network architectures and approaches

For non IN networks, interconnection of signalling networks is implemented mainly to provide call processing (call set-up, control, and release) between two networks, The signalling messages are exchanged at a physical POI between two signalling units (SCP) which are directly connected through a digital link. Physically separated signalling data links between the two networks ensure that signalling messages cannot be misdirected.

For IN networks, interconnection is implemented to provide the cooperation between high layer signalling applications. The signalling messages and remote requests may access through the POI to any signalling control point (SCP) or functional entity of the other network. Without specific protection mechanisms, failures can expand very easily in a network. As far as in IN management and control functions have divided responsibilities, it is harder to protect network integrity.

2. Approach for the Study

2.1. Users Requirements

The future regulatory environment will involve multiple TOs and multiple Service Providers. In such environment Interconnection and EA must ensure to comply with two key principles:

- the capability of any TO's customer to call other TO's customers by using standard dialling procedures irrespective of the TO network they are connected to (end to end connectivity/any to any communication),
- the availability to any customer served by a TO or by a Service Provider to select other TO or SP network (TO selection/customer choice).

In addition the proposed ONP Interconnection Directive calls upon NRA to encourage the earliest possible at the introduction of local portability, in order to allow a user to change his TO without changing his phone number.

Interconnection between competing networks and Service Providers has to achieve a seamless connectivity between the telecommunications users requiring public voice services. The basis for analysis of technical aspects is the requirements for service delivery and service development for users. This includes a range of aspects:

- simple call functions - point-to-point voice telephony based on dialled numbers;
- call information functions - CLI functions etc.;
- enhanced call functions - ISDN supplementary services;
- special call functions - emergency calls etc.;
- special billing functions - freephone, calling card, etc.;
- network functions - VPNs etc.;
- functions of a competitive supplier market - equal access, number portability etc.

Each of these is analysed in respect of the constraints it imposes on the interconnection of operators, for parameters such as:

- need to transfer call information;

- need to transfer routing information;
- need to transfer tariff information;
- need to transfer subscriber information.

In turn these impose a need for:

- harmonised information exchange standards;
- real-time (within signalling interexchanges messages) and non-real-time communications (exchange of management, billing information paths between operators;
- network security (e.g. to meet data protection and maintain quality of service).

2.2. Networks and Services

Usage of existing operator networks is still very largely based on `simple' telephony functions provided by POTS, i.e. call connection on the basis of dialled number and call completion using TUP-like standards. Operators are at varying stages of updating their access, trunk and (particularly) signalling networks to provide more complex services, in both voice and data communications.

A broad distinction can be made between:

- network architectures and services that rely on local processing (non IN networks) for decision making - routing tables at exchanges based on the `look up' of relevant flags and routing tree decisions. In this kind of architecture a call has, during routing and switching, no `memory' of where it has been.
- network architectures and services that utilise remote processing (IN networks) for decision making - specifically `intelligent network' architectures, with centralised switching control based on databases of customers, lines, services, tariffs or other aspects. In this kind of architecture a call carries with it, during routing and switching, complex information regarding its nature and origin.

As they move from TUP towards ISUP and beyond, networks are undertaking more and more of the latter kind of function. For instance CLI is routinely transported in the signalling network, while certain specific services are handled by partly or fully centralised IN functions (e.g. phone card, freephone and premium rate services). In the long term, network services will increasingly be provided in this way, which provides a more flexible and potentially more efficient approach for operators. However the feasibility of harmonising interconnection arrangements is very different between the two service types.

The standards position for local processing networks is relatively robust and well supported by suppliers. Section 5 analyses the technical aspects of these kinds of networks, including their inherent limitations on providing advanced services across interconnected networks, and recommends an approach to regulating and managing the process.

Interconnection of remote processing networks rely fundamentally on the exchange of *applications layer* (i.e. semantically significant) information. In principle there is no technical difficulty in this - applications level interconnection between computing networks has been commonplace for many years - but the development of industry standards (which take account of the particular functional and non-functional requirements of telecommunications networks) is at a very early stage. Section 6 analyses the options in this area and recommends a strategy towards ensuring that European TOs are in a position to offer well-integrated IN-type services as they mature.

2.3. Requirements for Interconnection

User requirements may be classified following 5 modules of services which need to be addressed at a pan European level between interconnected TO networks (see Table 1 below). Module 1, 2 and 3 services correspond to end-user services which can be provided through interconnected networks. Module 4 and 5 services correspond to special service requirements arising from a competitive environment:

Module #	Title	Services
Module 1	Basic call/ customer care and billing services	Basic call connection CLI services (CLIP, CLIR, MCID) Access to Directory Enquiries Emergency services Billing services (AOC, provision of itemised and unique billing)
Module 2	ISDN/GSM supplementary services	End to end ISDN supplementary services between two fixed networks End to end GSM supplementary services between two mobile networks Common ISDN/GSM supplementary services between a fixed and a mobile network
Module 3	advanced services	VPN services IN advanced services (Freephone, Premium rate, Virtual calling Card, UPT)
Module 4	TO selection services	
Module 5	number portability	Using non IN solutions Local number portability using call forwarding techniques Using IN solutions and remote databases Local number portability GSM number portability 800 number portability Non geographic number portability

Table 1: Modules list

Module 1 interconnection services will require the exchange of the following information at the NNI:

- circuit related signalling information, for the call completion,
- customer related information (calling party number including presentation indicator and redirecting number),
- charging related information (charging information elements, billing identity).

In addition to Module 1 information exchanges, Module 4 carrier selection services will require the exchange of Transit Network Information (to route the call to the selected carrier) and screened calling party number identification.

Module 2 services will require for the completion of some single-ended supplementary services like CCBS, call forwarding or multi-ended supplementary services like call transfer the change of non circuit related signalling information.

Module 1, Module 2 and Module 4 interconnection services can be provided by using non IN network interconnection techniques and standards.

Except for some local portability solutions, Module 3 and Module 5 interconnection services require IN interconnection solutions because these types of services rely fundamentally on the exchange of applications layer.

2.4. Development of Framework

It is recognised that effective management of the technicalities and the regulatory overview of network interconnection will be a significant factor in the implementation of the process. Indeed the study team believes that the development of suitable management and decision making structures, involving in addition to TOs both regulators and industry, is likely to be the main constraint or enabler of fully interworking services.

The focus of this study is the development of a European Framework for telecommunications interconnection. This will be the focus of the final report. However the technical issues and conclusions of this report will form a major input to the final report.

The Framework is not yet completely scoped, but is currently expected to contain:

- a review of the Interconnection Directive scope and content;
- advice to NRAs on the technical goals of interconnection and the migration planning required;
- advice to NRAs, TOs and the CEC on the manpower implications;
- recommendations on standardisation and research activities;
- a proposed structure for managing the Framework's implementation, upkeep and compliance.

3. Conclusions and Recommendations

3.1. Introduction

This section presents the summaries from Part II and Part III detailed analysis. It draws together the conclusions of the technical analysis regarding:

- the technical requirements for TO interconnection arising from specific telecommunications services;
- the direction for regulation of technical aspects;
- structures and approaches necessary;
- further work required, specifically on standardisation and compliance monitoring.

These conclusions has been based on the technical analysis of the relative merits of individual standards and approaches by our team of experts. The views of TOs, regulators and equipment manufacturers (as taken from both in direct discussions and feedback from the Brussels workshop) have been used to provide valid and viable conclusions.

3.2. General Conclusions

The overall conclusions of this technical overview are as follows:

- **Regulation of the new regime must be balanced** to weigh the need to maintain the integrity and development of networks against the operators' and manufacturers' ability to remain competitive and innovative.
- **The interconnection of `basic' networks (primarily PSTN but also ISDN, GSM etc.) does not present a significant technical problem.** The standards position and the experience of nations and TOs with interconnection agreements provides a sound basis for achieving and regulating the interconnection of such networks.
- **The interconnection of newer services based on IN-type remote processing principles is much less well developed.** As a short term solution, interconnection mechanisms based on GSM-type usage of SS7 are proposed. In the longer term there is much more work required on the agreement of suitable application-level standards and products that support them.
- Network integrity may well be threatened during and after the transition to a deregulated regime, both deliberately by unscrupulous service providers and individuals, and accidentally for unforeseen technical reasons. **The development of an effective testing regime is vitally important as are the development of network management standards.**

The nature of the integration of European networks is breaking new ground, and so many problems are likely to lie ahead. Easy answers are not available and it is unclear as to what extend is possible to mitigate potential problems, particularly when the overriding concern of most players is not to over regulate the market. NRAs are likely to be simultaneously asked to rule on many deeply technical points, and asked to limit their regulatory control to avoid constraining market development.

3.3. Service Oriented Regulation

It is important for the competition in a liberalised market that interconnection enables the provision of the same level of voice services between new entrants and the incumbent. As far as the market share of new entrants will not be significant before several years it does not make any sense to provide only supplementary services within their network, especially if they operate long distance networks through the incumbent's local loop. Therefore, the interconnection interface has to be as complete as necessary to achieve at least the continuity of all end to end services offered by the incumbent, in order to avoid discriminatory conditions for the new entrants.

Until now the primary role for interconnection has been the achievement of transparency of call management, end-to-end

across a number of PTO domains. **In the future a service oriented approach is necessary to rule interconnection. But the feasibility of managing the services will be different depending on the service modules**.

For `simple' telephony (Module 1 services) this is technically straightforward, but newer service offerings - specifically those that are based on remote processing capabilities (Module 3 and 5 services) - are more challenging. **Therefore module 1 services could be a mandatory class of services to be provided through interconnected networks** while an advisory approach and more flexible arrangements could be considered for module 2 and 3 services. However for the implementation of module 1 services relevant information from the incumbent need to be available to the other TOs. **A framework from NRA for the provision of adequate interconnection information is required at the national level**.

Technical solutions used for carrier selection (Module 4 services) have very little impact on the interconnection interfaces. The mandatory technical condition is the provision of reliable calling line identification, and charging information at the interconnection interfaces. A code of practice for the provision of calling party and customer billing information at the interconnection should be defined at the national level by NRAs.

As far as supplementary services (Module 2 services) are concerned, the provision of end to end ISDN/GSM supplementary services between interconnected networks should be aligned with the PTO's implementation phases of EURO-ISDN services/GSM services. Precise rules for the introduction of new supplementary services at the interconnection should be achieved at the European level.

Number portability (Module 5 services) represents a strong service requirement of consumers. These could be implemented in a number of ways, which may differ in time to implement, short term efficiency, long term efficiency and long term flexibility. In the long term, UPT is likely to remain the goal of telecommunications service providers. The precise way in which this occurs is unclear at present but is likely to be affected by the nature and provisions of the European Interconnection Framework. **Advice should be given to NRA in how numbers should be allocated and managed.** In particular for emergency calls, the data base access for caller address identification should be independent of the TO or of the local loop provider. The problem to solve is to designate the body in charge of maintaining such a data base taking care of the exact address of customer even if several operators are involved in the number allocation.

The completion of Module 3 services is based on the implementation of Intelligent Network architectures and databases. Even if the interconnection for the provision basic call and voice supplementary service is the first issue between competitive operators, the interconnection of services based on IN will be a major issue in the near future. **Therefore, it is recommended to complete interconnection standards and solutions for IN as soon as possible**.

3.4. Regulation of Technical Aspects

The balance of regulation versus freedom of competition within a European legislative framework as being imperative for the success of the newly deregulated markets. In most countries the framework has been set up so that the NRA acts in a reactive role acting to resolve disputes between PTOs and user groups, and between TOs and other operators.

It is recommended that NRAs ensure that PTO makes available an interconnection services catalogue and precise technical specifications at the NNI in order to provide appropriate information for the new TOs (this information would be expected to vary between PTOs to take into account national contexts).

There is deep concern at the implications of widespread interconnection for the integrity of the European telecommunications network. Care must be exercised in allowing access to network signalling functions to organisations without adequate regulatory control. It will be important to achieve both technical standardisation and operational regulatory control to enable interconnection without integrity fears.

In general, guidance from NRAs for service implementation and operational control will be sought:

- definition of a code of practice for the provision of calling party and customer billing information at the interconnection,
- definition of adequate procedures for ensuring call traceability at the interconnection,
- achievement of precise rules for the introduction of new supplementary services at the interconnection,
- development of an effective testing regime building on and developing the experience of public TOs in interconnecting with new TOs.

3.5. Network Integrity

For non IN network interconnection based on ISUP standards, establishing basic voice services with ISDN supplementary services, the risk is limited as messages exchanged are relatively low and mainly associated with the traffic channel. The risks are rather linked to the dysfunction of equipment. It is possible to take a few simple contingency measures in order to limit the consequences of dysfunction on the integrity of the networks:

- **by restricting the circuits** that can be manipulated from outside the network to those of the interconnection interface.
- **by limiting the level of services provided at the interconnection** interface: only a User Part Sub System is put in place on the interconnection interface.

- **by setting up validation procedures** for equipment supplying interconnection in order to guarantee their good running order.
- In addition to national industry structures for the follow up of network integrity issues and national testing procedures, we recommend to create **at the European level:**
- **an interconnection reference platform** (like the Bellcore approach in the US) in order to prepare test methodology, test suites, conformance testing and qualification testing for ISUP based interconnection,
- **an observatory for QoS and network integrity issues at the interconnection** this organisation will be in charge of the gathering and publishing of country experiences related to network integrity problems and solutions achieved.

In IN inter networking network integrity and security are much more complex issues than for non IN. The stands and operational practises are currently highly underdeveloped. A standardisation process is proposed in section 4.9.

3.6. Management

Management of the networks (including service upgrades) - both nationally and internationally - will be complex to implement and maintain. Individual networks will be managed by the network operators, but management of national and international networks is less clear. At an international level, management could be ruled by a new `super regulator'.

Because of these needs, regulators will - as the incumbent-dominated scenario decays into a multitude of `peer' operators - increasingly get more involved in the technical and operational process of interconnection. The funding arrangements for this will without doubt emerge as complex and various across the European Union, but it will be important that there is a consensus on where, in any Member State, responsibility for specific activities lies.

Already there is a view that certain aspects of telecommunications may be better retained centrally (or decentralised). There is at present a general move towards NRAs acting as numbering authorities, managing the number allocation process and strategy. Implicitly this means driving a national telecommunications service strategy, since issues such as number portability impinge deeply on network structure and TO services. **Operational aspects (such as the testing of new network connections and equipment) will become increasingly relevant. As INs emerge, other aspects of telecommunications - such as the operation of a national customer/number database - may be provided centrally, either directly by the NRA or by a specially licensed Government agency (i.e. not a PTO).**

3.7. Focus on ETSI Standardisation Policy

Until now, ETSI standardisation work has been completed in a restricted environment: service definitions and technical architectures have been designed to be used internally by one network, in a public national network context where the local loop and the long distance networks were operated by the same organisation. As a consequence, the current standardisation work is very much influenced by public operators, and very much oriented towards internal interfaces.

On the other hand, the first priority of new entrants has been related to interconnection charges and infrastructure roll-outs rather than involvement in standardisation bodies which is considered as a costly activity.

The scope and the involved parties in the ETSI standardisation work related to interconnection should be extended:

- **ETSI should involve new entrants in the standardisation process by promoting interconnection** standards and work programmes, by facilitating entry to new TOs, We recommend ETSI to create a new horizontal project related to interconnection. To ensure alignment with competitive environment, inputs to this project could be provided by achieving an ETSI Interconnection Panel involving new entrants.
- **ETSI should refocus on interconnection standards** by introducing new principles in the development of standards for an interconnected environment. For example: the standardisation work for a new service or a new UNI should include the corresponding enhancements and standards at the NNI.
- **NRAs should get involved in ETSI process for service definition** in order to ensure that proposed solutions and standards allow the non discriminatory provision of a service by the competitive Tos.
- In order to get stable standards in a reasonable time frame, **ETSI should avoid to define too many types of interconnection interfaces**. In particular, special access should use existing standardised NNI and UNI interfaces.
- **ETSI should start work items regarding enhancements of existing SS7 standards to network security** and include these aspects in all the future documents and standards. These mechanisms of security and protection in the signalling networks could benefit from those that have been defined by the Internet Community with the **concept of Firewall**.

3.8. Technical Tool Box for Regulating Non IN Network Interconnection

ETSI's standards process which is working towards a standard ISUP is perceived to work effectively, but slowly. Implementation of standards is slowed down by the plethora of N-TUPs available in various member countries, which makes a slowly-evolving formal standards environment acceptable. Generally, new market entrants adopt ETSI standard protocols within their networks. Incumbent PNOs, however, have significant investment in existing signalling system protocols and are reluctant to make immediate changes, because:

- of the massive network upheaval that would be required;
- some of the functionality included in the N-TUPs is not included in ISUP.

In developing new standards, therefore, ETSI needs to be pragmatic in its recommendations. A common partial standard is required defining the lower-level functionality of ISUP to enable the networks to inter-operate. This lower-level functionality should be in place within a reasonable time frame - perhaps two years.

At the European level, we recommend to promote:

- **access network V5 interfaces** for the access to the transmission part of a public voice network at the local loop level,
- **ISUP V1 and V2 standards** for the interconnection of fixed networks,
- **ETS 300 303,** based on ISUP V1 or **ETS 300-646-1**, based on ISUP V2 for GSM to ISDN interconnection.

In case of provision of POI based on national signalling systems mapping functions with ISUP standards should be achieved by the incumbent at least for the basic call and a minimum set of interconnect services (module 1 services).

For the introduction of new supplementary services at the interconnection between two TO networks, we recommend to promote the **EURESCOM approach and test suites for end to end service interoperability**.

In addition to present ISUP standardisation work in ETSI, we recommend ETSI to achieve technical frameworks related to:

- call charging and billing procedures, liability of customer information between interconnected networks. The key points to consider are the following:
  - the capability to provide real time AOC (Advice Of Charge) services for basic call and supplementary services by the transmission of charging information in the signalling messages at the interconnection interface,
  - the provision of call traceability procedures with the transmission of a Originating Network Identification for charging settlement procedures in order to provide unique billing and reliable AOC information to the users,
  - procedures to ensure the confidence in the calling party number received by a TO at a NNI,
  - the provision of additional information elements to calling party number in order to provide a customer billing address.
- **methods for defining a national TO identificatio**n code, and the encoding in Transit Network Selection Information Elements for the provision of carrier selection services:
  - description of the method to define a national TO identification,
  - the national TO identification code should preferably include an identification of the country that issued the identification code,
  - definition of pan–European TO identification codes including an identity code specifying Europe.
- implementation and management of a reference data base for non geographic numbers,
- management of interconnection interfaces, dealing with the following aspects:
  - fault management, procedures for tracking network faults, management of information delivered to interconnected TO,
  - performance/quality of service at the interconnection interface (probability of traffic congestion, provision of alternate paths, continuity of service in the event of link/node failures),
  - end to end performance and quality of service (transmission quality, call path integrity, network congestion, call performance, network availability).

3.9. Development of a Tool Box for IN Network Interconnection

Standardisation work on IN and network management standards is required to allow effective management of single-operator networks, and multi-operator (national, European) networks. A more responsive approach to standardisation is needed for higher layers that allows (for instance) new signalling message types to be developed, agreed upon and implemented on a short time scale, but within a co-ordinated and public plan. Regulators (national and supra-national) need to use this as a mechanism for planning and imposing regulatory deadlines.

IN standardisation and the provision of pan-European advanced services have to be balanced with the need for service differentiation in a very competitive environment. This will be particularly the case for VPN networks and services. To fasten IN interconnection standards, we recommend ETSI to work according to the following approach:

- concentrate on a very limited number of advanced services which need to be provided on a pan-European basis (Freephone) or in the short term (Number Portability),
- provide for these advanced services a common service definition,
- define for each service the interworking procedures and a unique interconnection interface,
- use the same approach as achieved for the definition and the standardisation of roaming services between GSM networks,
- complete a technical framework for charging, accounting and apportionment procedures and interactions on signalling systems in the provision of IN services.

PART II. INTERCONNECTION TO PROVIDE END USER SERVICES

4. Non-IN Network Interconnection

Interconnection of local processing networks requires primarily standards of two kinds:

- at the physical (electrical), data link and network (addressing) levels, using standards such as G.703,
- on exchange of circuit related signalling messages and charging details (the primary focus of ITU-T SS7 in interconnection).

This can be enhanced over time by the addition of specific SS7 information elements such as CLI exchange and non circuit related signalling information for supplementary services.

4.1. Access Network Interconnection

In a multidomain environment access network at the subscriber side may be required by local loop operators, In that case V5 interfaces will allow to easily connect a subscriber to an operator's local loop. The level of functions will be limited to the transmission level and the management of the link.

ETSI uses the term "Access Network" (AN) for the access to the local loop at the transmission level between a local exchange and the user and has standardised V5 interfaces. V5 interfaces are dedicated to interconnection at the transmission level, they do not deal with upper layers, with signalling messages. They allow to easily connect in a standardised way a subscriber to an operator's local loop in order to facilitate competition on fixed local loop.

V5 interfaces are not sufficient for the provision of switched services by a TO, interconnection at the switching/signalling level need to be achieved in addition to the transmission interconnection.

4.2. SS7 Standards for Interconnection

Signalling system No.7 (SS7) aims at providing a common channel signalling for use in circuit switched networks: PSTN, ISDN, CSDN and GSM. SS7 has been primarily defined by ITU-T for its use at the international level. In Europe, ETSI has transposed ITU-T standards to ETSI versions in order to define adaptations to European countries.

Although it is designed for international calls, nothing impedes the use of SS7 at a national level. Therefore it is now widely used in Europe and North America at the national level, while the national coverage of SS7 may vary from one country to another. **TUP and ISUP have been designed first at an international boundary (e.g. between two different networks). Therefore, in principle these standards are appropriate for the interconnections of different operators networks in the same country.**

Figure 3 shows the different SS7 user parts which can be concerned for the interconnection between two networks and can be considered in an interconnection agreement/framework.

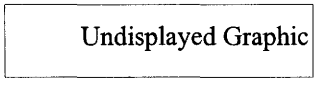


Figure 3: Current SS7 layered model

4.2.1. PSTN to PSTN Interconnection

In order to interconnect two PSTNs, any of the following user parts can be used as interconnection protocol:

- TUP
- TUP+
- ISUP

In this case only the basic voice services (those provided by an PSTN) corresponding to Module1 interconnection services and local number portability can be provided on an end-to-end basis.

4.2.2. PSTN to ISDN Interconnection

In order to interconnect an PSTN to an ISDN, any one of the following user parts can be used as interconnection protocol:

- TUP
- TUP+
- ISUP

Of course, in this case only the basic voice services (those provided by an PSTN) corresponding to Module1 interconnection

services and local number portability can be provided on an end-to-end basis.

4.2.3. ISDN to ISDN Interconnection

In order to interconnect two ISDNs, any one of the following user parts can be used as interconnection protocol:

- TUP (restricted to basic voice services)/Module1 interconnection services),
- TUP+ (to have the ISDN MoU level of services/local number portability and Module1 interconnection services),
- ISUP V1 (to have the ISDN MoU level of services/local number portability and Module 1 interconnection services),
- ISUP V2 (to have the full set of ISDN services/local number portability, Module 1 and Module 3 interconnection services).

4.2.4. GSM to ISDN Interconnection

In order to interconnect a GSM network to an ISDN network, ETSI has defined interworking standards l which are based on ISUP. Two ETSs exist:

- **ETS 300 303 which is based on ISUP V1** and provides the same level of service as ISUP V1 for the interconnection of GSM phase 1 networks to public ISDN (to have the ISDN MoU level of services/Module 1 interconnection services),
- **ETS 300-646-1 which is based on ISUP V2** and can potentially permit the same level of service as ISUP V2 for the interconnection of GSM phase 2 and DCS 1800 networks to ISDN (Module 1 and Module 3 interconnection services). It is worth noting that some of the services supported by ISUP V2 are not provided by GSM phase 2 networks (some are in phase 2+). However, ETS 300 646-1 does not limit the interface to those services supported by GSM phase 2 in order to facilitate the future extensions. In addition, specific services provided on GSM networks such as Call Barring and Advice of Charge do not impact the interconnection interfaces because they are provided locally by the GSM operator.

4.2.5. GSM to GSM Interconnection

In order to interconnect two GSM networks, two aspects need to be addressed:

- (i) the signalling information to handle the mobility between two GSM networks (e.g. roaming),
- (ii) the signalling information to establish calls and provide supplementary services.

For the first aspect the GSM set of standards MAP are designed to handle internetwork roaming services. Regarding the second aspect, either the two GSM networks are connected directly, either they are connected via an ISDN network. In the two cases the GSM to ISDN interworking standards can be used.

4.2.6. PSTN/ISDN Interworking Standards

Some standards defining interworking and gateways are available in ITU-T and ETSI for interworking between ISUP and other SS7 user parts and even some older signalling systems (e.g. R2):

- ITU-T Q.614: interworking of Signalling Systems - Logic procedures for incoming Signalling System No.7 (TUP);
- ITU-T Q.617: interworking of Signalling Systems - Logic procedures for incoming Signalling System No.7 (ISUP);
- ITU-T Q.624: interworking of Signalling Systems - Logic procedures for outgoing Signalling System No.7 (TUP);
- ITU-T Q.627: interworking of Signalling Systems - Logic procedures for outgoing Signalling System No.7 (ISUP);
- ITU-T Q.667: Logical procedures for interworking of signalling system No.7 (TUP) to No.7 (ISUP);
- ITU-T Q.692: Logical procedures for interworking of signalling system No.7 (ISUP) to No.7 (TUP);
- ETS 300 343: Signalling interworking specification for ISDN User part (ISUP) Version 1;
- ETS 300 360: Signalling interworking specification for ISDN User part (ISUP) Version 2;

It is worth noting that the ETSs handle the case for TUP+/ ISUP interworking.

4.3. Continuity of Service Issues at the Interconnection

4.3.1. Service Continuity Requirements

The services that digital telecommunication networks (e.g. ISDN) are able to provide can be divided into four categories:

- Those which are **provided locally** such like CLASS services, where no SS7 signalling needs to be exchanged between the terminating and the originating local exchanges though the interconnection interface.
- Those like CCBS (Call Completion on Busy Subscriber) which impact on the internal SS7 signalling protocol and at the interconnection interface for **processing reasons**. This kind of service requires the exchange of supplementary SS7 signalling messages and information elements between the terminating and the originating local exchanges in addition to the call completion phase. This kind of service implies non circuit related signalling.

- Those like CW and CF (Call Waiting and Call Forwarding) which impact the internal SS7 signalling protocol and the interconnection interface for the **notification of the service** (for example to deliver the indication to called/busy party that a new call is arriving and to inform the calling party that the called is busy and that the Call Waiting feature has been activated).
- **Services requiring end to end transmission of Information Elements** like CLI services (CLIP, CLIR, MCID) and Advice of Charge services which are provided locally by the terminating local exchange but **require the transmission of:**
  - **CLI information** (with the screening and presentation indicators information),
  - **AOC information** elements at the interconnection interface,

because this information is based on data from the originating local exchange or from the long distance carrier.

It is important for the competition in a liberalised market to succeed to have the same level of service provided by new entrants as the dominant operators at least for voice services: basic call, teleservice and supplementary services. **Therefore, the interconnection interface has to be as complete as necessary to achieve at least the continuity of all end to end services offered by the incumbent, in order to avoid discriminatory conditions for the new entrants in the service provision.**

The provision of ISDN services at the interconnection interfaces should be aligned with the implementation phases of EURO-ISDN services (see appendix 1, section 10.3.10.).

In addition, the interconnection interface should also have an inherent capability to support the future evolution towards all the standardised services. Enhancement capabilities should be planned at the interconnection interface in order to allow competitors to offer the same level of standardised service if they want.

On the other hand, in a competitive market operators will try to introduce unique and special features especially intelligent network services to differentiate their offerings from their competitors. In this case service differentiation is in contradiction with the provision of the fully signalling capabilities at the interconnection interface. The provision of these special features at the interconnection interface should be left for commercial negotiation between operators. The major problem with these special features will be the lack of terminal portability between each operator's network. Incumbents will keep the advantage to introduce new services to more users.

In order to limit the proliferation of competitive and inconsistent solutions for new services, it is important that the standardisation be efficient to specify those new services timely to the market.

4.3.2. ISDN Service Interoperability Standards

In order to promote EURO-ISDN service and supplementary services in Europe, PTOs have developed within the EURESCOM project and ETSI Project Team P412 (Methodology and tools for ISDN Network Integration Testing and Traffic Route Testing) a methodology for the testing of end to end ISDN services between two ISDN interconnected with ISUP standards.

This methodology is available and include test suites and test equipment. The EURESCOM approach for end to end service interoperability is the following:

- definition of functional test suites to verify end to end (UNI to UNI) service interoperability,
- definition of monitoring tools based on ISUP protocols for node to node interoperability at the NNI between two ISDN in order to monitor the signalling ISUP messages at the NNI and to provide fault localisation,
- specification of a traffic route testing system for end to end quality of service measurement.

This work is fully completed and available. ETSI deliverables are as follows:

- ETR 193: Network Integration Testing, methodology aspects and test coordination procedures guide,
- ETR 303: Test Synchronisation Protocol,
- TSSS/ TP and ATS to be published.

EURESCOM is now working on the application of this approach to heterogeneous networks: for example for the interoperability of services between a GSM and a ISDN network.

We recommend to promote the EURESCOM approach and test suites to test end to end service interoperability at the interconnection between two TO networks.

4.4. Liability of User Identification at the Interconnection Interface

4.4.1. Calling Party Number

In the case of interconnection of a local loop operator with a long distance operator, reliable calling party number information at the interconnection interface is mandatory because the long distance TO needs to identify the customer that

has issued the call in order to:

- verify if the caller is authorised to ask for a call,
- apply any service or filtering required by the identified customer,
- send relevant AOC information during call if this is required by customer,
- register relevant information in order to be able to establish the bill.

The identification of the customer is made by the **calling party number** information. Care should be taken with ISDN where this number may be provided by the user. **The TO shall be confident in the calling party number received. So this information either should be provided by the local loop provider or shall be screened (verified and passed).**

Some enhancement could be provided at the POI, as for example indication of the account to be billed. But this type of information is not mandatory and may be found in the TO data base using the calling party number.

If the call has been forwarded, the important information is no more the calling party number but the **redirecting number** which contains the number of the party that asked to forward the call to a new number. The user designated by the redirecting number is the one to be billed.

If the called user requests MCID, an **indication to trace the call** should be provided at the interface: it could be the **registration of a call reference** in order to be able to associate later on this reference with the information memorised by each involved TO.

4.4.2. Emergency Calls

Handling of emergency calls is an important requirement for interconnected networks. Emergency calls shall be given priority to ensure the maximum chance of success whatever is the number of TOs involved.

In order for the called emergency service to obtain maximum information for the identification and localisation of the caller CLI should be mandatory for inter-TO emergency calls.

Local number portability could create problems for emergency services to know on which operator the user is really connected. Even if Calling Line Information is received, it will be necessary to request information to all the possible operators to know on which operator the user is really connected. The emergency service shall be able to identify completely the address location of the caller. Today it is quite simple because there only one operator that is concerned with the translation CLI to caller address. It is important for the emergency service to access only one data base for the translation even if the number has been ported to another local loop provider.

The data base access for CLI to caller address conversion purposes should be independent of the TO or of the local loop provider. The problem to solve is to designate the body in charge of maintaining such a data base taking care of the exact address of customer even if several operators are implied in the number allocation.

4.5. AOC/Charging Settlement

Customer billing arrangements and the obligations of each TO with respect to billing services will be critical in an interconnection agreement. As far as SS7 standards are concerned charging aspects and procedures are not specified in the standards and left for specific implementation at a TO's network. For example in ISUP, charging aspects are only related to the provision of Advice of Charge services on the customer interface UNI and on the transport of charging information in the signalling messages.

4.5.1. AOC/UNI

Advice of Charge information (service provided at a UNI) requested by the caller may be a problem for interconnected calls. The caller may request advice of charge during the call or at the end of the call (total cost of the call including the cost of the supplementary services associated to the call):

- **Only the local loop provider can send the AOC information to the caller.** This is because he is the only one to have the knowledge of call reference value used on the link between the user and the local loop.
- If the choice is made to compute the AOC in the local loop exchange**, the local loop operator should receive charging information computed by the interconnected TO** and add its own cost before sending the AOC message to the caller.

It is worth noting that for analogue telephone lines, AOC-E information at end of call may be provided also using for example a V.23 modem. Only the local loop provider who is the last to disconnect the user call will have the capability to send AOC-E.

Additional standardisation work should be completed to ensure that charging information is provided properly at the interconnection for the provision of real time AOC services for basic call and supplementary services.

4.5.2. Charging Settlement/NNI

As far as GSM to PSTN/ISDN interconnection is concerned, each TO is completing call charging on his side: fixed TO charges the calls from fixed to mobile, mobile TO completes call charging from mobile to fixed. When several fixed networks are interconnected and used for handling a call, charging/billing services can be provided by one TO to another.

The provision of unique billing requires **call traceability** in order to ensure reliable identification of networks which have been crossed during a call, especially the **originating network** to which the caller is connected. This requirement will become mandatory with local number portability.

We recommend ETSI to achieve a technical report providing a framework related to call charging and billing procedures on interconnected networks. The key points to consider are the following:

- the capability to provide real time AOC (Advice Of Charge) services for basic call and supplementary services by the transmission of charging information in the signalling messages at the interconnection interface,
- the provision of call traceability procedures with the transmission of a Originating Network Identification for charging settlement procedures in order to provide a unique billing and reliable AOC information to the users.

4.6. Management of the Interconnection Interfaces

ITU-T and ETSI standardisation work on network management TMN (Telecommunications Network Management) should take into account interconnection requirements and specify the TMN management services—and TMN management functions—related to interconnection.

ETSI should work on a technical framework for the management on interconnection dealing with the following aspects:

- Fault management, procedures for tracking network faults, management of information delivered to interconnected TO.
- Performance/quality of service at the interconnection interface (probability of traffic congestion, provision of alternate path, continuity of service in the event of link/node failures).
- End to end performance and quality of service (transmission quality, call path integrity, network congestion, call performance, network availability).

4.7. Signalling Protocols for the Interconnection Interfaces

4.7.1. Relationship between an Internal Signalling Protocol and an Interconnection Protocol

Because of the time to complete standardisation, many European PTOs, such as BT, France Telecom, Deutsche Telecom, have first implemented specific national SS7 versions for their PSTN and ISDN. In order to provide services which were not standardised. these proprietary upgrades have led to national ISDN software versions which are difficult to realign with ETSI/ISUP standards. With the implementation of Euro-ISDN, PTOs are now working on the migration of their national SS7 systems towards ETSI/ISUP compliant signalling systems. But some PTOs already intend to deviate from ISUP.

It is worth noting that the signalling protocol used at an interconnection interface can differ from the signalling protocol used inside a PTO network. However, in order to allow the interworking of end to end supplementary services between two PTO networks it is mandatory to ensure the consistency between the signalling messages, information elements and procedures at the interconnection interface. This consistency requires the mapping between the internal protocol and the interconnection protocol.

When the interconnected networks are operating ISUP internally the situation is easy. However, if the internal protocol of a public network is different from ISUP and based on a national version, which will be the case during some years in most European countries, a mapping function is needed between the existing signalling protocol and ISUP. It is difficult to define a European standard for all the national protocols, this should be defined by each national incumbent under the NRA authority.

Since it relies on specific signalling protocols used by incumbents mapping functions should be achieved by the incumbent. This achievement depends on the willingness of an incumbent to promote end to end service interoperability at the interconnection interface.

However, some interworking cases have already been standardised by ETSI and ITU-T (see 5.3.2.) between ISUP and older signalling protocols. **The mapping of national protocols should comply with the existing interworking standards at least for the basic call and a minimum set of interconnect services.**

4.7.2. Promotion of ISUP as an Interconnection Standard

Most European countries have already their own signalling system which has been derived from TUP or TUP+, however most of these countries are migrating to ISUP (V1 or V2) to support their EURO-ISDN offering. In addition, the latest ETSI

interconnection standards are based on ISUP. Therefore, it appears that ISUP is the best candidate for the interconnection interface between two operator networks.

The provision of ISUP starting from 1998 provides the following advantages:

- ISUP enables the operation of multi-vendors networks, therefore it can facilitate the entry of European manufacturers to provide the new operators,
- Even if there will always be a national specific part (e.g., charging procedure unless inter-operators charging is harmonised then standardised) a whole range of services are already available in stable standards,
- ISUP will enable new operators to be independent from the incumbents and to choose the equipment providers who are the most appropriate for their business,
- as far as ISUP is being permanently enhanced by ITU-T and ETSI to introduce new services (e.g. VPN with ISUP+ to support DSS1+) ISUP guarantees the evolution of telecommunication services which is the contrary with national standards that seem to arrive to a stage where any new additional service needs a lot of effort of specifications and engineering,
- the use of standardised equipment will decrease the price and promote the whole telecommunications market.

However, none of the European countries has a complete coverage of ISUP signalling system in his national network. Therefore, even if the ISUP should be considered as the target solution for interconnection signalling protocols, national protocols will certainly be used during a transition period. The transition period will depend on the investment that the public operators can put to complete the migration towards ISUP. Anyway, it is not realistic that all the networks will entirely be based on ISUP. The national standards will still be operated internally by an incumbent.

What can be completed in a reasonable time scale is the provision of ISUP compliant interfaces at the POI (in that case, it will be mandatory by the incumbent to ensure the interworking of ISUP/ and its national protocol in its network and to provide the competitors the mapping capabilities for the consistency of end to end supplementary services).

The provision of ISUP interconnection interfaces by the incumbent has to be balanced with the number of available POI [POI: Point Of Interconnection] provided to the other TOs. Insufficient number of POI may impact on interconnection charges and the geographic coverage of services available to new TOs. National Regulatory policy should decide if ISUP should be mandatory as interconnection interface starting from 1998 or if national standards can be accepted during a transition period.

At the European level, we recommend to promote:

- ISUP standards for the interconnection of fixed networks,
- ETS 300 303, based on ISUP V1, or ETS 300-646-1, based on ISUP V2 for GSM to ISDN interconnection.

For the introduction of new supplementary services at the interconnection between two TO networks, we recommend to promote the EURESCOM approach and test suites for end to end service interoperability.

The provision of ISDN services at the interconnection interfaces should be aligned with the implementation phases of EURO-ISDN services. This approach is already agreed between public TOs for the provision of international EURO-ISDN services.

4.8. Network Integrity Issues

4.8.1. Introduction

The signalling protocol SS7 has been designed to be used within one national network (under the responsibility of one public operator) or between two national networks operated by non competitive national operators. Most interconnection interfaces were only used at the international level with limited interactions where each operator trusted the other one regarding the integrity of its network. In addition, the number of interconnection points where limited, so very few international gateways were needed to route international calls and PTOs were handling extensive testing before implementing an international connection.

In a liberalised market, the number of interconnection points will be very important and the operators to be interconnected will be competitors. On the other hand, the level of services to interwork between operators is increasing more and more. So the number of signalling messages to exchange at the interconnection boundary will increase constantly the load of the signalling network for call control, management or charging purposes. In such situations it is important to provide appropriate mechanisms to protect the telecommunication networks.

At the origin, SS7 signalling networks and sub-systems have been designed and implemented to be used internally by a unique public operator. By the way, present SS7 protocols do not include any integrity and safety mechanism.

Network integrity characterises the capability of a network to maintain a given level of services in terms of announced performances and functionalities. As far as network interconnection is concerned, network integrity can be characterised in terms of events occurring in a network and provoking degraded performances and degraded services on the interconnected

network. These events can be measured by criteria such as problem duration, number of disturbed subscribers, level of disturbed services (basic call, supplementary services, data bit rate and error rate...).

4.8.2. Risk Levels

The approach to SS7 signalling network integrity can be done following two major interconnection levels:

- first level: the interconnection is implemented to provide call processing (set up, control, and release) between two networks, this is the case for the call completion of a voice call between two fixed networks.
- second level: the interconnection is implemented to provide the cooperation between high layer signalling applications, this is the case for international GSM roaming services, and intelligent network interconnection.

The first level is related to the operation of circuit-related signalling information. The signalling messages are exchanged at a physical POI between two signalling units (SCP) which are directly connected through a digital link: Physical separate signalling data links between the two networks ensure that signalling messages cannot be misdirected

The second level is used for connectionless services, roaming services and non circuit-related signalling traffic operation. The signalling messages and remote requests can access through the POI to any signalling control point (SCP) of the other network. Without specific protection mechanisms, failures can expand very easily in a network.

In addition to interactions between supplementary services, the impacts of connectionless services and non circuit-related signalling traffic on network integrity need to be considered.

The volume of circuit-related signalling offered to any signalling link is limited by the traffic carrying capacity of the related trunk circuits.

At the contrary, there are no traffic circuits to limit the volume of non circuit-related signalling offered to signalling link. The support of mobile communications or ISDN supplementary services such as CCBS, CF makes use of non circuit-related signalling. With IN operation, the use of non circuit-related will increase dramatically. Additional protection mechanims will be necessary to enable the additional signalling to be carried efficiently without affecting the circuit-related signalling traffic for the establishment of switched connections.

4.8.3. Problems Encountered

Interconnection limited to the interworking of a single SS7 sub system has up until today not created any particular problems in European countries

Experiences in the USA and Great Britain, have demonstrated that extensive testing could prevent in general from network integrity problems which were mostly the following:

- Circular routing of messages in the signalling network (mainly due to maintenance activities on routing tables at a TOs),
- Inconsistency in signalling procedures,
- Software errors,
- Divergence in standard interpretation and implementation of protocol specifications,
- Timer values inconsistency,
- Errors in the rebooting procedure following a failure,
- Treating of incorrect messages due to erroneous data,
- Simultaneous breakdown of SS7 signalling transfer points.

4.8.4. Recommended Approach

4.8.4.1. Extensive testing to avoid design/software defects

Implementations of SS7 signalling systems within a network require extensive testing to verify conformance with the specifications and provocative testing to check the performances under various load conditions. The same approach is recommended at interconnection points.

Problems linked to software implementation and standard protocol specifications can be brought under control by installing an adapted testing method.

As far as protocol specification is available at the interconnection interface, the manufacturers of the interconnection material should be in charge of the validation testing and the checking of conformity of their equipment to the requested specifications. After that the two interconnecting operators proceed to test the interoperability of their two systems.

The tests should also examine the robustness of the software system by testing its reactions to the most often occurring errors.

The interconnection interface software should contain a specific mechanism verifying the validity of all information and screens exchanged between the two networks. In addition, this mechanism should manage the flow of signalling traffic as well as control the risk of congestion.

4.8.4.2. Introduction of security mechanisms

There is a need to include mechanisms for security and protection in the signalling protocols SS7. Yet such project should be worked on by a standardisation body like the ETSI or ITU-T.

These mechanisms could benefit from those that have been defined by The Internet Community with the concept of Firewall:

- a very powerful/simple checking algorithm is performed on each received message to determine the origin, the destination and the purpose of the message, in compliance with predefined rules,
- if the checking is OK the message is processed in order to provide the requested service, otherwise the message can be discarded.

Of course this kind of mechanism cannot be used directly for telecommunication networks. It is recommended that the ETSI starts work items regarding this domain to provide the required enhancements to the existing standards, and to include these aspects in all the future documents and standards.

Any TO may invest in its own network protection mechanism. But the introduction of security mechanism at the European level by ETSI standards will be beneficial to the whole European industry and lead to lower prices.

4.8.4.3. Maintenance of signalling routing data

It is important that TOs keep message routing data up-to date to ensure that signalling links are properly used and that circular routing of signalling messages is avoided. Particular care needs to be taken in the assignment of alternative routing to minimise the occurrence of circular routing under link or node failure.

4.8.4.4. Follow-up of network integrity problems by the network management

The systems of management of the signalling network should permit the detection and the follow-up of network integrity problems as well as the determination of causes and their possible corrections. This would help to prove the efficiency and the quality of a network to the interconnected TOs.

4.8.4.5. Network Behaviour

An incumbent should complete the calls transported from interconnected TOs in the same way it completes its own calls. No priority mechanisms should be based on the knowledge a call is coming from another TO. The quality of service of a TO network should be granted on the whole network coverage independently of the POI locations.

4.8.4.6. SS7 Signalling Network Interconnection using ISUP Protocols

MTP and SCCP signalling sub systems have been designed to provide a resilient transport system that will operate correctly under a wide range of conditions including signalling link and node failure. Basic principles and cautions need to be fulfilled:

- the systems are properly tested before being brought into service,
- the network which are interconnected are properly dimensioned,
- routeing data are accurate and up-to-date, and are protected from unauthorised actions within the TO's organisations,
- back-up procedures are used in case of sub-system failure.

For interconnection based on ISUP standards and the associated mode establishing basic voice services with ISDN supplementary services the risk is limited as messages exchanged are relatively low. The risks are rather linked to the dysfunction of equipment.

It is possible to take a few simple contingency measures in order to limit the consequences of dysfunction on the integrity of the networks:

- by limiting the circuits that can be manipulated from outside the network to those of the interconnection interface.
- by limiting the level of services provided at the interconnection interface: only a User Part Sub System is put in place on the interconnection interface.
- by setting up validation procedures for equipment supplying interconnection in order to guarantee their good running order.

5. Intelligent Network Interconnection

5.1. Introduction

Intelligent networks have been designed to enable the easy introduction of new value added services. The IN architecture enables progressive deployment of new services with a minimum modification of the core network because the targeted services are mainly based on software implementations within computers that are interconnected to the telecommunications network. These IN-based value added services can be provided by telecommunications operators or by independent service providers. In the ONP context the most important issue is to provide to these independent service providers the appropriate interfaces with the appropriate signalling protocols to enable harmonised interactions between the services/equipment of the SP and the services/equipment of the telecommunications operators.

Most IN-based services can be totally provided by each operator using its own IN infrastructure within its own network. However, some of these services become much more attractive if it can be provided globally: on a country-wide, Pan-European or world-wide basis (e.g. UPT). In order to ensure the provision of such services at a global level, it is important to interconnect INs from different operators and service providers. The following sections give a description of the most important services based on IN architecture and IN interconnection, and they present a survey of IN standardisation work.

5.2. Services requiring Intelligent Network Interconnection

The number of services that can be offered and provided by an IN infrastructure is not limited. The following services are considered to be of special interest (EC mandate BC-T-305 and ETR 244 which defines a work plan to fulfil the scope of the Commission mandate). It is required the interconnection framework to provide the necessary protocols and mechanisms to ensure:

- the standardisation of five IN services:

  Freephone
  Premium Rate
  Virtual Calling Card
  VPN
  UPT

- the resolution of service interactions and impacts on service differentiation,
- the capability for independent service provider to offer this kind of services,
- the capability to interconnect different INs to increase the coverage area of services,
- the integrity and the security of the IN telecommunication networks and the IN equipment (including short term solutions such as mediation devices or functions),
- the appropriate level of management of the involved equipment,
- probably a scheme or a framework for charging and billing of this kind of services.

ETSI NA (Network Aspects) technical committee has allocated the different work items to sub-committees but **for the moment the ETSI has not yet put out precise specifications**.

5.2.1. Freephone Services

This service enables Freephone service provider to allocate to his subscribers Freephone numbers. The charges for the calls towards this free numbers will be paid by the Freephone subscriber. The Freephone numbers are virtual numbers which do not correspond to a specific physical interface of the network. In order to route the calls towards such a number, the Freephone number needs to be translated to a real number. When the telecommunication network detects that the called number is a free number it stops the normal call processing and sends an enquiry to the predefined Freephone Service Control Point (SCP). The SCP may use a database facility to translate the Freephone number into a real number which is sent back to the requesting switch. At this point the switch achieves the call processing towards the Freephone subscriber.

At the end of the call the network entity which is able to calculate the call charges can inform the Freephone service provider about the cost of the call to be allocated to the Freephone subscriber instead of the caller.

Interconnection is needed when the Freephone service provider wants to enable the users to access the service from another network. At the moment this service is provided by fixed TOs for mobile users who want to access to public network Freephone services, the GSM user is billed for the GSM resources which have been used during the call.

As far as Freephone numbers are allocated separately to different TOs, interconnection for Freephone services can be achieved by using current non-IN interconnection. The major problems to solve are related to charging, accounting and apportionment between the TOs. When portability is provided for Freephone numbers, IN interconnection techniques are required.

5.2.2. Premium Rate Services

The Premium Rate service allows a service subscriber to provide value added services to calling users. The calling users pay a "premium rate" for this call and this revenue is collected by the service provider or the network operator. The generated

revenue is partly transferred to the service subscriber. The Premium Rate numbers may not be real numbers, in which case they need to be translated as for Freephone numbers. In addition, Premium Rate service can be enhanced by almost the same additional features as Freephone numbers.

IN interconnection is needed when the Premium Rate service provider wants to enable the users to access the service from another TO's network. The major problems to solve are related to charging, accounting and apportionment between the TOs, and the procedures to identify and to screen the caller.

5.2.3. Calling Card Services

The Virtual Card Calling (Calling Card) service allows the user's calls to be automatically charged to the service subscriber's account (his company). The user accesses the service by dialling a service access centre, then enters the card number, the PIN and the destination number.

IN interconnection is needed when the Calling Card service provider wants to enable the users to access the service from another TO's network. The same approach as roaming services for GSM users could be used (a kind of fixed terminal roaming).

5.2.4. VPN

VPN is a business oriented service that enables to interconnect PBX as well as simple user installations serving the same company (the subscriber) in order to create the equivalent of private network using the public network facilities.

VPN allows the subscriber to define a private numbering plan for on-net or off-net locations and to have the calls routed correctly. This basic scheme can be enhanced by adding as required one or more of the following features:

- centralised operation, administration and maintenance,
- call screening,
- accounting code,
- speed dialling,
- abbreviated dialling...

Although the VPN service may be offered by a single network, it is generally likely that the service will span multiple networks. In the later case, the VPN participating service providers or operators should interconnect and ensure the necessary inter-networking capabilities in order to provide a consistent end-to-end set of services to end-users.

As far as most VPN services will be implemented in the future on IN architecture, VPN interconnection standards will require IN interconnection standards.

5.2.5. UPT

The UPT (Universal Personal Telecommunication) service enables users to access to telecommunication services while allowing personal mobility. It enables each UPT user to initiate and receive calls on the basis of a unique, personal and universal number. The number is network and terminal independent. With UPT telecommunication can be accessed from any terminal from any networks irrespective of geographical location.

In order to access to a telecommunication service, the UPT user has to perform a registration procedure where he has to provide his identity and to authenticate himself. Registration can be limited to only incoming calls or outgoing or both. The charges for the calls initiated by UPT user and may partially the called towards the UPT number will be charged to UPT bill. The terminal used to access should not be charged at all.

IN interconnection is needed when the UPT service provider wants to enable the users to access the service from another TO's network. The same approach as roaming services for GSM users could be used (a kind of fixed terminal roaming).

5.3. INAP Protocol State of the Art

A telecommunication network with Intelligent Network equipment is a huge distributed system, where switches and computers cooperate using a complex set of protocols called INAP (Intelligent Network Application Protocol).

The standardisation of IN is under development within several organisms. the most important in Europe are ITU-T (study groups XVIII et XI) and ETSI (NA6 and SPS).

Because of the complexity of the specification to be elaborated the standardisation bodies have adopted a phased approach: the work has been divided into Capability Sets (CS):

- CS-1 is almost finished regarding basic architecture which is widely accepted. Some work is still ongoing regarding aspects such like interactions with DSS1 and security. The CS-1 defines the interfaces necessary to introduce IN concepts into one single network. There is no set of services available under CS-1. As a result of the focus on

"internal interfaces" network interworking is very limited in CS-1.

- CS-2 should take into account problems linked to the interconnection of several INs and focus on specific IN services (Cordless Terminal Mobility, Corporate Networks, Global VPN, UPT). The standardisation of management interfaces and interconnection interfaces are planned in CS-2. With the interconnection of INs, problems of security and integrity naturally become a crucial issue. This is therefore a major issue for CS-2 in defining security procedures.

5.4. IN Interconnection Standards

5.4.1. Interconnection of two INs

Different interworking points between two INs have been identified (as shown in Figure 4 below). Taking as an example two networks A and B, here are the possible points of interface:

Interface Point	Network A	Network B
N	SSFa	SCFb
O	SCFa	SCFb
P	SCFa	SDFb
Q	SDFa	SDFb

As a result of the focus on "internal interfaces" IN interworking is very limited in CS-1. For phase 1 (CS-1) and envisaged services, only point P is retained.

The SCF of network A converses with the SDF of network B. It is the service UPT that uses this point of interworking. In effect, while a UPT user of network B links up on a terminal of network A, the SCF of network A has to inform the user's SDF via this point of interface. Likewise, while a subscriber of network C calls this user UPT, the SCF of network C has to consult the SDFa to obtain the number of the user's current terminal. In this case the call will be routed directly from network C to network B.

For phase 2 (CS-2) and envisaged services, the 3 points O, P and Q are retained.

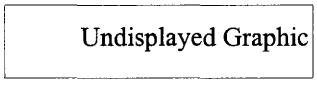


Figure 4: Possible interconnection interfaces between two INs

5.4.2. Service Providers Access to IN

While the UIT-T norms are developed under the aspect of public network and the equipment of an IN belongs to the same operator, it is possible at least in theory that there are different providers of IN services than the operator of the IN itself. These service providers may supply, depending on the service, one or several of the functional entities (SSF, SCF, SDF, SRF) of an IN. The interface between the public network and the equipment of the service provider occurs, according to the specific case as described below:

Network A Function Entity	Service Provider B Network entity	Interface Point
Call Control/CCFa	SSFb, SCFb, SDFb	CCF-SSF (non-defined)
SSFa	SCFb, SDFb	N
SCFa	SDFb	O, P

It is evident that in this kind of link security measures become very important. The integrity, confidentiality and level of service rendered need to remain protected for the public network as well as the supplying thereof.

At present (CS-1, CS2) [Capability Set N• 1 et N• 2, phase 1 and 2 for IN] the CCF and SSF are not separable as the SSF has to be too close to the infrastructure (CCF) to be operated by another supplier.

For CS-1, the link SSF-SCF (N interface) is not usable because considered too risky, Only the link SCF-SDF is possibly usable but is not clear what service can operate it.

For CS-2 the link SCF-SCF (O interface) could be used. Functionally this link could be operated similarly to a SCF-SDF link.

5.4.3. VPN Interconnection

Until now, ETSI work related to VPN has been completed in a very restricted environment: service definition and technical architectures have been designed to be used internally by one network, in a public national network context where the local loop and the long distance network are operated by the same organisation. The current VPN standardisation work has been very influenced by public operators in order to provide VPN services by using ISDN interfaces and IN capabilities (integrated VPN).

Even if entry points to service providers and other VPN have been defined, very little attention has been paid to the various interconnection requirements:

- international VPN,
- opening a VPN to third party SP,
- indirect access to other competitor's VPN,
- interconnection between VPN,
- combined fixed plus mobile VPN services.

No standardisation work has been completed on these aspects.

5.4.4. Integrity / Security Standards for IN

No security mechanism is currently defined for the CS-1. In effect, all IN equipment is for the moment presumed to belong to the operator which means that only the security measures vis-à-vis the users of each service are clearly defined. The security mechanisms for UPT users are on the other hand clearly defined.

The definitions concerning the securisation of interworking links planned for phase 2 (CS-2), permitting the above mentioned supply of services are currently being worked on. ETSI is considering security between customers and between organisations:

- security features for the services (authentication, confidentiality, access control),
- management of network integrity (security of management, fraud management).

At ETSI, this project has been divided into the following two tasks:

- DTR/NA-061201 (technical report) is to thoroughly analyse and identify all risks linked to the IN.
- DE/NA-061202 is to define the security mechanisms to be implemented to protect the network based on the results of the technical report

For the moment the ETSI has not yet put out precise specifications.

5.5. Approach to IN Interconnection

Until now, INAP (CS1 and CS2) has been mainly designed to be used internally by one network. At the moment, most of the standardisation work for IN has been concentrated on internal interfaces and generic procedures for the signalling and the interactions between these internal interfaces. Interconnection of IN will require a lot of standardisation effort and time. Even if some of the standardised interfaces (SCF-SDF) can be used for the interconnection of two INs, some security and integrity aspects needs to be solved to take into account the fact that one operator needs to access the data base of another. In addition, the standardisation technical model do not define clearly the interactions between TOs for IN interconnection.

IN standardisation and the provision of pan-European advanced services has to be balanced with the need for service differentiation in a very competitive environment, This will be particularly the case for VPN networks and services. In a competitive environment, voice telephony services on non IN networks and advanced services on IN networks need to be addressed differently.

Therefore it seems very difficult to standardise in the near future a whole set of advanced services in an interconnected IN environment. Instead of defining generic interconnection interfaces, we recommend ETSI to work the following approach:

- concentrate on a very limited number of advanced services which need to be provided on a pan European basis (Freephone) or in the short term (Special Number Portability),
- provide for these advanced services a common service definition,
- define for each service the interworking procedures and a unique interconnection interface,
- use the same approach as achieved for the definition and the standardisation of roaming services between GSM networks,
- complete a technical framework for charging, accounting and apportionment procedures and interactions on signalling systems in the provision of IN services.

PART III. SPECIAL REQUIREMENTS ARISING FROM COMPETITIVE ENVIRONMENT

6. Equal Access and TO Selection Technical Aspects

TO selection major issues are the following:

- to offer to the users the capability to choose any TO or Service Provider independently of the local loop provider,
- to have a procedure for choosing a TO or Service Provider that does not advantage any of the different providers. This procedure with equality between each operator is called **Equal Access**,
- to guarantee technical compatibility and interoperability between the user's terminal and the provider's network. This includes terminal equipment and intermediate systems which are crossed for the end-to-end communication path such as PBX and the TO's to Provider interconnection interface.

TO selection and Equal Access can be provided either by the incumbent or by all licensed TOs. To facilitate new local loop TOs entry on the market, it could be decided to allow them not to provide Equal Access and carrier selection. This could allow them to get better arrangements with long distance TO. This allowance should be given by the NRA during a restricted time duration.

6.1. Technical Issues

Most telephone subscribers are connected to only one local loop that is generally provided by the incumbent for historical reasons. The caller may wish to choose a specific TO for long distant or international calls in order to take advantage of this TO's offer. TO selection means the capability given to a user to select the TO he wants to use for its long distance or international call.

TO selection implies technical points:

1) the user needs to indicate to the local loop provider that he wants his long distance call be conveyed by a TO that is not the local loop provider,

2) if several long distance TOs are offered, the caller needs to indicate his TO choice to the local loop provider,

3) the TO that is chosen by the caller has to find the identity of the account to bill. The account may be the one related to the interface from where the caller is making the call or a more general account for a company; In any case the TO that will establish the bill needs to be ensured of the identity of the caller in order to prevent billing errors.

6.2. Methods for specifying the TO

There are several ways to provide Equal Access in TO selection:

a) Choice of TO by subscription which is named **preselection**. The caller indicates to the local loop provider the identity of the long distance TO he wants to use for long distance calls. The information is stored in the local exchange associated to each subscriber line.

b) Choice of TO by dialling a **prefix code** before the called number.

If all Operators prefix codes use the same number of digits, Equal Access is provided.

c) For ISDN terminals choice of TO can be made by using the **"Transit Network Selection"** information element that is defined in ETSI ETS 300 403 (ISDN DSS1 for circuit-mode basic call control).

6.2.1. Choosing a TO by Preselection

Preselection consists in registering in the local exchange the choice that the user has made in advance for selecting a TO. Preselection eliminates the need for customers to dial a code ahead of the required number. Calls are automatically routed to the preferred TO.

If several TO identifications can be stored for each subscriber, it is also necessary to provide a mean for choosing or a rule to exploit the different choices that are offered.

For example it may be considered to have a preselected choice for national long distance calls and another preselected choice for international calls. It may be also considered to have a TO choice depending on hour of day, or day of the week. For international calls, there could be different preselection according to the country or continent to be reached.

This different aspects do not impose special technical constraints on interconnection interfaces, **but impose technical requirements on local loop exchanges**. The memory for preselection would preferably be of **several numbers** to deal with future more open services.

6.2.1.1. Over-ride code

As preselection is a choice made in advance, it seems also necessary to provide means to change the choice on a call by call basis. Therefore it is necessary to provide a mechanism to override the registered choice. This is often provided by entering an **over-ride code**. The over-ride code allows the user not to be restricted to only one TO. Equal Access will be reinforced if over-ride code is available for each TO.

There is no special impact of an over-ride code on interconnection interfaces. The only impact is on the local loop exchange which should be able to analyse such codes even when it provides preselection.

6.2.1.2. Barring of over-ride code

A customer who has indicated to the local loop provider the TO he wants as preselected choice may also want to forbid any use of over-ride code. This type of restriction could be mandatory for companies which have made a contract we a TO and want a full respect of contract by employees.

Impact of this requirement is only on the local exchange capabilities. The local exchange should have the capability to register the preselected choice and also to register that override capability is forbidden (barred).

6.2.2. Choosing a TO by a Code

Equal Access to other TO using a prefix to designate the TO means that the prefixes have the same number of digits for each TO. The number of digits used to designate the TO only impacts on the terminal capability.

6.2.2.1. Impact on the interconnection interface

There is no real impact on the interconnection interface, but the provision of calling party number information for the customer identification. In order to ensure the consistency and the liability of the information, at the NNI, the calling party number should be provided by the local loop TO and screened.

There could be an impact if the TO chosen by the caller is not directly connected to the operator providing the local loop but this case seems not very relevant in term of cost. A local loop provider that wants to offer a choice for long distance TO will prefer to have a direct interface with the TOs to avoid to pay for the call through the incumbent.

6.2.2.2. Impact on the terminals

The terminal used by the caller should have the capability to send all the digits required for the choice of TO: prefix plus called number.

If we attempt to determine the number of digits necessary for a call we may find:

- PBX prefix to join public network = 1 or 2 digits,
- international prefix = 2 digits (00 according to ITU-T recommendation),
- called number = up to 15 digits according to the new ITU-T E.164 recommendation,

This gives up to 19 digits for an international call made by a terminal behind a PBX.

If the user also wants to select a long distance TO, he has to provide the code for TO selection. If the code is more than one digit, the called number becomes more than 20 digits long and the ISDN terminal of the user has to use the **overlap sending method** because ETSI protocols allow only a 20 digits long called party number. The Called Party Number information element is 23 octets long in ETS 300 403 and 3 octets are reserved for the header. So it remains 20 octets for digits with one digit by octet. The problem is that a lot of ISDN terminals used for data exchange (PCs, routers, etc.) have implemented only the en-bloc method of sending digits in a set up message and they do not allow to enter more than the 20 digits allowed in the ETSI recommendation.

6.2.2.3. ISDN Transit Network Selection

The purpose of the Transit Network Selection information element provided in ISDN Signalling messages is to identify the requested transit network. ISDN signalling authorises to repeat the information element in order to select a sequence of transit networks through which a call must pass. The number of authorised repetition is network dependent. Today it seems that no terminal has implemented this information element. No terminal seems to have a man machine interface that allows a user to specify the TO he wants to use.

There is a capability in the Transit Network Selection Information Element to specify TO identity on a national or international identification plan. **ETSI ETS 300 403 indicates that for national identification plan the TO is coded according to national specifications**.

A clear description of the method to define a national TO identification code should be provided by ETSI. The national

TO identification code should preferably include an identification of the country that issued the identification code. As there will exist several pan-European networks ETSI may have to define pan-European (international) TO identification codes. These codes should have an identity which should clearly start with a code specifying Europe. No such code is today provided by ITU where international codes are always designing a nation.

As far as this Information Element is transmitted at the interconnection within signalling messages, there is no specific problem at the interconnection interface, because the Transit network information element used in ISUP has the same format as the one used in ISDN.

7. Number Portability

7.1. Number Portability Services

Number portability embraces many services and many technical solutions. A first identification of the different types of number portability can be proposed as the following:

1) **local or geographic number portability** to allow a user to keep his phone number when changing his network operator, at the condition he will not move and change his location;

2) **non geographic number portability** allowing a user to keep his number when changing his location and his network operator;

3) **special number portability** (for freephone numbers, premium services, share cost services.) between several network operators;

4) **mobile number portability** between GSM, DCS, AMPS networks or paging service networks,

5) **UPT service** (Universal Personal Telecommunication) which aims at allocating a number to a person rather than at a physical user interface on a local exchange. The UPT user is in position to handle a call on any terminal as far as he has been authentified. UPT between different networks require specific arrangements and database interconnection between network operators;

6) **number portability between fixed and mobile networks** which will become a requirement in the future with combined fixed plus mobile service offerings.

7.1.1. Implementation of Number Portability Services

Technical implementations and solutions will depend on the type of portability to cover. It will also depend on the planned schedule:

- **short term solutions** are already available for local portability. They rely on **call forwarding techniques**. These solutions present a major drawback: they don't optimise network resources. These solution are relevant for a limited percentage of users (about 10% of subscribers attached to a local exchange) because local exchanges have limited capabilities to forward users calls, and they waste a lot of numbering capacities,
- **long term solutions** rely in IN architectures and **interconnection of IN databases** between the different network operators (SDF "Service Data Function" entities). Because of the lack of interface standardisation in IN, interworking of distributed databases in a multiTO environment will result in specific developments. In addition they may cause network integrity problems.

IN solutions are relevant for all types of number portability, but can be based on different technical options. As an example allocation and management of Freephone numbers can be achieved following the two ways:

- by allocating shortages of number par TO or service provider. Each shortage of number is managed by the TO database.
- by sharing a common reference database.

In addition, the use of a common reference database for the portability of intelligent service numbers can use a wide range of implementation options in between the following two opposite approaches (see Figure 5):

- approach 1: data updating between a network operator data base and the reference data base is processed off line periodically using file transfer mode. This solution limits integrity problems and interactions between the network operators databases, but problems may occur about information inconsistency between the two operators.
- approach 2: data updating between the reference data base and the network operators databases is made on a real time and a call by call basis. This avoids inconsistencies of information between the data bases but introduces a lot of network integrity problems and protection procedures.

Undisplayed Graphic

Figure 5: Reference database implementations for number portability

7.1.2. Standards for Number Portability

ETSI-NA2 (Network Aspect) technical committee has decided in April 96 that the numbering issues were needing specific efforts and project teams, therefore the work has been allocated into work packages and work items whose:

- Number portability for Pan European Services (DTR/NA-0211409) and Number Portability studies (DTR/NA-021111),
- Routing calls using a Pan European Numbering Scheme (DTR/NA-021410),
- Scenarios for the creation of a European Telephony Numbering Space (DTR/NA-021404, 021407),
- Evolutionary aspects of numbering and addressing (DTR/NA-021112).

In addition ECTRA/ETO [ECTRA: European Committee on Telecommunications Regulatory Affairs/ ETO European Telecommunications Office] has ordered the following work "Numbering related to the implementation of UPT [UPT: Universal Personal Terminal] in Europe including the creation of ETNS [ETNS: European Telephony Numbering Space] and the problem of PCN numbering and portability". This work covers UPT and PCN [PCN Personal Communication Network] aspects only.

At the moment no standardisation work in ETSI has been completed on Number Portability, In addition it seems that the solutions under consideration are based on UPT services which limits the scope of portability services and do not take into account short term solutions and current non IN networks.

PART IV. APPENDICES

8. Access Network Interconnection

ETSI uses the term "Access Network" (AN) for the access to the local loop at the transmission level between a local exchange and the user.

The work on a new V interface was initiated by a request from the ETSI Technical Assembly (TA) to technical Committee Network Aspects (TC NA), in particular sub-Technical Committee (STC) NA4 to consider, in cooperation with other STCs involved, possible new structures and interfaces for the connection of new access arrangements to local exchanges. The work has been completed in 1994.

TC SPS identified two interface concepts:

- V5.1 is a 2Mbits/s interface based on a static multiplexer principle, intended for AN supporting PSTN, ISDN basic rate users,
- V5.2 is a multiple 2 Mbits/s interface based on a dynamic concentrator type, intended for AN supporting ISDN primary rate users. The overall concept is such that an evolution from V5.1 to V5.2.is possible.

The document first part of ETS 300 324 specifies the electrical, physical, procedural and protocol requirements for V5.1 interface between an Access Network (AN) and the Local Exchange (LE) for the support of the following access types:

- analogue telephone access,
- ISDN basic access with a NT1 separated from the AN,
- ISDN basic access with a user network interface at the user side of the AN (T reference point),
- other analogue or digital access for semi-permanent connections without associated outband signalling information.

The V5.1 interface provides the functional capability:

- bi-directional transmission of B-channels,
- bi-directional transmission of ISDN-D channel,
- bi-directional transmission for signalling information of PSTN user ports,
- control of user ports,
- control of 2048 kbit/s link,
- control of layer 2 link
- transmission of the necessary timing information for synchronisation.

A complementary ETS specifies interface V5.2 which is based on the V5.1 interface. Interface V5.1 is upgradable to interface V5.2.

For the two interfaces definition, protocol implementation conformance statement, test suite and test purposes have been defined.

The following set of standards relating to the V5 concept has been produced:

- ETS 300 324-1 to 9:V interfaces at the digital Local Exchange (LE) V5.1 interface for the support of Access Network (AN),
- ETS 300 347-1 to 9 V interfaces at the digital Local Exchange (LE) V5.2 interface for the support of Access Network (AN),
- ETS 300 376-1 Q3 interface at the Access Network (AN) for configuration management of V5 interfaces.

9. SS7 Signalling Systems State of the Art

9.1. Principles

Signalling system No.7 (SS7) aims at providing a common channel signalling for use in circuit switched networks: PSTN, ISDN, CSDN and GSM. Signalling information is carried in separate channels from voice or data circuits. A signalling channel is common to several voice or data circuits and carries the signalling information for those circuits.

SS7 is primarily defined by ITU-T for its use at the international level. In Europe, ETSI has transposed ITU-T standards to ETSI versions in order to define adaptations to European countries. Although it is designed for international calls, nothing impedes the use of SS7 at national level. Therefore it is now widely used in Europe and North America at the national level, while the national coverage of SS7 may vary from one country to another. The development of SS7 is clearly linked to the digitalisation of telecommunications switches. It is a necessary feature for the provision of nation-wide ISDN bearer services and supplementary services.

9.2. SS7 Protocol Architecture

SS7 is structured according to a layered model similar to OSI. Initially, four layers were defined for SS7 (see Figure 6 below), with:

- user parts at layer 4;
- signalling network at layer 3;
- signalling link at layer 2;
- signalling data link at layer 1.

Layers 1, 2 and 3 are known as the Message Transfer Part (MTP).

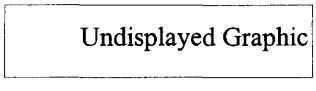


Figure 6: Layered structure of SS7

Initially, the main effort was devoted to the design of the Telephony User Part (TUP) which defines the formats and procedures to be used to establish, monitor and release a voice telephone call through the PSTN. The protocols used were connection oriented with a relationship between the call and the use of a circuit in the network. The first version of SS7 included a Data User Part (DUP) and a very preliminary version of the ISDN User Part.

After the initial specification, SS7 has evolved due to five major factors:

- the need for common channel signalling system for ISDN and associated supplementary services;
- the need for common channel signalling system for mobile networks;
- the need to transfer non-circuit associated information;
- the need for operation and management functionality;
- use of SS7 in Intelligent Networks.

For these reasons, the first model has been extended with (see Figure 7):

- the Signalling Connection Control Part (SCCP);
- a complete ISDN User Part (ISUP);
- the Mobile Application Part (MAP);
- the Intelligent Network Application Part (INAP);
- the Transaction Capabilities Application Part (TCAP);
- the Intermediate Service Part (ISP);
- the Operation and Maintenance Administration Part (OMAP).

Undisplayed Graphic

Figure 7: Current SS7 model

- SCCP has been introduced to provide a service compatible with OSI network service. SCCP should be viewed as an extension of MTP to support connection oriented and connectionless mode for network service.
- ISUP is the part defining formats and procedures signalling for purposes of ISDN calls for basic and supplementary services. Early versions of ISUP were based on MTP while the latest use both MTP and SCCP.
- MAP is designed for mobile applications and INAP for intelligent network applications.
- TCAP belongs to the application layer of OSI model and includes ISP. ISP provides OSI connection oriented presentation service to TCAP. It corresponds to layers 4 to 6 of OSI model.
- OMAP is an application designed for operation and maintenance of the SS7 network.

9.3. SS7 Standards State of the Art

9.3.1. MTP

The Message Transfer Part is defined in the ITU-T recommendations Q701-Q708. MTP has been standardised by CEPT with recommendation T/S 43-01. However, T/S 43-01 is not strictly conformant to Q.701 and has not been updated since then. T/S 43-01 has been used for early implementations of ISDN and/or GSM.

The message Transfer Part is defined in the following ITU-T recommendations:

- Q.701: Functional description of the message transfer part of SS7;
- Q.702: Signalling data link (layer 1);
- Q.703: Signalling Link (layer 2);
- Q.704: Signalling network functions and messages;
- Q.705: Signalling network structure;
- Q.706: Message transfer part signalling performance;
- Q.707: Testing and maintenance;
- Q.708: Numbering of international signalling point codes;
- Q.710: Simplified version of MTP applicable to small systems.

ETSI has standardised MTP on the basis of the ITU-T recommendations with a few exceptions listed in ETS 300 008 (amended in 1993). ETS 300 008 is fully approved by ETSI members.

9.3.2. SCCP

The SCCP is described in the following ITU-T recommendations:

- Q.711: Functional Description of the signalling connection control part;
- Q.712: Definition and function of SCCP messages;
- Q.713: SCCP formats and codes;
- Q.714: Signalling connection control part procedures;
- Q.716: Signalling connection control part performances.

SCCP was standardised by ETSI based on ITU-T recommendations with a few modifications listed in ETS 300 009 (amended in 1993). ETS 300 009 is fully approved by ETSI members.

9.3.3. TCAP

TCAP is a new part of Signalling System No.7 to be used by applications (in the OSI sense), e.g. OMAP. TCAP is defined in the following ITU-T recommendations:

- Q.771: Functional Description of the TCAP;
- Q.772: Definition of information elements of the TCAP;
- Q.773: TCAP formats and codes;
- Q.774: TCAP procedures;
- Q.775: Guidelines for use of the TCAP.

ETSI has standardised TCAP in ETS 300 287: TCAP version 2.

9.3.4. TUP

The Telephony User Part (TUP) describes the functions of the SS7 for use in an international telephone network (PSTN).

National and international versions of the TUP have been implemented for several years now.

TUP is defined in the following ITU-T recommendations:

- Q.721: Functional Description of the Telephone User Part;
- Q.722: General function of messages and signals;
- Q.723: TUP formats and codes;
- Q.724: TUP signalling procedures;

TUP supports basic call functions. In addition, a few services are available such as:

- calling line identity;
- closed user group;
- malicious call tracing;
- charging information.

However, TUP has not been designed to support the supplementary services defined in ISDN (Table 2 below):

Bearer Services	Teleservices	ISDN supplementary services
64 Kbit/s unrestricted Speech 3.1 khz audio	Telephony 3.1 khz	None

Table 2: TUP services

TUP implicitly supports **telephony** teleservices and the equivalent of **speech or 3.1 khz audio** (non digital path) and **64 kbit/s unrestricted** (digital path) bearer services.

Many national versions of SS7 have been derived from this international TUP. The modifications on the international TUP are all different and generally result in a different implementation from the international standard.

9.3.5. TUP+

The CEPT recommendation which defines TUP+ is T/S 43-02 E (1988): Signalling System Telephone User Part "Plus".

TUP+ is a modification of TUP to support the ISDN services included in Stage 1 of ISDN MoU. The services provided are shown in Table 3 below:

Bearer Services	Teleservices	ISDN Supplementary Services
64 kbit/s unrestricted Speech 3.1 khz audio	Telephony 3.1 khz Telephony 7 khz audioconferencing Teletex basic and mixed mode Telefax Group 4 VideoTex Telefax Group 2/3	Calling Line Identification Presentation/Restriction (CLIP/CLIR) Closed User Group (CUG) Subaddressing (SUB) User-to-User Signalling 1 implicit (UUS1)

Table 3: TUP+ services

Direct Dialling In (DDI) and Multiple Subscriber Number (MSN) do not have any significance at an international interface between two networks. Terminal Portability (TP) is implicitly supported.

9.3.6. ISUP

ISUP was developed for the support of ISDN bearer services, teleservices and supplementary services. ITU-T published the first version of ISUP in the red book. However, ISUP has been modified slightly since then and the following versions are not compatible with the early red book version.

The following ITU-T recommendations define the ISUP:

- Q.761: Functional description of the ISDN user part;
- Q.762: General function of messages and signals;
- Q.763: Formats and codes;
- Q.764: Signalling procedures.

This set of recommendations describes basic call procedures and information about messages, parameters and indicators. The supplementary services are defined in:

- Q.730: ISDN supplementary services;
- Q.731: Description of stage 3 for line identification supplementary services using SS7;
- Q.732: Description of stage 3 for presentation supplementary services using SS7;
- Q.733: Description of stage 3 for call completion supplementary services using SS7;
- Q.734: Description of stage 3 for third parties supplementary services using SS7;
- Q.735: Description of stage 3 for community of interest supplementary services using SS7;
- Q.737: Description of stage 3 for information transfer supplementary services using SS7.

In ETSI, there are 2 stable versions of ISUP: version 1 and version 2.

9.3.7. ISUP Version 1

ISUP version 1 is based on Q.767 (1991). ETS 300 121 refers to Q.767 without any modification. ETS 300 121 has been adopted.

- Q.767: Application of the ISUP of SS7 for international ISDN connections;
- ETS 300 121: Application of the ISUP of SS7 for international ISDN connections (ISUP version 1).

ISUP version 1 is intended to be applied between 2 international exchanges and supports the following services:

Bearer Services	Teleservices	ISDN Supplementary Services
64 kbit/s unrestricted	Telephony	Calling Line Identification Presentation/Restriction (CLIP/CLIR)
Speech	Teletex	
3.1 khz audio	Telefax Group 4	Connected Line Identification Presentation/Restriction (COLP/COLR)
	Mixed mode	
	VideoTex	Closed User Group (CUG)
	Telefax Group 2/3	User-to-user Signalling service 1 implicit (UUS 1 [During Call Setup and Call Release phase] implicit)

Table 4: ISUP version 1 services

Direct Dialling In (DDI) and Multiple Subscriber Number (MSN) do not have any significance for an international interface because they are provided locally. Subaddressing (SUB) and Terminal Portability (TP) are implicitly supported.

Interworking between the ISUP version 1 and the TUP is supported for the following services:

- telephony;
- voice band data;
- digital connectivity.

ISUP version 1 corresponds to stage 1 and stage 2 of ETSI ISDN service definitions.

9.3.8. ISUP Version 2

Based on the latest versions of the ITU-T recommendations, ETSI has developed standards for the definition of **ISUP version 2**. The 1993 versions of Q.761, Q.762, Q.763, Q.764 and Q.730 are used. The ETSI standard is ETS 300 356. This standard is chosen to be adopted by ETSI members. ISUP version 2 is now available as a commercial product. It is made of 19 parts:

- ETS 300 356 - Part 1: ISUP version 2 for the international interface, Part 1: Basic services;
- ETS 300 356 - Part 2: ISDN supplementary services;
- ETS 300 356 - Part 3: Calling Line Identification Presentation;
- ETS 300 356 - Part 4: Calling Line Identification Restriction;
- ETS 300 356 - Part 5: Connected Line Identification Presentation;
- ETS 300 356 - Part 6: Connected Line Identification Restriction;
- ETS 300 356 - Part 7: Terminal Portability;
- ETS 300 356 - Part 8: User-to-User Signalling;
- ETS 300 356 - Part 9: Closed User Group;
- ETS 300 356 - Part 10: Subaddress;
- ETS 300 356 - Part 11: Malicious Call Identification;
- ETS 300 356 - Part 12: Conference Call, add-on;
- ETS 300 356 - Part 13: Freephone;
- ETS 300 356 - Part 14: Explicit Call Transfer;
- ETS 300 356 - Part 15: Call Diversion (CFU, CFNR, CFB, CD);
- ETS 300 356 - Part 16: Call Hold;
- ETS 300 356 - Part 17: Call Waiting;
- ETS 300 356 - Part 18: Completion of Calls to Busy Subscriber;
- ETS 300 356 - Part 19: Three party.

Table 5 shows the services provided by ISUP version 2:

Bearer Services	Teleservices	ISDN Supplementary Services
Speech	Telephony 3.1 khz	Calling Line Identification Presentation/Restriction (CLIP/CLIR)
64 kbit/s unrestricted	Telephony 7 khz audioconferencing	Connected Line Identification Presentation/Restriction (COLP/COLR)
3.1 khz audio	Teletex basic and mixed mode	Malicious Call Identification (MCI)
64 kbit/s unrestricted preferred	Telefax Group	Multiple Subscriber Number (MSN)
2 x 64 kbit/s unrestricted	Teletex basic and processable mode	Direct Dialling In (DDI)
384 kbit/s unrestricted	Teletex basic mode	Subaddressing (SUB)
1,536 kbit/s unrestricted	VideoTex	Explicit Call Transfer (ECT)
1,920 kbit/s unrestricted	Telefax Group 2/3	Call Forwarding Busy (CFB)
	Videotelephony	Call Forwarding No Reply (CFNR)
	OSI applications MHS	Call Forwarding Unconditional (CFU)
	Euro File Transfer	Call Deflection (CD)
		Call Hold (CH)
		Call Waiting (CW)
		Completion of Calls to Busy Subscribers (CCBS)
		Terminal Portability (TP)
		Conference call, add-on (CONF)
		Three Party Service (3PTY)
		Closed User Group (CUG)
		Freephone (FPH)
		User-to-user Signalling (UUS)

Table 5: ISUP version 2 services

ISUP version 2 ensures backward compatibility with ISUP version 1 and with ISUP procedures compliant with the blue book (1988). In addition to the standards defining formats and procedures of SS7, test specifications are available:

- ITU-T Q.780: SS7 test specification;
- ITU-T Q.781: Test specification for level 2 of the MTP;
- ITU-T Q.782: Test specification for level 3 of the MTP;
- ITU-T Q.783: TUP test specification;
- ITU-T Q.784: ISUP basic call test specification;
- ITU-T Q.785: ISUP protocol test specification for supplementary services;
- ITU-T Q.786: SCCP test specification;
- ITU-T Q.787: TCAP test specification.

It is worth noting that the same kind of test specification standards are under development at ETSI.

9.3.9. ISUP Version 3

In the ETSI sub-technical committee SPS 1 held in Copenhagen in June 1996, the plenary meeting underlined the need to produce a set of standards for ETSI ISUP V3. This set will be based on ITU-T recommendations for ISUP 97. **The ETSI ISUP V3 will include the SS7 application transport mechanism for the support of integrated VPN, CTM (Cordless Terminal Mobility) and ISDN /IN CS-2 interactions as well as the CCNR (Call Completion on No Reply) supplementary service**. The STC approval date was agreed to be Spring 1997 at last.

In addition, the ETSI ISUP V3 will include interworking aspects with existing signalling systems like SS5, R2, TUP and DSS1.

9.3.10. EURO-ISDN Implementation Timetable

The timetable for the implementation of EURO-ISDN services between public operators is indicated in the table 6:

□ Phase 2 Services corresponds mainly to basic ISUP-V1 services

Bearer Services	Teleservices	ISDN Supplementary Services
64 kbit/s unrestricted	Telephony	Calling Line Identification Presentation/Restriction (CLIP/CLIR)
Speech	Teletex	
3.1 khz audio	Telefax Group 4	Multiple Subscriber Number (MSN)
	Mixed mode	
	VideoTex	Direct Dialling In (DDI)
	Telefax Group 2/3	

□ Phase 2 Services corresponds to the complete set of ISUP-V1 services and supplementary services

Bearer Services	Teleservices	ISDN Supplementary Services
64 kbit/s unrestricted	Telephony	Calling Line Identification Presentation/Restriction (CLIP/CLIR)
Speech	Teletex	
3.1 khz audio	Telefax Group 4	Connected Line Identification Presentation/Restriction (COLP/COLR)
	Mixed mode	
	VideoTex	Multiple Subscriber Number (MSN)
	Telefax Group 2/3	
		Direct Dialling In (DDI)
		Closed User Group (CUG)
		User-to-user Signalling

□ Phase 3 Services corresponds to ISUP-V2 services

Bearer Services	Teleservices	ISDN Supplementary Services
Speech	Telephony 3.1 khz	Calling Line Identification Presentation/Restriction (CLIP/CLIR)
64 kbit/s unrestricted	Telephony 7 khz audioconferencing	Connected Line Identification Presentation/Restriction (COLP/COLR)
3.1 khz audio	Teletex basic and mixed mode	Malicious Call Identification (MCI)
64 kbit/s unrestricted preferred	Telefax Group 4	Multiple Subscriber Number (MSN)
2 x 64 kbit/s unrestricted	Teletex basic and processable mode	Direct Dialling In (DDI)
384 kbit/s unrestricted	Teletex basic mode	Subaddressing (SUB)
1,536 kbit/s unrestricted	VideoTex	Explicit Call Transfer (ECT)
1,920 kbit/s unrestricted	Telefax Group 2/3	Call Forwarding Busy (CFB)
	Videotelephony	Call Forwarding No Reply (CFNR)
	OSI applications	Call Forwarding Unconditional (CFU)
	MHS	Call Deflection (CD)
	Euro File Transfer	Call Hold (CH)
		Call Waiting (CW)
		Completion of Calls to Busy Subscribers (CCBS)
		Terminal Portability (TP)
		Conference call, add-on (CONF)
		Three Party Service (3PTY)
		Closed User Group (CUG)
		Freephone (FPH)
		User-to-user Signalling (UUS)

Table 6: EURO-ISDN Service implementation milestones

9.4. Intelligent Network Architecture

Figure 8 shows the most important functional entities used in an Intelligent network.

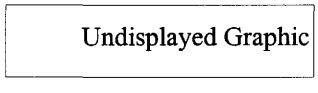


Figure 8: Intelligent Network functional architecture

CCF "Call Control Function". The CCF is the call control function in the network that provides call/service processing and control.

SSF "Service Switching Function". The SSF is the service switching function which, associated with the CCF, provides the

set of functions required for interaction between the CCF and a SCF.

SCF "Service Control Function". The SCF is a function that commands call control functions in the processing of IN service request.

SDF "Service Data Function". The SDF contains customer and network data for real time access by the SCF in the execution of IN services.

SRF "Specialised Resources Function". The SRF provides the specialized resources required for the execution of IN services (voice announcements, digit receivers...).

SMF "Service Management Function" This function allows deployment and provision of IN services and allows the support of ongoing operation.

SCEF "Service Creation Environment Function" This function allows services provided in IN to be defined, developed, tested and put into SMF.

SMAF "Service Management Access Function" This function provides an interface between service managers and the SMF.

9.5. ETSI VPN Conceptual Framework

The ETSI VPN Task Group has been working since 93-94 and has published some technical reports to describe VPN scenarios and architectures. This report is very complex. It contains an extensive description of the services, the requirements and the different architectures of a VPN (see Figure 9).

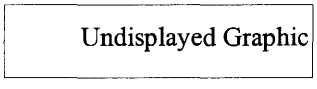


Figure 9: VPN service entry points and interconnection points

Several service entry points corresponding to network interconnection points have been defined:

1) UNI:

- **"a1" service entry point** corresponding to a dedicated user access to a public VPN. At a1 entry point only VPN services can be used which are predefined and permanently available.
- **"a2" service entry point** corresponding to a registered user access to a public VPN. The user is registered to use VPN services through a public PSTN/ISDN indirect access. At a2 entry point users can use either the pre-defined set of VPN end-user services, or the public network services. It is necessary in this case to provide a procedure to swap between the two modes.
- **"a3" service entry point** corresponding to a non-registered user access to a public VPN. The user access the VPN through public PSTN/ISDN indirect access with a specific identification and authentication procedure. Otherwise, a3 is a normal public PSTN/ISDN network interface.
- **"b" service entry point** corresponding to the connection of private networks and PBX to VPN for the provision/support of services to its end-users. Two type of PBX are considered:
  - type 1 PBX (generally small PBX) which support only public ISDN or PSTN services.
  - type 2 PBX (generally Medium and large PBX) which support both public ISDN or PSTN services and VPN services.
- **"d" service entry point** corresponding to the access of a VPN subscriber to management functions.

2) NNI:

- **"c" service entry point** corresponding to the to the provision of inter-VPN services via the interconnection of two VPN networks or via the interconnection of a service provider to a VPN network.

10. Manufacturers Views

10.1. Introduction

10.1.1. General

This document has been prepared by Smith System Engineering and Arcome as import to the EC DGXIII study on issues related to fair and Equal Access and the provision of harmonised offerings for interconnection to public networks and services in the context of open network provision (ONP).

It provides a review of the views of major telecommunication manufacturer on issues of Equal access and interconnection.

10.1.2. Background

On 1 January 1998, large parts of the European telecommunications network will be deregulated to encourage competition within the market. In order to cope with the technical requirements of this major change, a comprehensive technical framework will need to be in place to allow multiple operators to operate in the same geographical areas.

Two major and related issues associated with this framework are those of Equal Access: allowing customers a choice of network service provider; and Interconnection: the mechanism by which independent networks connect to one another to form a homogeneous and efficiently functioning network from the point of view of the customer.

The overall study, co-ordinated by Arcome, is funded by the EC and will help to guide NRAs and Tos in implenting the EU legislation on interconnection.

10.1.3. Contents

Section 2 describes the procedure used to approach various telecommunications equipment manufacturers.

Section 3 is a compilation of the answers given by the manufacturers to the specific questions and a summary of any other opinions that were expressed.

Section 4 draws together the comments of the manufacturers into a structured discussion.

Section 5 is a summary of the significant conclusions drawn from the exercise.

Appendix A contains a list of the manufacturers that were approached.

10.2. Analysis of the Views of Manufacturers on Equal Access and Interconnection Issues

10.2.1. Introduction

Five groups or organisations are affected by issues of Interconnection and Equal Access:

- NRAs
- PTOs
- Equipment manufacturers
- Subscribers
- Service providers

The purpose of this part of the study is to investigate the position and views of equipment manufacturers with respect to Equal Access and Interconnection.

Manufacturers are in a unique position in the chain of provision of telecommunications services. They dictate the availability of equipment and the direction of development of equipment which is used by the telecommunications community. Having a global presence; existing product ranges reflecting the global market; and being in a position to plan new market offerings (both wider world as well as European markets), they are in a position potentially to influence greatly the future of telecommunications services.

Manufacturers have been operating in a competitive environment for many years, and therefore provide a link of continuity through the deregulatory phase: as PNOs move into a new era of competitive operation, and Service providers emerge.

The experience and views of the manufacturers, therefore, is likely to have a significant impact on the direction of movement of the sector. The views of the manufacturers are an important component of the input required before new legislation is introduced.

10.2.2. Approach to the Manufacturers

In order to promote a dialogue with the various manufacturers of telecommunications equipment for the European market, a questionnaire was formulated and, following telephone contact, sent to each manufacturer. A list of the manufacturers that were contacted is contained in appendix A. Most manufacturers responded in some way to the questionnaire, and a follow-up call was made to each to discuss the answers in more detail, and to elicit any other views the manufacturers may have on similar topics.

The questions sent were as follows:

Current national networks

1. In which EU member states are your products used? How? (Give system diagrams if possible.)
2. For which of these do you provide continuing *development* support, i.e. support other than maintenance (e.g. software upgrades)? Is extensive support called for?
3. Where are the technical barriers to interconnection between systems operated by the various types of network operator/service provider? What could be done to overcome these barriers? (Give estimated costs wherever possible. `Order of magnitude' estimates, such as `approx. 1 - 5 MECU', are still useful.)
4. Which of these barriers are caused by inherent limitations of old switches, and which are caused by differences between different manufacturers?
5. What problems of management would arise from interconnection at different points in the network - local exchange, trunk exchange, remote (IN)?
6. Product range and plans
7. How do your current products address the needs to provide improved interconnection and equal access services? In particular how advanced is the development of interfaces compliant with the relevant ETSI standards (TUP/TUP+/ISUP v1/ISUP v2)?
8. What are your future plans for enhancing these services?
9. What requirements for such services are network operators/service providers indicating they may have for such capabilities, and how is this affecting your development programme? How does this vary between Member States?
10. How do operators' requirements for network security affect the range of interconnection services which are offered or under development?

Regulatory position

1. What impact, if any, does the current regulatory regime (at national and European levels) have on your market opportunities? How does this impact on the ability of network operators to use or provide sophisticated interconnection services?
2. In your opinion, would more regulatory coordination on the technical aspects of interconnection be valuable or detrimental? Why? In which technical areas should this regulation be focused?
3. Is the standards development process adequate? Where are the weaknesses in the current ETSI standards?
4. Are you involved in national or European-level regulatory committees, and if so, at what level (e.g. the UK's NICC - which reports directly to the national regulator OFTEL)? In which member states? Does this process work effectively?

In addition, further research was carried out into aspects of Equal Access provision in existing networks, IN services already in operation, and an analysis of the UK numbering scheme. The results were then compiled and analysed in preparation for this report.

10.3. Responses to Questions

10.3.1. Current National Networks

1. In which EU member states are your products used? How? (Give system diagrams if possible.)

The major manufacturers have, in conjunction with partners, presence in all EU countries plus Switzerland and Norway, and many countries on other continents. Manufacturers were reluctant to divulge further information of national sales statistics.

Manufacturer	Coverage
Siemens	All EU countries except UK, Netherlands and France, plus many other world-wide
GPT	Siemens products are offered by partner organisations in these countries e.g. in the UK by GPT
Alcatel	All member states: largest subsidiaries in France, Germany, Italy, Spain and Belgium
Nortel	All EU countries and large global presence
Ericsson	Most EU countries
Nokia	No response
AT&T	No response

Table 7: Countries in the EU in which the respondees offer products

No manufacturers provided system diagrams.

2. For which of these do you provide continuing development support, i.e. support other than maintenance (e.g. software

upgrades)? Is extensive support called for?

Companies are obliged by law to provide at least maintenance support in all countries in which they have a presence; and in most countries make all newly developed products available (providing the infrastructure in the relevant country is suitable for the new products).

3. Where are the technical barriers to interconnection between systems operated by the various types of network operator/service provider? What could be done to overcome these barriers? (Give estimated costs wherever possible. `Order of magnitude' estimates, such as `approx. 1 - 5 MECU', are still useful.)

The extent of technical barriers to the process of interconnection provoked a variety of responses.

Some of the manufacturers maintain that technical barriers to interconnection (and intraconnection - connection within a PTO's network) are not significant, and that the necessary interface standards -chiefly CCITT SS7- are sufficiently stable to allow interconnection between PNOs' networks to proceed. Indeed in some member countries - for example in the UK - and for mobile telephone operator network interconnection, such interconnections have already been made.

Some manufacturers are of the opinion, however, that the existence of many national variants of the ISUP - mainly evolutions of TUP - make the situation in the European market place complex. Currently, in order to allow these variants to interface to one another, `gateway' nodes are required to translate the various national implementations e.g. B-TUP in the UK. These manufacturers were sceptical about ETSI's efforts to arrive at a clear, and universally accepted EURO-ISUP standard from this position within the next ten years.

Development of hardware to conform to any new standards required by Open Network Provision legislation was not perceived to be problematic.

Other manufacturers, however, cited less technical but more co-ordinational problems for the new European Open Network. Some of the broad areas of concern were:

- policing of access to networks;
- apportionment of charges to network operators;
- controlling of the flow of signalling;
- establishment of end-to-end management;
- the introduction of `one-stop' maintenance to support `one-stop' shopping.

In particular, no common standards exist for:

- network management;
- service management.

Use of signalling resources on third-party networks is not restricted, and can lead to local overloading of that operator's network, degrading service and whilst providing no revenue. Operators are keen to have the possibility of screening signalling traffic to prevent the overloading of their networks by signalling-only connections.

No manufacturer was prepared to divulge information on product prices and sales.

4. Which of these barriers are caused by inherent limitations of old switches, and which are caused by differences between different manufacturers?

Once again the response of manufacturers varied. Most agreed however, that a prerequisite for the successful interconnection of European networks is the move to digital switching systems, providing flexibility and adaptability.

Some saw the problem of old switches as insignificant, particularly as many switches throughout Europe are being rapidly updated in most countries. Within `3-4 years' most countries' networks should be updated to digital equipment allowing much more flexibility than analogue equipment. In addition, the provision of value-added services is technically possible even without using digital equipment.

Most manufacturers however, see generic interconnection to switches as a major problem in the current climate of multiple signalling standards. They point out that much investment has been made in the development of new systems to comply with the existing systems in operation in the different countries, and to interface with other manufacturers' equipment (most operators prefer to multi-source equipment); this equipment will only be replaced reluctantly in a new Open Network environment.

5. What problems of management would arise from interconnection at different points in the network - local exchange, trunk exchange, remote (IN)?

It was generally felt that issues of management were not of concern to the manufacturers, and from a purely technical point-of-view no problems with existing switching products should arise.

However, the lack of management standards was seen as a problem for the operators, though development of TMN and V5 is addressing this problem.

In particular, threats to network integrity due to updating of software across networks was also noted as a potential problem; Bellcore in the USA has created a special team for handling such co-ordination.

10.3.2. Product Range and Plans

6. How do your current products address the needs to provide improved interconnection and equal access services? In particular how advanced is the development of interfaces compliant with the relevant ETSI standards (TUP/TUP+/ISUP v1/ISUP v2)?

All manufacturers say they are closely involved with the standardisation process and network operators, and so product ranges generally support all new services. Generally, national TUPs are being phased out of networks, though all are currently supported.

7. What are your future plans for enhancing these services?

No manufacturers were prepared to divulge information on future product plans, however, some commented that standards generally lag the services and features offered by equipment manufacturers which are inevitably proprietary until the standards committees can be persuaded to accept the new features. This was seen by the manufacturers as a desirable situation, allowing new features to be launched quickly and as sole suppliers to provide initial commercial advantage.

8. What requirements for such services are network operators/service providers indicating they may have for such capabilities, and how is this affecting your development programme? How does this vary between Member States?

This is generally considered confidential information. One manufacturer commented that it tries to persuade its customers to agree to a common development program for interconnection to reduce development costs.

9. How do operators' requirements for network security affect the range of interconnection services which are offered or under development?

No clear information was forthcoming on this subject. One manufacturer commented that network operators are reluctant to give SS7-access to basic service providers.

10.3.3. Regulatory Position

10. What impact, if any, does the current regulatory regime (at national and European levels) have on your market opportunities? How does this impact on the ability of network operators to use or provide sophisticated interconnection services?

Most manufacturers were positive about deregulation of the networks and saw clear commercial advantages for state-of-the-art equipment manufacturers. It was generally considered likely to significantly increase the size of the telecommunications equipment market.

Caution was expressed, however, over the over the way forward for the standardisation process: the correct balance must be struck between sufficient regulation - both national and international - to make the system effective, and over regulation causing technical innovation to be stifled.

It was felt that in some countries the incumbent PNO was in a position to veto evolution of technical standards within the country, and suppress the liberalisation process.

11. In your opinion, would more regulatory co-ordination on the technical aspects of interconnection be valuable or detrimental? Why? In which technical areas should this regulation be focused?

Regulatory co-ordination was cautiously welcomed by most manufacturers, providing it is not too prescriptive. The regulation should be aimed at:

- guaranteeing open access and interconnection, but not specifying detailed standards;
- ensuring network integrity.

The regulation should be flexible and able to develop, and not remove the freedom for innovation.

12. Is the standards development process adequate? Where are the weaknesses in the current ETSI standards?

The ETSI standards process runs well, though some manufacturers felt that they were under represented on the committees, and that the PNOs are unfairly strongly represented; some of these PNOs are seen to be actively slowing the process.

The process has not developed with competition in mind, however. For example if one manufacturer develops a mechanism for transmitting low rate data over the D channel of an ISDN link, other implementations of similar applications by other organisations are effectively blocked.

13. Are you involved in national or European-level regulatory committees, and if so, at what level (e.g. the UK's NICC - which reports directly to the national regulator OFTEL)? In which member states? Does this process work effectively?

The manufacturers see support of the technical demands of deregulation as important, and try to actively participate in the process of standardisation, being able to give significant technical and commercial input to the process.

All manufacturers are involved to a limited extent with the relevant national and European-level regulatory bodies, most complain of having little influence. Most manufacturers participate on the Open Network Provision Consultation & Co-ordination Platform (ONP - CCP), an open forum for all interested groups allowing discussion of the forthcoming liberalisation process and working with the CEC.

10.4. Summary of Questionnaire Replies and other Issues

10.4.1. Introduction

This section draws together in a coherent structure the views of the manufacturers from the responses to the questionnaire and other issues raised during dialogue with the manufacturers.

10.4.2. Regulatory Issues

10.4.2.1. Level of regulation

Manufacturers see the balance of regulation versus freedom of competition within a European legislative framework as being imperative for the success of the newly deregulated markets. In most countries the framework has been set up such that the NRA acts in a reactive role acting to resolve disputes between PTOs and user groups an PNOs and other operators.

Manufacturers feel that their level of involvement in regulatory affairs is low. In the UK their influence is via Oftel's consultative organisation the NICC, and indirectly through contact with the PTOs.

In the area of interconnection, testing of new network connections and manufacturers' equipment will become increasingly relevant as the PNO loses its central organisational role. Until now all testing of new networks and type testing of new equipment has been carried out by the PNO. In a more complex multi-operator environment, a testing regime to satisfy the requirements of all of the PTOs, as well as testing against international connection points will be less easy to define.

Manufacturers see no requirement for special access for Service Providers (SPs) in addition to the existing `retail' UNI and SS7-based NNI access already provided.

10.4.2.2. Network integrity

Several manufacturers expressed deep concern at the implications of ONP for the integrity of the European telecommunications network. Care must be exercised in allowing SPs access to network signalling functions: network operators are unhappy to allow SPs access to SS7.

Development of an effective testing regime is important, building on and developing the experience of PNOs in interconnecting with new PTOs.

The nature of the integration of European networks is breaking new ground, and so many problems are likely to lie ahead. Easy answers are not available and it is unclear as to what action is possible to mitigate potential problems, particularly when the overriding concern of most players is not to over regulate the market. In general, guidance from NRAs will be sought.

10.4.3. Standards

10.4.3.1. The standards process

Most manufacturers believe that ETSI's standards process which is working towards a standard ISUP works well. Complaints against the process include:

- progress is slow;
- it is dominated by the PTOs;
- it is hindered by the plethora of N-TUPs available in the member countries;
- it is not well suited to facilitate competition in the telecommunications sector.

Some manufacturers believe that some PNOs are able to slow down the process to suit national agendas and protect their national market.

Most of the manufacturers agree that a common agreement on at least lower levels of the specification needs to be established within a reasonable time scale (perhaps five years); variations at higher levels within the standard to accommodate local market variations may be desirable.

Standardisation work on IN and network management standards are required to allow effective management of networks, national networks and the super network or `network-of-networks'.

10.4.3.2. ISUP Harmonisation

ETSI's original aim was to arrive at a fully defined and internationally accepted ISUP towards which all PTOs would migrate away from the existing N-TUPs. Generally, new market entrants adopt ETSI standard protocols within their networks. Incumbent PNOs, however, have significant investment in existing signalling system protocols and are reluctant to make immediate changes, because:

- of the massive network upheaval that would be required;
- some of the functionality included in the N-TUPs is not included in ISUP.

In developing new standards, therefore, ETSI needs to be pragmatic in its recommendations. Most manufacturers believe that a common partial standard is required defining the lower-level functionality of ISUP to enable the networks to inter-operate, but that higher level functionality should be treated more carefully. This lower-level functionality should be in place within a reasonable time frame - perhaps five years. In some areas of functionality it may be desirable for national variants of ISUP to exist to suit local market needs.

10.4.3.3. Migration to Open Networks

To implement harmonisation of switching systems subsequent to a directive will take an additional five years to implement. Implementation of network-wide functionality such as call forwarding and number portability would require five years to implement.

Management of the networks (including service upgrades)- both nationally and internationally - will be complex to implement and maintain. Individual networks will be managed by the network operators, but management of national and international networks is less clear. National networks could be managed by the NRAs or the PTOs. At an international level, management could be organised by a new `super regulator'.

10.4.4. Other Technical Issues

10.4.4.1. Number Portability

Number portability - the opportunity for customers to retain a `number for life' is perceived to be a strong requirement of consumers. Current technology, however, means that the cheapest way to implement the function is by re-routing calls from local switches. This option is cheap but requires operator co-ordination, and as the number of customers with this re-routing facility increases, becomes more and more cumbersome.

Alternatively, Intelligent Network (IN) technology could be implemented, requiring all dialled numbers to be referenced to a central resource library before being routed. Though simple to manage, this option is impractical to implement at present until IN services for other uses become more widespread.

In the UK a small number of companies have been set up to provide personal number portability, but customers are forced to change to a new number with an 07 prefix initially. Limited number portability is to be implemented in the near future allowing alternative local loop providers to transfer existing numbers within a customer's premises, more easily facilitating Equal Access.

Pan-national organisations, such as AT&T and MFS with single networks covering the whole of Europe are more easily able to co-ordinate such services within its own network.

Manufacturers believe that full Europe-wide Universal Personal Telephony (UPT) - a system able to automatically redirect incoming calls to the individuals - is demanded by subscribers, though it is not clear whether this service will be offered by network operators or service providers; whether it will be implemented using IN or call diversion; and what the exact nature of the service will be. UPT may imply full number portability out of local areas - potentially requiring a complete reorganisation of geographically-based numbering schemes -, or the ability to transfer numbers between operators at a fixed location, as is being implemented in the UK.

10.4.4.2. Intelligent Network Services (IN)

IN technology is still establishing itself commercially and is likely to play a significant role in the operation and management of the future `network of networks'. Technical standards based originally on Bellcore standards are emerging via the standards processes, but little is known about future IN requirements of these networks. The technology is currently used for

premium services, paid for by the customer, or special numbers, e.g. 0800-freephone services, paid for by the service provider. Implementation is straightforward - IN-requiring services being identified by a limited set of number prefixes.

Some of the first new uses of IN functions are number portability and personal numbering services. Examples of service providers offering personal numbering services in the UK are Flextel and the Personal Number Company.

As the use of these services becomes more widespread, the growth of IN services will grow rapidly. It is thought that an initial `shake-out' period of two to three years will be required for the newly deregulated telecommunications market to settle, before network operators are prepared to make significant investments in IN facilities. In the manufacturers' view it is, therefore, imperative that work on IN standards continue.

10.5. Conclusions

The survey has revealed that the manufacturers are largely satisfied with the current regulatory regime, though three main issues emerged that are causing concern. These issues are:

- Regulation of the new regime must be balanced to weigh the need to maintain the integrity and development of networks against the operators' and manufacturers' ability to remain competitive and innovative.
- Standards development require much work to establish a basis ISUP, maintain network integrity, develop network management and IN standards. Some manufacturers complain of their lack of influence over the standards process.
- Network integrity may well be threatened during and after the transition to a deregulated regime, both deliberately by unscrupulous service providers and individuals, and accidentally for unforeseen technical reasons. The development of an effective testing regime is vitally important as are the development of network management standards.

10.6. Companies Contacted

The following manufacturers were approached by Smith System Engineering, the responses of individual companies varying widely in its level of interest in the study.

- Nortel
- AT&T
- Siemens
- Alcatel
- GPT
- Ericsson
- Nokia

11. List of Acronyms

3PTY Three-Party

AN Access Network

ASN.1 Abstract Syntax Notation number One

CCBS Call Completion to Busy Subscriber

CCF Call Control function

CCNR Call Completion on No Reply

CD Call Deflection

CEPT Conference of European Posts and Telecommunications

CFB Call Forwarding Busy

CFNR Call Forwarding No Reply

CFU Call Forwarding Unconditional

CH Call Hold

CLIP Calling Line Identification Presentation

CLIR Calling Line Identification Restriction

COLP COnnected Line identification Presentation

COLR COnnected Line identification Restriction

CONF CONFerence calling

CS-x Capability Set number "x"

CUG Closed user Group

CW Call Waiting

DDI Direct Dialling In

DUP Data User Part

ECT Explicit Call Transfer

ECTRA European Committee on Telecommunications Regulatory Affairs

ETO European Telecommunications Office

ECTRA European Committee on Telecommunications Regulatory Affairs

ETNS European Telephony Numbering Space

ETSI European Telecommunication Standard

FPH FreePHone

GSM Global System for Mobile communications

IN Intelligent Network

INAP Intelligent Network Application Part

ISDN Integrated Services Digital Network

ISP Intermediate Service Part

ISUP Vx ISDN User Part version "x"

ITU-T International Telecommunications Union - Telephony

MAP Mobile Application Part

MCID Malicious Call IDentification

MHS Message Handling System

MoU Memorandum of Understanding

MSN Multiple Subscriber Number

MTP Message Transfer Part

NNI Network to Network Interface

OMAP Operation and Maintenance Administration Part

OSI Open Systems Interconnection

POI Point Of Interconnection

PCN Personal Communication Network

PLMN Public Land Mobile Network

PNO Public Network Operator

PSTN Public Switched telephone Network

POTS Plain Old Telephone Services

PTO Public Telecommunications Operator

SCCP Signalling Connection Control Part

SCEF Service Creation Environment Function

SCF Service Control Function

SDF Service Data Function

SMAF Service Management Access Function

SRF Specialised Resources Functions

SSF Service Switching Function

SS7 Signalling System number seven

SUB Subaddressing

TCAP Transaction Capabilities Application Part

TO Telecommunication Operator

TP Terminal Portability

TUP Telephone User Part

TUP+ Telephone User Part "Plus"

UNI User to Network Interface

UPT Universal Personal Telecommunications

UUS1/2/3 User-to-User Service 1/2/3

VPN Virtual Private Network

Last modification: April 28, 1997