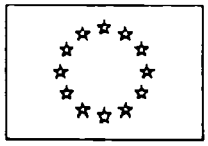

COMMISSION OF THE EUROPEAN COMMUNITIES

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COMMUNICATION FROM THE COMMISSION
TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

Towards a Trans-European Positioning and Navigation Network:

including

A European Strategy for Global Navigation Satellite Systems (GNSS)

EXECUTIVE SUMMARY

Executive Summary

This communication proposes a strategy for the European Union (EU) for ensuring a European dimension to the Global Navigation Satellite System (GNSS). This will contribute to the development of a Trans-European positioning and navigation network. The EU institutions and Member States are invited to endorse the strategy proposed and the supporting Action Plan on GNSS (Annex I of the communication).

GNSS involves major strategic, political, economic, industrial, employment, security and defence interests for the EU:

- Satellite navigation and positioning systems offer the potential for major improvements in the safety and efficiency of transport systems for all modes of transport. They also have applications in a wide range of other activities, from agriculture to oil and gas exploration.

- There are security and defence considerations, since the two present global satellite systems remain, for the moment, under the military control of the US and the Russian Federation.

- Reasonable estimates suggest that the world market could be worth 50 billion dollars within 7 years. As well as a large domestic market, Europe has the opportunity of creating a new market for the system and services in third countries. But our industries need to have full opportunity to contribute to GNSS development, which may be difficult if the basic systems and technologies are outside European influence.

- There are strategic and political interests, in relation to Europe's capacity to control the positioning and navigation services for its own territory.

These considerations have a major impact on our relations with other countries in terms of whether we can develop systems jointly with them, or need to go it alone.

In putting forward a strategy, one of the Commission's key objectives is for the EU and its Member States to demonstrate their commitment to a full European participation in GNSS, so that European industry and potential users have the confidence to invest in its development. This is also essential for European credibility in negotiations with other countries.

The EU strategy must continue to embrace the two phases of GNSS:

- Getting an initial European component (EGNOS)[1] of the first generation global satellite system (GNSS-1) up and running. This means relying on the basic US and Russian signals, but augmenting their accuracy and integrity by additional ground and space-based infrastructure. This stop-gap system is intended to be in operation from 2000;

- GNSS-2, which is envisaged as a system designed for civil use, which would be

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[1] European Geostationary navigation overlay Service

the successor of existing military systems. This is still in the design phase.

European involvement in GNSS-1 will provide an initial foothold in this crucial sector, and facilitate our full participation in GNSS-2.

Overall strategy

The key strategic issue is how best to ensure an effective EU role in long-term development of GNSS.

Both technically and in political terms GNSS raises complex issues. There are technical and financial uncertainties, as well as uncertainty about the willingness of our international partners to co-operate. An EU strategy has to be flexible enough to respond to these uncertainties.

Beyond EGNOS, the political and strategic dangers of reliance on a system controlled by one or more third countries have been highlighted by Member States, the user community (especially civil aviation) and military interests:

- There is a need to ensure that European users are not hostage to possible future charges or fees which appear excessive: if a dominant position or virtual monopoly were established, it would be difficult to resist such charges and perhaps impossible to develop alternatives quickly.

- The capacity for EU industry to compete in this lucrative market would be seriously constrained. (Europe's capacity to compete in the potentially lucrative market for services would be undermined if it did not have equal access to the technological developments in the system itself, and the US in particular shows every sign of using the strategic advantage provided by its military positioning system (GPS) to establish a dominant position in the world market for systems and services.

- There are serious problems of both sovereignty and security if Europe's navigation systems are out of Europe's control.

This is why the Commission proposes that the EU and its Member States should unequivocally confirm their commitment to a full European contribution to GNSS.

There are three broad options:

- Joint development of GNSS by all the major players;

- The EU developing a GNSS with one or more international partners. This could be one of the two countries that currently have systems, and/or other major players such as Japan.

- Independent development by the EU of its own system.

The ideal long term position is a global system involving the EU and some, or, preferably, all of our international partners in a GNSS for civil use; if this is not possible, on acceptable terms, the EU will need to opt for an independent European GNSS, taking into account the technological developments which might substantially reduce costs for such a system.

Through intensive contacts with our main international partners, the possibility of

achieving an acceptable joint system should be urgently assessed, based on the following conditions:

- firm guarantees from the outset that the service (on which Europe will depend for certain vital and safety-related applications) will not be withdrawn or disrupted, with, ultimately, a full EU role in the control of the system;
- full European participation in its design, development, and operation;
- and an opportunity for European industry to compete in all segments of the market, with equal access to the basic technologies.

The importance of these discussions needs to be recognised. It is therefore proposed that they should be launched at the highest level, in the structures that have been put in place to manage our bilateral relationships. The Commission would conduct the discussions, and would keep the Council fully informed.

It is by no means clear that other major players will be willing to meet these conditions. It is, therefore, proposed that Europe should intensify work on GNSS-2 (research, demonstration, etc) to ensure that the option of developing a fully independent European system remains open.

Final decisions on the European contribution to GNSS can be taken in the light of the results of these discussions, and of the ongoing technical and cost/benefit assessment of the options for GNSS . This decision will need to be based on the medium and long term needs and interests of Europe rather than any short term view. As the target date for initiating the decision-making process on GNSS, the first quarter of 1999 is proposed when the Commission will come forward with recommendations. A slower timetable could impair the prospect of Europe achieving a competitive position in this market.

Implementation

A wide range of issues need to be addressed if EGNOS is to be implemented successfully. Similar issues will arise for GNSS-2. It will be essential for Member States and the Community institutions to work in close co-operation with the other bodies involved in this field, notably ESA and Eurocontrol. The main issues are discussed in this communication, and the Action Plan at Annex 1 sets out responsibilities and timescales for addressing them.

The most sensitive issues relate to international negotiations, organisational issues, and finance.

International dimension

Contacts need to be intensified with our main international partners. The priority is to assess the feasibility of developing a joint global system that meets European needs. But negotiations are also needed to put in place the arrangements to allow GNSS-1, with EGNOS, to be brought into operation as a primary navigation aid, both in Europe and elsewhere. The Commission will draft mandates for negotiation:

- with the US and the Russian Federation, as providers of the basic satellite signals, particularly on service guarantees and liability for GNSS-1

- with the US, the Russian Federation and Japan on interoperability of their

GNSS systems and components with ours.

Discussion should also go forward with other countries which might wish to use EGNOS themselves. This may also require consideration of the case for using Community financial instruments.

Organisational/institutional issues

Timely implementation of EGNOS requires clear arrangements for regulatory approval for safety sensitive activities, and ensuring a structure for operating the system:

- a suitable body at EU level would appear to be the most practical means to put in place rapidly arrangements to regulate services provided through EGNOS, reflecting the multimodal nature of the system, and drawing fully on the expertise of existing organisations.

- on the basis of further work and in consultation with the GNSS High Level Group, decisions should be taken, preferably before the end of 1998, on a legal and operational structure, initially for EGNOS and GNSS-1. This should include a service guarantor (accepting responsibility for maintaining the service) and an operator of the EGNOS service.

Satisfactory resolution of these issues is essential if European systems are to be available in time to be competitive, and is seen by the private sector as a litmus test of the EU's determination to implement GNSS.

Questions of the civil/military interface also need to be addressed as a priority. The availability of highly accurate navigation and positioning services across the continent raises both risks and opportunities. The possibility of dual-use of GNSS needs to be explored, not least on cost-effectiveness grounds. But it is also essential to ensure that the capabilities of a system designed for civil use cannot be used in a way that creates security concerns.

Financing

Financial arrangements will need to be agreed for future GNSS development at the same time as strategic decisions are taken in early 1999. Options for charging for GNSS-1 and 2 services should be explored, with the objective of approaching self-financing in the medium term. This will provide a key element, together with the cost-benefit analysis of the options, for taking decisions on financing GNSS-2 in whatever form it takes.

Industrial issues

Recognising GNSS as a significant opportunity for the EU space and high technology industries and its potential dual civil/military use, a dialogue on GNSS issues should be set up with industrial interests, both producers and users.

Conclusion

The Council and the other institutions are therefore requested to give clear backing for the overall strategy, and to endorse the action plan, so that the Commission, together with the wide range of other actors, both public and private, can press ahead with implementation.

1. INTRODUCTION

This communication proposes a strategy for the European Union (EU) for a European dimension to the Global Navigation Satellite System (GNSS). This will contribute to the development of a Trans-European positioning and navigation network, supported, as necessary, by terrestrial systems. The strategy builds on the approach in the Council's resolution of 19 December 1994[1], developing a GNSS which provides an optimal service at an acceptable price.

Satellite positioning and timing offer opportunities for applications in many domains from navigation to surveying, agriculture, oil and gas exploration and others. The degree of support from terrestrial systems which will be necessary will depend largely on the way GNSS develops. However, the communication includes a preliminary analysis of the potential future role of the existing systems and seeks to ensure a consistent approach in planning for the navigation aid system mix to meet future needs.

In putting forward a strategy, one of the Commission's key objectives is for the EU and its Member States to demonstrate their commitment to a full European participation in GNSS, so that European industry and potential users have the confidence to invest in its development. Transport, economical, industrial, security and defence issues are at stake.

GNSS represents a strategic challenge impacting on Europe's position in the world.

Underpinning this strategy is a specific Action Plan for developing a GNSS[2], as proposed in the Commission's Communication on Space[3] and taking into account the work of the High Level Group[4]. Work has also been done on the current situation regarding Loran-C and some of the other main terrestrial radio-navigation systems[5] and a Commission staff working document on this is under preparation.

2. AIMS

In line with the overall objective of sustainable mobility, and Europe's industrial and strategic interests, the Commission has identified the following aims for developing the positioning

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1 Council Resolution of 19 December 1994 on the European contribution to the development of a Global Navigation Satellite system (GNSS), 94/C 379/02, hereafter referred to as 'the 1994 Council Resolution.'

2 The Action Plan is contained in Annex I to this communication.

3 Communication on the European Union and Space: fostering applications, markets and industrial competitiveness, COM (96) 617 final of 4 December 1996.

4 The high level co-ordinating group is composed of representatives of national governments, users, telecommunications operators, the relevant international organisations, particularly the European Space Agency, ICAO and Eurocontrol, and industry to ensure that activities undertaken in Europe in the satellite navigation field tend towards the same end and to assist the Commission in its tasks (cf. Council Resolution, cited above).

5 the report follows up Council Decision 92/143/EC of 25 February 1992 on radio-navigation systems for Europe, OJ. L59 of 4 March 1992, hereafter referred to as 'the 1992 Council Decision.'

and navigation network:

- efficient and cost-effective systems of navigation and positioning for civil use and compatible with military needs;
- high levels of safety, with guarantees of adequate European control on any future system, on which the safety of transport in Europe depends;
- ensuring that European industry is able to compete on an equal basis in the emerging satellite navigation markets.

Assessing options against these criteria means balancing economic, political and technical concerns.

3. PRESENT SITUATION

3.1. Terrestrial systems

Existing terrestrial navigation systems have been primarily developed for specific modal uses. As satellite navigation becomes more accepted for use in increasingly precise applications, there will be opportunities to rationalise existing infrastructure. Many terrestrial systems are, therefore, intended to be phased out over the coming decade. However, at least for the present, certain terrestrial systems will continue to play an important role, largely for local precision purposes and possibly as back-up to the satellite systems. This communication considers the relationship between terrestrial and satellite components of the trans-European positioning and navigation network and the principal issues concerning the maintenance and possible development of terrestrial systems.

In planning, the EU will also need to take full account of the plans and specific needs of its Member States and the investments they have made, the recommendations and requirements of the relevant regulatory organisations, such as ICAO and IMO, and the plans of other influential countries. Together, these will have a critical impact on the future of the different terrestrial systems.

3.2. Satellite systems

3.2.1. Potential benefits from satellite navigation

As pointed out in previous communications[6], satellite navigation and positioning can play a central role in achieving the policy objective of efficient and sustainable mobility - transport of freight and passengers that is affordable, safe, productive and as benign as possible for the current and future environment. Indeed, satellite-based systems can provide a more cost effective approach to positioning and navigation than terrestrial aids and it is expected that their development should reduce demands on national treasuries in the medium term. Depending on governments' willingness to charge users for services, the system could be completely self-financing.

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[6] specifically, communications on satellite navigation services: a European approach, COM(94) 248 of 14 June 1994, and on the European Union and Space, COM(96) 617 final of 4 December 1996

In addition, as the civil use of satellite-generated signals for navigation, timing and positioning is growing rapidly, it is clear that the production opportunities generated by satellite navigation will grow and create jobs. Reasonable estimates suggest that the world market could be worth 50 billion dollars within 7 years[7].

All modes of transport can potentially benefit:

- air traffic management can be altered beyond recognition, by putting much of air traffic control on aircraft flight decks and regulating aircraft speed and spread to increase capacity safely and to generate time, fuel and cost savings. In addition, many airports which are not currently equipped to allow all-weather landing will be able to offer such facilities through satellite systems, without the large investment in physical infrastructure that would otherwise be needed;

- shipping will be able to navigate safely around hazards and rough weather and docking will be simplified;

- private cars and lorries will be able to use satellite guidance, helping reduce congestion and, alongside GSM, helping to revolutionise truck fleet management by reducing empty journeys from the current European figure of around 30%. It could also contribute to implementing a comprehensive system of electronic fee collection as part of a policy of fair and efficient road pricing, either for freight transport, or more generally; and

- rail fleet management will also be simplified, with new scope for signalling and train control, especially in sparsely populated regions - again at a fraction of the cost of physical upgrading. The efficiency of combined transport logistics can also be radically improved by locating the load units.

In addition, satellite systems can also facilitate interoperability across the continent because of their pan-European availability, with the most immediate benefits evident in peripheral regions, where existing navigation infrastructure is generally less well-developed.

There is also considerable potential in non-transport applications, including for leisure (yachting, hiking, mountaineering), agriculture (spreading and spraying fertilisers), fisheries (net recovery, location of shoals, monitoring fishing operations), precision timing, guidance for the blind, earth observation and geodesy, natural risk management (seismic activity, landslides, vulcanology) meteorology, fraud prevention (through the location of stolen goods) and oil and gas exploration. Developing GNSS should, therefore, support other Community policies, such as for employment, industry, cohesion, environment and co-operation and development.

3.2.2. *GPS and GLONASS*

At present, there are two global satellite systems for positioning and navigation, providing signals in space. These were developed, primarily for military reasons, by the USA (GPS)

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[7] cf. section 7 of the present Communication.

and the USSR (GLONASS[8]). Both countries opted for constellations of, basically, 24 satellites in orbit providing:

- precision signals which are encoded and currently available only to authorised (generally military) users; and
- standard signals which are generally available but not accurate enough for most safety-sensitive applications (e.g. to allow aircraft approach to landing or ships to docking). Supplementary aids to navigation are, therefore, needed.

GPS and GLONASS both lack guarantees of availability and integrity[9] (e.g. it may take 12 hours or more for users to be alerted to incorrect signal data).

3.3. Policy of the US

3.3.1. Promoting GPS as a Global Standard

The standard GPS signal is and, according to presidential assurances, will remain for the foreseeable future available free of direct user charges. This has encouraged the development of a large civilian market for GPS equipment which the US dominates. At present, the standard signal is, however, degraded by the US to restrict its precision. The government has given an undertaking to review annually the need for the degradation from the year 2000.

According to its Federal Radio-Navigation Plan, the US, as a general strategy, will continue to promote the international acceptance and implementation of GPS as part of GNSS for navigation in all phases of flight and will progressively discontinue terrestrial systems. A draft timetable for withdrawal of the different systems suggests that GPS will be the only prime system by 2010.

3.3.2. WAAS and LAAS and Loran-C

However, the US accepts that GPS without augmentation will not meet all performance requirements for aviation, for harbour entrance and approach phases of marine navigation or for many land uses and a wide area augmentation (WAAS) will be developed in the next 6 years in two stages: initial services should be available for certification in 1999 and higher levels of service available from 2001.

Supplementing GPS and WAAS, the US anticipates a need for local area augmentation systems (LAAS) to support certain precision operations. LAAS specifications are to be developed by late 1998 and the capability should be available for public use by 2005. Until LAAS is fully operational, precision approach requirements will be met by other terrestrial systems.

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[8] The Global Navigation Satellite System (GLONASS) is now under the control of the Russian Federation.

[9] Accuracy: precision (military) signals are accurate to ± 20 metres; standard (civil) positioning signals, ± 70-100 metres.
Integrity (or assurance): users must be sure of receiving the signals required. Any malfunction should be reported to users within a given time frame.
Availability: the system must be available for use on a continuous basis in a given geographical area.

The US Federal Radio-Navigation Plan acknowledges that Loran-C is one of the largest user communities employing a single radionavigation system. Use of Loran-C is, however, expected to decline as GPS becomes progressively more established and the Plan envisages withdrawal of the system by 2000. The Department of Transport has already developed a differential GPS[10] network along the US coastline and it is expected that the network will be expanded to serve the railway sector.

3.3.3. New generation GPS

The US is already developing a new generation GPS[11] with a second civil signal: its frequency and a detailed plan for its provision are to be developed by March 1998. This will increase the accuracy available from GPS. It is anticipated that the new system should be fully operational shortly after 2010.

3.4. Policy in the Russian Federation and CIS

The GLONASS constellation offers greater precision than is available for civil use from GPS and better coverage of the northern European latitudes. The standard GLONASS signal, like GPS, will continue for the foreseeable future to be provided free of direct user charges. System improvements are under development but the maintenance of the system will require considerable resources which the Russian Federation may have difficulty in finding without external assistance.

The Intergovernmental Radio-Navigation Programme of the CIS Member States aims to co-ordinate the development of radio-navigation aids to improve safety. It envisages increased co-operation with the relevant international organisations and other States with the aim of developing a consistent global radio-navigation policy. The Programme, covering the period to 2000, does not foresee the withdrawal of any systems currently operated by the CIS States.

3.5. Policies of other countries

Several other countries are actively involved in developing their own space augmentations or negotiating to use the EGNOS[12] signal to maximum advantage. In particular, Japan, India and Australia are working on possible regional contributions to GNSS and are key partners in terrestrial systems, especially for air routes and maritime transport. The development of their radio-navigation plans needs to be closely monitored with a view to seeking co-ordination of regional approaches and maximum interoperability of systems for the benefit of users. This should also help avoid possible duplication and thus minimise costs.

The African countries are aware of the urgent need to develop a navigation infrastructure,

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[10] Differential GPS involves providing corrections of GPS signals to enhance the service available in a particular local area.

[11] Congress has approved the launch of feasibility studies on the development of a third generation of dual-use civil/military GPS satellites proof against nuclear attack. The cost of such a constellation is estimated at $ 10 bn.

[12] The European Geostationary Navigation Overlay Service, being developed as Europe's contribution to GNSS-1.

particularly for the civil aviation sector. There is a considerable amount of air traffic over Africa which, among others, involves European carriers and there are serious safety concerns. The countries concerned have recognised that GNSS, specifically through EGNOS, could offer a solution for the whole region. They are, therefore, negotiating for a suitable development plan, preferably with Europe[13].

A similar situation exists with South America and the Caribbean, with considerable European traffic and very limited navigation infrastructure and interest being shown in obtaining the benefits of GNSS. Furthermore, the geography of the region means that terrestrial coverage is difficult to arrange and space offers an attractive solution. Supporting the development of suitable navigation infrastructure would be in the interest of Europe and the countries concerned.

3.6. The international organisations

The International Maritime Organisation (IMO) and International Civil Aviation Organisation (ICAO) are the principal international organisations setting standards and recommended practices for aviation and maritime transport. Most of these are not in themselves mandatory but become so when transposed by Member States or their relevant organisations (e.g. Civil Aviation Authorities). For GNSS, work is already under way to establish a framework of recommended practices and minimum operating standards.

IMO recognises the present need to use at least two different and independent positioning systems. In July 1996, the IMO Sub-Committee on the safety of navigation noted the intention of the governments of France, Germany, Ireland, the Netherlands, Norway, Russia, Japan, Korea and China to propose their Loran-C/Chayka chains for recognition as appropriate systems. Global systems, such as GPS and GLONASS, are also recognised[14]. These views have largely been endorsed by other relevant organisations, including the International Association of Lighthouse Authorities (IALA), the General Lighthouse Authorities of the UK and Ireland and the Internavigation Council of the CIS.

ICAO has accepted GNSS for its future communications, navigation, surveillance/air traffic management (CNS/ATM) concept. They have recognised the benefit of having two base systems (GPS plus GLONASS) and recommended the use of augmentation services for safety. A GNSS panel is considering these issues further and elaborating global standards; a legal panel has also been established to consider legal aspects of GNSS, including liability.

4. THE EU ROLE AND CURRENT SITUATION

Conventional terrestrial navigation systems have generally been organised at national level, and it is member states which have taken on binding obligations in the various international bodies to ensure minimum navigation standards. Member states will thus continue to have a

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[13] ICAO regional meeting, AFI 7, Abuja, May 1997.

[14] GPS was recognised by IMO in June 1996 as an appropriate system. However, IMO warned users that the present system is not suitable for navigation in harbour entrances and approaches, and other waters in which freedom to manoeuvre is limited, and that it does not provide instantaneous integrity warning of system malfunctions. GLONASS was recognised, subject to the same conditions, in December 1996.

leading role in the development of satellite systems.

It is accepted, however, that satellite navigation is, by its nature, a cross-border matter and the Community institutions have recognised that a common effort is required to ensure that Europe has the opportunity to participate fully in its development. In order to ensure a coherent approach and optimum use of relevant expertise in these actions, a European Tripartite Group (ETG[15]) has been set up. An agreement, which defines the respective roles to be played, has been initialled by the three organisations concerned and has been presented to the Community institutions for approval[16]. Primary responsibilities under this framework are:

- institutional, industrial and strategic issues and research:
  the European Community, represented by the European Commission (supported by advisory groups from the Member States, international organisations and industry),

- technical and scientific development:
  the European Space Agency (ESA), supported by Member States' national space organisations, and

- defining user requirements:
  Eurocontrol (for civil aviation) and the Commission (for other users).

The current EU strategy, as set out in the Council resolution of 1994, embraces the two phases of GNSS:

- GNSS-1, to which the EU contribution is EGNOS, involves using the basic US and Russian signals, but augmenting their accuracy and integrity by additional ground and space-based equipment. EGNOS is planned to be in place by 2000;

- GNSS-2, which is envisaged as a civil controlled system, which would be the successor of existing military systems. This is still in early stage of development.

European involvement in GNSS-1, through EGNOS, will provide an initial foothold in this crucial sector, and facilitate GNSS2. Though the two phases are conceptually distinct, in practice there may well be a gradual transition from one to the other as existing systems age.

Early benefits through Europe's Contribution to the Augmentation of GPS and GLONASS (GNSS-1)

Already, Europe is developing a contribution to GNSS-1 in the form of EGNOS[17]. This will monitor the GPS/GLONASS signals and provide corrections in real time, guaranteeing the accuracy, integrity and availability of the signals over a wide area, from the western North Atlantic to the Far East, from the Arctic to the tip of South Africa and from South America to

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[15] The ETG consists of the Community (represented by the European Commission), ESA, and Eurocontrol.

[16] Proposal for a Council decision on the agreement between the European Community, the European Space Agency and the European Organisation for the Safety of Air Navigation on a European contribution to the development of a Global Navigation Satellite System, COM(97) 442 final of 23 September 1997.

[17] The European Geostationary Navigation Overlay Service

the ASEAN countries and Western Australia. The use of GPS plus GLONASS has particular advantages over reliance on one system alone: one can act as a back-up to the other in case of satellite failure or signal error and the fact that GPS and GLONASS operate on different frequencies increases the overall robustness of the system (resistance to interference, jamming, etc).

This GNSS-1 approach will provide improvements in the navigation services available[18]. through guaranteeing the integrity of the GPS and GLONASS signals, bringing for the first time full harmonised and integrated coverage of the whole European area, increasing transport capacity through the ability to support reduced separation and ultimately reducing the cost of navigation aids. It also gives EU industry a stepping stone towards GNSS-2.

The early benefits will particularly assist cohesion since they will be felt most where present navigation infrastructure is lacking.

The development of EGNOS is allowing the EU space sector to participate, at least on a modest basis, in GNSS and will provide the transport community (the main potential beneficiaries) with a system meeting most navigation and traffic management needs.

Further Benefits and a System Designed for Civil Use (GNSS-2)

GNSS-2 should provide additional benefits over GNSS-1 in the form of navigation services covering precision applications in all modes of transport, notably in all phases of flight and for ship docking, and allowing rationalisation of existing infrastructure.

There are a number of interesting proposals from European industry which might, inter alia, use micro-satellites or exploit the possibility of joint developments with other applications, notably through installing navigation payloads on board telecommunication satellites. This could help industry to achieve much greater involvement in a large and expanding global market for equipment and services. The related costs and benefits of the different approaches need to be evaluated and the optimum level of service to be provided through space technology has to be determined.

5. STRATEGY FOR THE EU

This section sets out the broad choices faced by the EU, and puts forward a strategy designed to ensure a full European role in GNSS on the best available terms.

The suggested strategy for GNSS will have to provide a practical vision around which all the varied interests (public and private sectors, regulators, industry and users) can unite in a working partnership.

The Community is already committed to EGNOS, as a short term means of making satellite navigation services available in Europe. However, the specific actions needed to complete the programme successfully must be put into effect. The action required to achieve this is set out in subsequent sections and in Annex I.

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[18] Initial accuracy ± 20 metres.

Beyond EGNOS, the political and strategic dangers of reliance on a system controlled by one or more third countries have been highlighted by Member States, the user community (especially civil aviation) and military interests.

- There is a need to ensure that European users are not hostage to possible future charges or fees which appear excessive: if a dominant position or virtual monopoly were established, it would be difficult to resist such charges and perhaps impossible to develop alternatives quickly.

- The capacity for EU industry to compete in this lucrative market would be seriously constrained ;

- There are serious problems of both sovereignty and security if Europe's navigation systems are out of Europe's control.

A full role for the EU in GNSS is therefore essential. There are three broad options:

- Joint development of GNSS by all the major players;

- The EU developing a GNSS with one or more international partners. This could be one of the two countries that currently have systems, and/or another major player such as Japan. In this context it is relevant to note that Russia intends to pass control of GLONASS to the civil sector, and is finding the burden of maintaining the system onerous. The scope for co-operation with Russia may therefore be significant.

- Independent development by the EU of its own system, on either a regional or global basis.

There are already extensive contacts amongst the other players, with the US taking a leading role, which reflects their strategy of ensuring dominance of GPS.

In principle, joint development is likely to be the most cost-effective option, since it would avoid duplication of existing satellite constellations, and allow sharing of the costs of system development. But developing a system with US or Russia would, in all probability, involve taking GPS and/or GLONASS as a starting point. The EU would therefore, at the very least, need to negotiate equitable and binding arrangements with our international partners that assure, in effect, a transition towards a jointly controlled system. This must include

- firm guarantees from the outset that the service (on which Europe will depend for certain vital and safety-related applications) will not be withdrawn or disrupted, with, ultimately, a full EU role in the control of the system;

- a full European participation in its design, development and operation

- and an opportunity for European industry to compete fair and freely in all segments of the market.

This analysis leads to the following proposed strategy.

The best option for the EU would be to develop a civil GNSS jointly with our international partners, but only if our conditions for joint development, set out above, are fulfilled.

Intensive contacts with the countries concerned therefore need to take place to assess whether an acceptable joint global system which meets Europe's strategic interest is a realistic possibility. If Europe's conditions cannot be met, a decision should be taken to pursue an independent European system, taking into account the technological developments which might substantially reduce costs for such a system.

Meanwhile, Europe should continue to invest in GNSS-2 (research, demonstration, etc[19]) to ensure that, if a joint approach does not prove realistic, it will be possible to go ahead with a European system keeping European Industry in a position to compete effectively in this domain.

The assessment of our partners' intentions will be a key determinant of the strategic decisions on GNSS that need to be taken. The importance of these discussions needs to be recognised, and they should be launched at the highest level, in the context of our bilateral relationships: the Transatlantic dialogue with the US, and the Partnership and Co-operation agreement with Russia. Similar discussions with Japan are warranted. The Commission would conduct the discussions, and keep the Council fully informed.

Final decisions on the European contribution to GNSS can be taken in the light of the results of these discussions, and of the ongoing technical and cost/benefit assessment of the options for GNSS . This decision will need to be based on the medium and long term needs and interests of Europe rather than any short term view. As the target date for initiating the decision-making process on GNSS, the first quarter of 1999 is proposed.

GNSS raises a whole range of complex legal and political, technical, financial, industrial and organisational issues because of its multi-national and multi-modal, multi-application nature. These are set out in the following sections, and in the action plan[20].

6. ESTABLISHING COST EFFECTIVE AND SAFE SATELLITE NAVIGATION IN EUROPE (INITIALLY THROUGH GNSS-1)

Many of the issues concerned with establishing a cost-effective and safe satellite navigation system and addressed in this section will also have implications for GNSS-2. In particular, liability and certification, frequency and orbit protection and interoperability are all critical.

6.1. Users needs and mission requirements

A cost effective service must be designed and implemented for both safety-related and commercial applications which are likely to develop as new services become available. It is important, therefore, that users needs are identified as early as possible. A definitive assessment of user needs therefore needs to be completed as soon as possible within the framework of the ETG. The Commission should monitor the situation, as far as possible, consult, as appropriate, user groups and industry and report to the GNSS High Level Group and the Space Advisory Group on progress. Users should be able to provide input to support

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[19] Research, technological development and demonstration work ('RTD') is under way under the 4th Framework Programme and elsewhere; further projects will be included in the 5th Framework Programme.

[20] see Annex I

the Commission's work and the website being created for the present GNSS office[21] will be one of the channels available for this.

Technical issues to be resolved include defining the level of service EGNOS should provide to serve a multi-modal community ('mission requirements'), with appropriate geographical coverage (which means identifying which other countries want to use EGNOS) and signal characteristics.

EGNOS is being developed to provide initial services from 2000 and to be capable of enhancement for more safety-critical uses by 2003[22].

6.2. Guarantees and Liability

If GNSS services are to be used for safety-sensitive civil applications, a solid legal framework will be required, establishing:

- guarantees that signals will be made available at or above a minimum guaranteed level of accuracy on a permanent basis;

- notice periods before significant changes (e.g. signal characteristics, frequency or infrastructure) can be introduced in order to allow governments, industry and users time to adapt;

- the scope of permissible action and timescales for the withdrawal, permanently or temporarily, of the provision of signals, including in case of force majeure (such as unavoidable technical failure of a system or part of a system or in the event of hostile action); and

- administrative or judiciary complaints procedures applicable and a regime defining the scope and limits of liability for different applications (requiring different levels of assurance).

Whether these issues can be resolved satisfactorily will have an important bearing on the final formulation of the GNSS system. For GNSS-1, which will depend on the signals provided by the GPS and GLONASS constellations, there is, therefore, a pressing need to negotiate with the US and the Russian Federation to determine whether acceptable and binding agreements can be reached. Agreements will also be needed to cover the EGNOS, WAAS and MSAS wide area augmentation systems. If such agreements can be concluded, they could form the basis for a wider international convention which might evolve as GNSS develops. If the guarantees cannot be obtained, an urgent decision will be required on possible alternative approaches: this could affect the development of the second phase of EGNOS and the structure of GNSS-2.

The Commission, supported by the ETG, should monitor discussions on liability in the international organisations (especially ICAO, IMO and IALA) and ensure that the

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[21] ref. article 5.207. The EIG agreement establishes a secretariat to provide administrative support and technical assistance to the EIG.

[22] Dates derived from ARTES-9 planning

Community approach is fully taken into consideration. This will require at least co-operation between Member States in preparing for meetings and co-ordination with other influential countries and blocks with approaches in line with the Community.

6.3. Certification

Before GNSS can be used for safety-related applications, it needs to be certified by appropriate bodies (on the basis of the guidelines produced by ICAO for aviation, IMO for maritime uses; there is no current equivalent for land transport). This includes the signal in space, the ground network and user equipment.

As a European system, it is clear that EGNOS should be certified at European level. Complementary systems (the US and Japanese wide area augmentations WAAS and MSAS) will also need to be certified by the relevant authorities and some form of mutual recognition may then be appropriate. The EGNOS service could be easier to certify for safety-sensitive applications than WAAS and MSAS since it will not be reliant on GPS alone but will have an alternative source of satellite signal should either GPS or GLONASS fail or become unreliable (temporarily or permanently).

The other key question is whether certification should be done mode by mode or whether there could be a generic certification procedure applied for all modes of transport. Efficiency argues for the latter approach if it is practically feasible.

6.4. Securing Frequencies and Orbits

For the development of GNSS, it is essential that the necessary frequencies are made available and adequately protected once GNSS is operational. Furthermore, it is important to secure the relevant orbits and ensure, as far as possible, that satellites are not liable to be affected or damaged by space debris. Similarly, any strategy must address the need to ensure that these navigation satellites themselves, when obsolete, are properly dealt with.

The recent World Radiocommunications Conference (WRC) in 1997 highlighted the importance of frequency issues for GNSS, both in terms of the requirement for additional frequency allocations as well as concerns the need to ensure that the operation of GNSS is not interfered with by other radiocommunications services. These issues will be discussed at the forthcoming WRC in 1999. It is recognised that the expanding demand for telecommunications services (such as mobile personal communication) may increasingly lead to conflicts of interests, as access to the frequency bands presently reserved for navigation is requested.

Specific frequency requirements for EGNOS and other European elements of GNSS should be identified and the scope for sharing of frequency bands should be explored. The Community must then ensure a common position on frequency issues in international organisations such as the International Telecommunications Union and its WRCs and make clear its commitment to ensuring necessary frequency availability for GNSS, while also ensuring that this commitment is implemented in a way that involves the minimum possible restrictions on other users of frequency bands.

Appropriate measures, including co-ordination of action with other interested countries, in particular the US, the Russian Federation and Japan as GNSS contributors, should be taken to ensure that the international community endorses the frequency requirements for GNSS at the

forthcoming WRC-99 and that parties comply with their obligations under the international framework for the allocation of radio frequencies.

6.5. Interoperability and optimum development and use of EGNOS

Optimum efficiency of the GNSS-1 infrastructure requires all the component elements in different countries, such as monitoring stations and control centres, as well as all the space-based augmentations being developed (e.g. in Japan and the US), to be fully interoperable. Technical discussions on interoperability should be pursued vigorously (see section 9 below).

At present, the GNSS ground infrastructure is largely being developed through national bodies providing contributions in kind. If this is not co-ordinated, it could lead to an unbalanced development of the infrastructure. The Commission, therefore, envisages that, in collaboration with ESA and the Member States, it should take action to develop a detailed blueprint of the required infrastructure (space and ground segments). Organisations contributing to the programme should, in future, select elements from among those included in the blueprint.

There are many countries outside the European region which will receive the EGNOS signal. In a number of these, current navigation aids are insufficient. Extension of the EGNOS ground network into these regions should, therefore, be considered, particularly since suitable monitoring activities outside the EU will considerably enhance the EGNOS/GNSS-1 solution. This will bring users early operational benefits through the improvement in safety of the transport system. Once again, the configuration should be based on a blueprint defining an optimal operational ground structure for EGNOS in order to ensure the best service at the lowest cost.

Implementation of ground stations beyond EU territory is not only important for EGNOS but could also facilitate the development of GNSS-2.

A final technical point is the need for harmonised geographic references to be used so that signalled positions can be directly related to digitised charts and maps. Co-ordination with the relevant international standardisation bodies is required.

6.6. Studies, Research and Technological Development

There are several important GNSS-related RTD projects and feasibility studies which have received or are proposed for Community funding. These include the development of multi-channel high-quality receivers which are vital to the success and commercial viability of the GNSS programme. Future RTD needs may, in particular, involve co-operation with the countries of Central and Eastern Europe, especially with the Russian Federation and include tasks related to improvement of manufacturing processes and identification of solutions for frequency issues and for the problem of space debris.

Increasingly, consortia are being formed for joint approaches to studies and RTD which is strongly encouraged and supported by the Commission. It will also be important to ensure that actions taken by the EU, Member States, ETG and agencies are complementary; this refers, in particular, to the work of ESA and its ARTES programmes as well as the thematic programmes, direct and indirect actions of the 5th FP.

7. GNSS-2

7.1. Options and consultations

The Community and ESA have been working on the GNSS-2 concept with industry which, using particularly the research framework, has already developed a number of proposals[23]. These are currently being evaluated. They include dedicated satellites for transport applications, building on the experience and success of GPS and GLONASS, as well as low or medium orbit constellations intended primarily for telecommunications but also able to carry navigation payloads, and micro-satellites. Questions to be addressed will inevitably include the adequacy of the navigation signal and the total cost of developing and maintaining the full navigation network in relation to the benefits it can provide. In any event, interoperability with other satellite navigation systems and services should be ensured.

Users requirements, possible applications and markets will need to be identified as early as possible in order to define an optimum level of performance which the system (space segment, ground segment and possible augmentations) should be designed to meet. This approach should promote fruitful public-private partnerships for pre-operational and operational phases. The possibility of accommodating, at the same time, navigation and other requirements (such as for military purposes and fraud prevention) will also be thoroughly explored.

As indicated in the strategy section, a further decision on deployment of GNSS-2 should be taken as soon as the technical and comparative studies have been completed and the results assessed in the context of progress on certification and enhanced GPS services becoming available. As appropriate, a timetable might then be proposed for the procurement phases of GNSS-2, including the development of a blueprint for the infrastructure, and for the experimentation, deployment and validation of the system. The respective roles of ESA and other GNSS-2 contributors would need to be determined.

7.2. Studies, research and development

Further studies, research and development and feasibility studies have a particularly important role for GNSS-2, in particular aiming at concept validation and demonstration, development and validation of generic technologies, optimisation of system design, implementation of early demonstration/pilot networks, specification of innovative systems supporting advanced services, improvement of manufacturing processes and identification of solutions for frequency issues.

The revised proposal for the 5th Framework Programme[24] allows for such types of action.

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[23] Current proposals for GNSS-2 procurement costs range from 300 MECU to 4000 MECU.

[24] Proposal for a decision of the European Parliament and the Council covering the 5th Framework Programme of the European Union for research, technical development and demonstration activities (1998 to 2002), COM(97) 142 final.

8. INDUSTRIAL ISSUES

By 2000, the European market for GNSS-related equipment and services is expected to exceed 4 billion ECU. Comparable markets are developing in the US, Japan and other parts of the world.

European industry is aware of the economic importance of this rapidly growing market and the opportunities it will offer in the future[25]. However, it starts from an unfavourable position: for equipment, European industry's present market share is only around 15% of the European market and 5% of the global market.

A key issue for the Community in the development of GNSS is therefore to ensure that European industry has a full opportunity to compete in all segments of the market (space, ground and user segments and value-added applications). In the proposed international negotiations, the Commission intends to treat as a priority the need to establish a fair basis for industrial co-operation. Inter alia, this means promoting access to technology developed by the military and to new specifications or standards being developed at the same time as international competitors, and the use of open procurement procedures.

Keeping industry informed through regular consultation should ensure maximum scope for involvement in the global market. Particularly in view of the number of interested groups, the technical complexity of satellite navigation solutions and the importance of a co-ordinated European approach, the Commission proposes to set up a specific dialogue with industrial interests, both producers through-out the chain from space infrastructure to service provision, and users in all transport modes.

This dialogue should promote the exchange of technical, scientific and industrial views as well as practical co-operation on GNSS and will be an important means of confirming users requirements. Contacts with other sectors using satellite technology should similarly be developed so that joint applications and synergies can be considered. Questions of standardisation, commercial confidentiality and intellectual property rights will need to be addressed. The scope of industrial involvement is likely to span industry in space, ground, applications and added-value services. Action to promote the emergence of new applications and added-value services will be considered.

The proposed approach to international co-operation and development should also create opportunities for the possible establishment of joint ventures between European and local industries.

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[25] For the US Global Positioning System (GPS), US estimates project equipment sales of $600 million in 1994, rising to $2 billion by the year 2000 and $30 billion by 2005; for integrated driver information systems alone, annual sales of $14 billion are expected by 2011, with the largest markets in Europe and Japan. (previously footnote 9) This also prompted the High Level Group on the development and competitiveness of space industry in Europe in January 1996 to recommend to the Commission that action be taken at the EU level. (see also previous footnote 22)

9. INTERNATIONAL ISSUES

Progress so far

The Commission has already started exploratory discussions with some international actors directly concerned by the global implementation of GNSS.

Discussions with the US are taking place on two levels. The New Transatlantic Agenda contains GNSS as a priority topic for discussions between the E.U. and the U.S. Meetings already took place in this context. Through these discussions the Commission intends to assess the feasibility of receiving guarantees on the availability of the GPS signals for EGNOS. Technical exchanges have also taken place in order to assess the feasibility of a joint approach for the use of geostationary satellites augmenting the GPS signals and to look at interoperability requirements.

The E.U. and Russia also recognise the importance of cooperation in this field in the framework of the Agreement on Partnership and Cooperation. It has been agreed that both sides should implement and strengthen the EU-Russia Dialogue on Space, continuing and reinforcing efforts to establish cooperation on the GLONASS system in view of further development of global satellite navigation for civil requirements. Exploratory discussions have already taken place, and studies are being carried out in the context of TACIS to identify areas for cooperation.

To ensure interopability between the Japanese programme MSAS and EGNOS technical exchanges on co-operation and interoperability have been initiated. These exchanges should enable an enhancement of the navigation conditions between Japan and Europe.

The Commission is supporting a study group of experts from the African region to investigate the possibility of implementation of GNSS.

Next steps

The suggested strategy for GNSS means building on contacts made so far to assess strategic options and negotiate equitable and binding arrangements with our international partners. The shape of the future GNSS will largely depend on the outcome of these negotiations.

There is a formidable agenda arising from the approach outlined above:

a) High level strategic discussions with relevant countries, particularly the US and the Russian Federation, on how they see the development of second generation systems, to assess whether the option of a jointly developed global system is feasible, or if the EU should press ahead with its own separate, but interoperable, regional component or global system.

b) negotiations with the US and the Russian Federation, as controllers of the basic signals, on service guarantees and liability and industrial issues for GNSS-1;

c) negotiations with the US, the Russian Federation and Japan, as operators of basic systems and wide area augmentations, on interoperability which is critical: GNSS can only succeed

fully if the infrastructure developed and installed in different countries and in space is fully compatible. This means both political agreement on the objective and technical agreement on the means;

d) regional co-operation with other interested countries and blocks, if the European approach is to be accepted as part of a global satellite navigation service. The full potential of EGNOS needs to be exploited, especially for the benefit of countries covered by the signal but where current navigation aids are insufficient (Africa, India, Southeast Asia, the CIS, China, South America and the Caribbean). Exploratory discussions should be urgently continued with a view to reaching provisional political and technical agreements, where possible within the frameworks of existing EU-third country co-operation agreements;

e) promotion of the Community strategy in the international organisations (e.g. ICAO, IMO, ITU) and emphasis on the Community's commitment to free trade and open markets: any breaches of international rules, such as on public procurement or barriers to trade, should be referred to the appropriate arbiters (e.g. WTO).

In this way, Europe can influence the definition of global standards. If the EU fails to take the opportunity, other countries with highly proactive policies will seize the market and the considerable industrial, commercial and employment opportunities for the EU will be irretrievably lost.

The strategic discussions, under (a) above, do not require a formal negotiating mandate, but are clearly of vital importance. On the basis of Council endorsement of the overall strategy, and on the conditions for co-operation on a joint system, the Commission would conduct discussions in the framework of the New Transatlantic Agenda, and the Partnership and Co-operation Agreement, and report back to the Council.

The Commission intends to submit a request for a negotiating mandate from the Council on issues (b) and (c). Proposals for common positions or negotiating mandates may also be necessary in the case of work going on with other countries and in the international institutions.

10. ORGANISATIONAL AND INSTITUTIONAL FRAMEWORK

10.1. Roles and responsibilities

Getting the right organisational set-up is essential if EGNOS is to be implemented on time. This has two main components, regulatory, and operational, and urgent decisions are needed on each. The setting up of appropriate organisational structures is also seen by the private sector as a test of the public authorities commitment to GNSS.

Up to now, a range of European actors, including the ETG, have been involved in developing the European contribution to GNSS. Many of the responsibilities assumed will sooner or later be passed to other organisations, though each body should continue to fulfil the functions it has assumed until they can be efficiently handed over. To ensure, as far as possible, that implementation and management of the European contribution to GNSS is carried out in line

with the timetable laid down and within budget, existing co-operation arrangements will be fully used, and the effectiveness of the present structures will be monitored and appropriate action taken where it is apparent that they can be improved.

GNSS raises new institutional issues for two main reasons: it is, intrinsically, international in scope, and it has applications in a wide range of transport modes, and beyond. The national regulatory and operational framework which has, to date, ensured the provision and maintenance of navigation aids is no longer, therefore, adequate: individual States will not be providing the navigation signals but will retain responsibility for them within their territories. Similarly, existing international bodies have responsibility for a single transport mode (e.g. Eurocontrol).

As in other cases, the Commission considers that regulatory and operational responsibilities must be kept separate.

Regulatory issues

The regulator would need to organise certification of EGNOS for safety sensitive activities. It could also have a role in licensing local area service providers and applications and monitoring interoperability agreements with third countries.

By 2000, there will be a need for a functioning safety regulator: if this is not achieved, implementation of EGNOS will be delayed, at least in respect of safety sensitive activities.

Rapid decisions on this are therefore needed, given the time that will be required to implement arrangements.

The regulatory structure should:

- First and foremost be in place quickly;
- Build on existing structures;
- Reflect the multimodal nature of GNSS;
- Ensure European responsibility for certifying satellite systems for Europe (in the longer term, if a global civil system evolves, it may be possible to carry out these responsibilities at global level).
- Ensure that the competences of member states and the Community are respected.

No existing bodies comply with these criteria. A system based on mutual agreement between competent national authorities to certify the EGNOS service could be envisaged by the Community, but this would be likely to involve duplication, and could create uncertainty as to the nature of regulatory requirements.

Given the critical importance of adopting a structure in good time for the introduction of EGNOS, the Commission considers that the most attractive option is to establish an organisation at EU level, respecting all Community law requirements, particularly concerning

the delegation of powers. This is likely to be quicker than negotiating the creation of a new international body with wider membership, and, though desirable, it is not essential for all countries (whether European or from other regions that may choose to use EGNOS) to be members of the regulatory body, at least initially. Further consideration is needed how best to draw on the expertise of existing bodies such as Eurocontrol, and on the involvement of third countries.

Operational issues

On the operational side, a number of separate roles can be distinguished, and further work is needed on the best organisational structure to encompass them.

The functions are:

- The service guarantor, which is responsible for ensuring that a service is provided, and would need to accept the responsibility from the Member States for establishing and maintaining the service. It is recommended that the guarantor is established as soon as possible.

- The operator of the EGNOS service. This is distinct from responsibility for ensuring that there is a service. It could, for example, be carried out through a public private partnership .

- Ownership of the infrastructure is the final organisational issue which needs to be considered at this stage of GNSS development. The infrastructure has, to date, been built by national contributors and ESA. However, since ESA cannot, under its constitution, own infrastructure once its development and deployment have been completed, there is a need to establish an appropriate structure by 2001/02.

The working group set up by the High Level Group[26] should consider these issues and the linkage between ownership, operation and guaranteeing the service. Given the importance of putting appropriate structures in place in good time, it should make its recommendations by July 1998.

10.2. The civil/military interface

The question of military involvement in GNSS needs to be addressed. This includes assessing the possibility of a military-controlled system being approved for civil uses or of a GNSS-2 answering military concerns concerning, on the one hand, possible misuse and, on the other, meeting military needs. The possible further development of dual use (civil/military) technology[27], the risk of jamming, and possible synergy between military and civil user

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[26] The high level co-ordinating group is composed of representatives of national governments, users, telecommunications operators, the relevant international organisations, particularly the European Space Agency, ICAO and Eurocontrol, and industry: *cf.* the 1994 Council Resolution.

[27] *cf. Commission* Communication on the Challenges facing the European Defence-Related Industry, COM

requirements must also be investigated. These issues are currently being considered by a working group set up by the High Level Group, in contact with the relevant organisations and interests. Appropriate channels for the exchange of information between civil and military interests should be identified.

11. FINANCIAL ISSUES:

i. Development costs

Preliminary studies of EGNOS indicate that the future GNSS will be more economic than the present systems in providing navigation services for civil aviation and other modes of transport.

The first stage of EGNOS development is costing approximately 270 MECU, including contributions from ESA Member States and Eurocontrol (contribution in kind). The Community contribution (1995-1999) is intended to amount to 50 MECU, covering primarily the access charge to the navigation transponders on the Inmarsat and Artemis satellites.

The second stage of EGNOS development would require a further investment of the order of 130 MECU. The Community would again be likely to contribute although it is too early to estimate how much would be required. This would depend, inter alia, on the degree to which users were paying for the system.

To support development in third countries where Community aid and assistance programmes are already widely used and, at the same time, to maximise the potential service which EGNOS can provide, ground stations would be needed in Africa, South America and the Caribbean, Central and Eastern Europe, and the former Soviet Union at a cost of around 50 MECU.

For GNSS-2, there are a considerable number of option, representing diverse concepts still to be evaluated, for which procurement costs range from 300 MECU to 4000 MECU.

ii. Financial planning

It is difficult at this stage to determine the optimum approach to funding the development and operation of the second generation GNSS since its nature and specification remain to be finalised. The Commission has initiated studies of the different options and should be in a position to make recommendations in 1998, based on the estimated cost/benefit ratio[28] . Other countries are also examining costs and benefits of different options and the Commission will monitor results. A business case and cost estimates will be provided before decisions are

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[28] Throughout this Communication, the term 'cost/benefit' should be understood not to be restricted to income and expenditure but to include an assessment of all relevant considerations, such as related cost savings and efficiency gains, environmental impact, employment potential and socio-economic implications.

required.

The European contribution to GNSS is clearly an important project eligible for funding under the Trans-European Networks budgets. A multi-annual indicative programme may also be considered at an appropriate time in the light of progress. For research and development activities, it is intended that the 5th Framework Programme should be used to support GNSS development.

Further, the Community should ensure that EGNOS provides operational benefits as widely and as early as possible. Inter alia, this implies the development of infrastructure outside the Community territory (such as ground stations forming part of the EGNOS monitoring network). Support from the European Investment Bank (EIB) and the European Investment Fund (EIF) may also be available for GNSS development. The possibilities of using Community funding instruments to support this will be further investigated. Such projects would benefit the developing countries by meeting their infrastructure requirements cost-efficiently.

iii. Charging options

Public authorities clearly have a central role in ensuring the provision of navigation services but this does not mean that the public sector should necessarily bear the costs of such systems. Indeed, it would be more consistent with the general thrust of Community Transport policy for the user to cover the costs. Accordingly, the aim should be for GNSS to be close to self-financing in the medium term : indeed, development, implementation and operation on a commercial basis is not impossible. Charging in this area should be consistent with the more general approach to infrastructure charging that will be set out in the forthcoming White Paper.

However, there are two major constraints in this area:

- the fact that there is already a free service (from GPS and GLONASS) may limit users' willingness to pay for a new, even if improved, service;
- there is a very broad range of potential users, some of which it will be more difficult to identify and charge than others.

It is clearly too early to take decisions on charging, which are closely linked both to the broad options for GNSS-2 that are adopted, and to the organisational structure that develops, but any system should ensure that different groups of users are treated on a non-discriminatory basis. The Commission will, therefore, carry out further work on the feasibility and desirability of different charging options. These might include:

- charges on the purchase of receivers (for all modes);
- integration in existing user charging frameworks (primarily aviation and maritime);
- charging for licenses for service providers (or some form of auction);

- coding of the EGNOS signal, which would allow charging for decoders (as with satellite TV);

- cover by a liability regime being subject to users paying a registration fee with a designated authority (like an insurance premium).

The Commission invites comments on which of these options should be pursued further.

12. SATELLITE AND TERRESTRIAL SYSTEMS : ESTABLISHING A EUROPEAN RADIO-NAVIGATION PLAN

While pursuing optimum development of satellite systems, it is important for the EU to have a strategy that covers both satellite and conventional terrestrial systems. This will be the European Radio Navigation Plan envisaged in the TENs so as to avoid unnecessary expenditure and to ensure the safety of navigation. this communication represents a first step towards establishing an ERNP.

Terrestrial systems (which are described in Annex IV) are likely to play an important role in their own right and as back-up to satellite systems in the short to medium term, although, once in place, satellite-based navigation will be cheaper to maintain and operate than alternative terrestrial means. Some existing systems are being withdrawn; others may need to be maintained and developed. The criteria which affect the future phasing out of terrestrial systems can be identified : essentially, terrestrial aids become superfluous once GNSS is certified for a particular level of service in a particular location, subject to there being adequate back-up so long as there is any possibility of the GNSS service becoming unavailable.

However, the essential decisions on terrestrial systems (i.e. which systems to maintain, develop and when) can only be taken when the overall planning and progress on GNSS and the performance standards and a timetable for certified GNSS services have been settled.

But the High-Level Group is engaged in important preparatory work, with the Commission, in identifying technical conditions, in terms of service provision, that will allow specific terrestrial services to be run down. National radio-navigation plans of the Member States and of third countries will also have a significant bearing on the final proposals.

It is unlikely in the near future that a single system will meet all requirements. To implement a positioning and navigation network, there is therefore a need to define and regularly re-evaluate the role of terrestrial systems as GNSS services develop. This should establish the radio-navigation systems mix for the provision of comprehensive services in the short to medium term. Users will participate in the consultation. It is expected that the Commission should be able to begin work on developing such a European Radio-Navigation Plan in 1999, covering both satellite and terrestrial systems.

In the meantime, the Commission will also cooperate with the Member States wishing to improve the coverage or performance of radio-navigation aids and associated equipment, such as geographic reference systems and digitised maps. To do this, the Commission will consider suitable requests for funding under the RTD frameworks or the TENs budget. The Commission will thus seek to encourage the maintenance and, as appropriate, development of existing systems to ensure that terrestrial radio-navigation aids meet the needs of users in a

way which is consistent with the development of GNSS.

13. CONCLUSIONS AND RECOMMENDATIONS

1. Overall strategy

- the EU should confirm the importance of GNSS for the Trans-European Networks;
- the EU should continue with EGNOS implementation, using both GPS and GLONASS signals, as our contribution to GNSS-1;
- the ideal long term position is a global system involving the EU and some, or, preferably, all of our international partners in a GNSS for civil use; if this is not possible, the EU will need to opt for an independent European GNSS;
- through intensive contacts with our main international partners, the possibility of achieving an acceptable joint system should be urgently assessed, based on the following conditions:
  - firm guarantees from the outset that the service (on which Europe will depend for certain vital and safety-related applications) will not be withdrawn or disrupted, with, ultimately, a full EU role in the control of the system;
  - full European participation in its design, development, and operation
  - and an opportunity for European industry to compete fair and freely in all segments of the market.
- The importance of these discussions needs to be recognised. It is therefore proposed that they should be launched at the highest level, in the context of our bilateral relationships. The Commission would conduct the discussions, and would keep the Council fully informed.
- meanwhile, Europe should intensify work on developing a European approach to GNSS-2, including through use of the 5th Framework Programme, to ensure the option of developing a fully independent European system remains open;
- a decision on the approach to GNSS should be taken on the basis of progress in international discussions, developments affecting GPS and GLONASS, and the evaluation of technical and financing options. The target date for initiating the decision-making process on GNSS should be the first quarter of 1999, when the Commission will come forward with recommendations.

2. Implementation

Putting GNSS-1 in place

- Binding guarantees from the US and the Russian Federation on signal availability and accuracy should be sought, in order to allow EGNOS/GNSS-1 to be accepted as a primary

navigation aid for defined safety-sensitive applications;

- a detailed blueprint of the required infrastructure (space and ground segments) should be prepared, to avoid unnecessary duplication and ensure value for money.

Financing

- The Community should continue to fund work on GNSS-1 and 2 from the TENs and Research Budgets, pending decisions in early 1999. Firm financial arrangements for achieving the European contribution to GNSS should be put in place, when strategic decisions are taken early in 1999;
- options for charging for GNSS-1 and 2 services should be explored, with the objective of approaching self-financing in the medium term. This will provide a key element, together with the cost-benefit analysis of the options, for taking decisions on financing GNSS2 in whatever form it takes;

Industrial issues

- recognising GNSS as a significant opportunity for the EU space and high technology industries and its potential dual civil/military use, a specific dialogue on GNSS issues should be set up with industrial interests, both producers and users;

International dimensions

- The top priority must be the discussions with our partners on the possibility of joint development of a system that meets our criteria of acceptability, since this is vital to forthcoming strategic decisions;
- Contacts with relevant third countries should also be intensified on other issues, focusing on the questions of service guarantees and liability, interoperability, and wide acceptance of the European contribution to GNSS
- European institutions, Member States and industry should promote the EU position in international meetings. In particular, the Community should identify specific needs for frequency, orbits, etc, and ensure these are recognised and endorsed in the relevant international fora and ensure that EGNOS is presented to third countries as a viable component of GNSS and a valuable navigation tool available for their use;
- mandates will be drafted for negotiations:
  - with the US and the Russian Federation, particularly on service guarantees and liability for GNSS-1;
  - with the US, the Russian Federation and Japan on interoperability of EGNOS, WAAS and MSAS;

Discussion should also go forward with other countries which might wish to use EGNOS themselves. This may also require consideration of the case for using Community financial instruments.

Organisational/institutional issues

- Timely implementation of EGNOS requires clear regulatory structures and a structure for operating the system. Therefore:
  - a body at EU level should be created to regulate satellite navigation services and, possibly, local area augmentation services. This would, in principle, cover all modes of transport, and other uses. Further consideration is needed on its precise mandate

and its link with other organisations, such as Eurocontrol and the future European Safety Agency;

- further work is needed, with the GNSS High Level Group, to allow decisions before the end of 1998 on a legal and operational structure, initially for EGNOS and GNSS-1. This should cover the functions of service guarantor (accepting legal liability for maintaining the service) and operator of the EGNOS service (possibly a private-public partnership); the questions of who will take over ESA's role and ownership in general of the infrastructure must also be dealt with;

- questions of the civil/military interface need to be addressed as a priority.

Terrestrial/conventional systems

- GNSS will allow the phasing out of a number of conventional navigation systems but it would be premature to make detailed plans for this until definitive decisions on GNSS implementation have been taken. At that point, the Commission will elaborate proposals, in consultation with the High Level Group. Meanwhile, significant new investment in such systems does not seem justified.

3. Next steps

The Community institutions are invited to endorse the overall strategy and the action plan. On that basis, the Commission will pursue the action set out in these conclusions.

ANNEX I: ACTION PLAN

para.	Action: *Overall strategy*	Lead responsibility	Date
5	press ahead with EGNOS implementation, using both GPS and GLONASS signals, as EU contribution to GNSS-1	ETG	AOC in 2000
5	Assess whether the objective of a single global system involving the EU and some or all of its international partners in a GNSS fully meeting EU conditions is possible: this requires intensive contacts with the EU's main international partners.	Commission, on basis of Council conclusions	Report back for decisions in Q1 1999
5	Intensify co-ordinated work on GNSS-2 to ensure the option of developing a fully independent European system remains open;	Commission, ETG assisted by HLG	Ongoing, from now
5	take a decision on the approach to GNSS-2, taking into account progress in international discussions, developments affecting GPS and GLONASS, and new concepts under development .	Council on basis of Commission proposal	Take decisions-by mid- 1999

para.	Action: *Establishing cost effective and safe satellite navigation in Europe (initially through GNSS-1)*	Lead responsibility	Date
6,1	Establish definitive mission requirements for EGNOS, based on evaluation of users needs and of desired geographic coverage of system: identification of user needs for aviation identification of user needs for other modes	ETG Eurocontrol Commission	completion end 1998
6,2	seek binding guarantees from the US and the Russian Federation on signal availability and accuracy, in order to allow EGNOS/GNSS-1 to be accepted as a primary navigation aid for defined safety-sensitive applications	Commission, on basis of Council mandate	completion in 1999
6,5	Ensure interoperability of wide area augmentation systems (in particular, EGNOS, WAAS and MSAS), including relevant guarantees and liability clauses	Commission, supported by ETG	completion in 1999
6,5	Consider the development of an international convention on rights and obligations (including liability)	Commission	1999-
6,3	Support certification of EGNOS through developing safety assurance files to permit the approval of its use in regulated applications for all modes of transport	ETG, pending establishment of specific body	1998
6.5	Promote geographic reference harmonisation, in co-operation with relevant international bodies	ETG /Community	completion in 1999
6.5	Prepare a detailed blueprint of the required infrastructure (space and ground segments), to avoid unnecessary duplication and ensure value for money: for the initial service level	ETG members, with HLG subgroup	by end 1998
6.6	Identify needs for RTD and feasibility studies and support them from Community funds in close co-operation with ESA programmes (validation, demonstration, pilot projects, promotion of commercial applications, user equipment development, etc.)	Commission, member states, ESA/ETG	1998-

para.	Action: *GNSS-2*	Lead responsibility	Date
7,1	Co-ordinate studies and RTD activities to assess the technical feasibility of alternative proposals for system architecture, as well as their potential compliance with user needs, estimated development and operational costs, the feasibility of certification for defined safety-sensitive uses and financing options	Commission/ETG/ member states	1998
7,1	Support the comparison of alternative proposals and the selection of the best option	Commission	1998-9
7,2	Identify needs for further studies and research under the 5th Framework Programme to support the development, demonstration, optimisation of design and final validation of that system.	Commission	1999-

para.	Action: *Industrial aspects*	Lead responsibility	Date
8	Establish a systematic and regular dialogue on GNSS issues with industrial interests, both producers and users, with a view to: - validating user requirements - keeping industry informed - promoting synergies between different sectors - promoting the development of value added services and applications.	Commission/ETG	Commencing Q1 1998

para.	Action: *International dimension*	Lead responsibility	Date
5	Pursue high level discussions to, in context of existing structures for bilateral relationships (notably New Transatlantic Agenda, Partnership and Co-operation agreement with Russia)	Commission, on basis of Council conclusions	Report back for decisions in Q1 1999
9b,c,d	Intensify contacts with relevant countries to establish an appropriate framework for GNSS operation and use. In particular, this concerns the following: • The US and the Russian Federation, related to GPS and GLONASS respectively, particularly on service guarantees and liability for GNSS-1 • The US, the Russian Federation and Japan on interoperability of EGNOS, WAAS and MSAS • Africa, India, the CIS, China, South America and the Caribbean on use of GNSS to improve current navigation infrastructure and optimise coverage and use of the global system Mandates should be drafted for negotiations on the first two issues	Commission/ETG Commission, for submission to Council	1998 End 1998
6,4	ensure a common position on the frequency and orbit requirements for GNSS in international meetings such as WRC, on the basis of established requirements	Commission and Member States	1998-99
9	ensure co-ordination, as necessary, and promote the EU position on issues such as scope to interrupt or materially alter the provision of services, liability, standards and authorised uses of GNSS services in international meetings (e.g. in ICAO, IMO, IALA)	Commission , member states	1998-
9	seek co-operation with like-minded third countries in discussions on GNSS development, standards and practices in international fora	Member states, Commission/ETG	1998-
9e	pursue a free trade policy in GNSS, referring any unfair practice to the appropriate international body	Community	1998-

para.	Action: *Organisational/institutional issues*	Lead responsibility	Date
10.1	Establish a regulatory structure for EGNOS: taking into account possible links with other organisations, such as Eurocontrol and the future European Safety Agency, an EU level body should be created to regulate services provided using EGNOS and, possibly, local area augmentation services	Commission/ HLG/ ETG	In operation by end 1999
10.1	intensify work on legal and operational structure for EGNOS to allow decisions before the end of 1998, initially for EGNOS and GNSS-1, covering liability for service provision, operation; and ownership Establish transitional arrangement before the legal and operational structure is established	Subgroup of HLG and ETG ETG	1998 1998
10.2	analyse questions of the civil/military interface urgently so they can be taken into account in overall strategy decision and in development of GNSS	Working group set up by HLG	initial report by end 1998

para.	Action: *Financing*	Lead responsibility	Date
	Drawing on work below, to put forward proposals for financing of proposed EU strategy for GNSS	Commission	Q1 1999
11.ii	• finalise business plan for EGNOS, based on decisions on technical options, on work on user charges and prospects of private sector involvement in operations • assess need for Community budget multi-annual allocation for GNSS • consider use of Community financial instruments to support the offer of use of EGNOS in third countries	• ETG • Commission • Commission	by end 1998 by end 1998 1998-
11.iii	explore options (through external studies) for charging for GNSS-1 and 2 services, with the objective of approaching self-financing in the medium term	Commission, with ETG and member states	1998-

para.	Action: *Terrestrial Systems*	Lead responsibility	Date
12	establish which terrestrial systems can be run down and when	Commission and HLG subgroup	initial work in 1998; validation after decisions on GNSS strategy
12	support the development of necessary local area augmentations in a cohesive network to minimise costs and ensure interoperability	Member states/ Commission/ ETG	1998-

para.	Action: *Establishing a coherent European Radio-Navigation Plan*	Lead responsibility	Date
12	revise the action plan, as required, and develop a European Radio-Navigation plan, covering both satellite and terrestrial systems	Commission	Commencing 1999

ANNEX II: ACRONYMS

GNSS: (Global Navigation Satellite System)	a world-wide position, velocity and time determination system which fulfils on a permanent basis potential user requirements for civil applications
• *GNSS-1*	an initial implementation of GNSS, based on GPS and GLONASS augmented by civil systems (such as EGNOS, WAAS and MSAS) designed to provide the user with sufficient independent monitoring of the whole system
• *GNSS-2*	a world-wide civil navigation satellite system to be internationally controlled and managed, which meets the requirements of all categories of users for position, velocity and time determination and capable of providing a sole means of navigation for defined applications
GPS: (Global Positioning System)	satellite navigation and positioning system developed and operated by the USA
GLONASS: (Global Navigation Satellite System)	satellite navigation and positioning system developed and operated by the USSR (now operated by the Russian Federation)
Differential GNSS:	a correction of basic satellite signals (GPS and GLONASS) calculated at a ground station and broadcast to provide local or wide area enhancements of services
EGNOS: (European Geostationary Navigation Overlay Service)	regional augmentation of GPS and GLONASS being developed by Europe, using geostationary satellites with a ground network of monitoring stations and a control centre. EGNOS is the European component of GNSS-1. 1. initial service level (from 2000): capable of use as a prime means of navigation for defined applications (accuracy ± 20 metres) 2. full service level (from 2003): capable of use as a sole means of navigation for defined applications (accuracy ± 5 metres); requires additional infrastructure
MSAS: (Multi Satellite-based Augmentation System)	regional augmentation of GPS being developed by Japan
WAAS: (Wide Area Augmentation System)	regional augmentation of GPS being developed by USA
LAAS: (Local Area Augmentation System)	local area augmentation, generally required for specific applications, such as precision navigation (eg. to support aircraft landing in poor visibility) or enhancement of satellite signals where necessary because of geographic situation (eg. the far north, being far from the augmentation satellites which are geostationary over the Equator). These may form sub-regional networks.

ANNEX III: FINANCIAL STATEMENT

1. TITLE OF OPERATION

Communication from the Commission: "Towards a Trans-European Positioning and Navigation Network."

2. MAIN BUDGET HEADINGS INVOLVED

B2-702	Specific measures, in particular in transport safety.
B2-704	Establishment and development of a common sustainable transport policy.
B5-700	Financial support for projects of common interest in the trans-European network
B6-7	Scientific and technical support activities Telematics applications of common interest Transport (Research Programme)

Other budget headings will be used as appropriate notably following approval of the 5th Framework Programme.

3. LEGAL BASIS

One or more of the following depending on the actions undertaken:

Articles 74, 84(2), 113, 129c and 130i of the Treaty.

Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network.

Council Regulation (EC) No 2236/95 of 18 September 1995 laying down general rules for the granting of Community financial aid in the field of trans-European networks.

Council Decision of 23 November 1994 adopting a specific programme for research and technological development, including demonstration, in the field of telematics applications of common interest (1994 to 1998).

Council Decision of 15 December 1994 adopting a specific programme for research and technological development, including demonstration, in the field of transport (1994 to 1998).

Proposal for a Council Decision concerning an agreement between the European Community, the European Space Agency and EUROCONTROL on a European contribution to the development of a Global Navigation Satellite System (GNSS) COM(97) 442 final of 23 September 1997.

4. DESCRIPTION OF OPERATION

4.1. General objective

The strategy proposed contributes to the implementation of a trans-European positioning and navigation network. The objective of establishment of such a network is to improve the efficiency of transport systems by placing at the disposal of users a system allowing geographical positioning. This contributes to development of sustainable and safe mobility for persons and goods, one of the fundamental objectives of the Common Transport Policy. The strategy also supports other Community policies such as for employment, industry, environment, cohesion and co-operation and development.

This initiative will also enable European industry to access export markets currently dominated by the US which uses public funding to assist its national industry.

4.2. Period covered and arrangements for renewal or extension

1998 - 2002

5. CLASSIFICATION OF EXPENDITURE OR REVENUE

5.1. Non-compulsory expenditure

5.2. Differentiated appropriations

5.3. Type of revenue involved

Not applicable

6. TYPE OF EXPENDITURE

- Subsidy for joint financing with contributions from other parties (European Space Agency, EUROCONTROL);
- Research and Development activities (Framework Programme);
- Feasibility studies and demonstration projects (maximum Community contribution: 50%) eligible for financial aid under the TEN;
- Feasibility studies and demonstration projects.

7. FINANCIAL IMPACT

7.1. The decisions put forward in this Communication have only limited financial impact and do not require resources additional to those already envisaged in the existing financial programming or, for the TEN's, in a reasonable extrapolation of resources beyond 1999. But the strategy that is proposed will involve subsequent decisions (for example on GNSS-2, the range of options under discussion is from 355 MECU to 4 BECU).

This financial fiche therefore deals only with the areas where financial implications are clearer:

- Ongoing spending from the TENs Budget on implementation of the Community component of GNSS-1, EGNOS, and on the initial stages of GNSS-2;
- Research and development activity, mainly on GNSS-2, where the Commission's proposal for the Fifth Research Framework Programme already identifies this as a priority: both in the key action on Sustainable mobility and intermodality in the programme on competitive and sustainable growth, and that on systems and services for the citizens in the Programme on the information society.

The two main areas in which the strategy proposed would involve subsequent decisions requiring additional finance are:

- A decision on implementation of GNSS-2, where it is planned that decisions will need to be taken in early 1999. The Community contribution will need to be financed mainly from the TENs and RTD Budgets;
- If the EGNOS system is to be made available in third countries, in Eastern Europe, FSU, Latin America and the Caribbean, or Africa, this may require mobilisation, in agreement with the countries concerned, of the relevant Community financial instruments.

7.2. Itemised breakdown of cost[1],

ECU million (current prices)

Breakdown	1998	1999	2000	2001	2002	Total
TENs *(B5-70)*	17	[20]	[20]	[25]	[25]	[107]
Research *(B6-7)*	4	[20]	pm	pm	pm	pm
Total	21	pm	pm	pm	pm	pm

[1] figures applicable from 1999 are indicative and depend on the approval procedures of the respective instruments and the Action Plan timetable.

7.3. Indicative schedule of appropriations

ECU million (current prices)

	1998	1999	2000	2001	2002	Total
Commitment appropriations	[21]	pm	pm	pm	pm	pm
Payment appropriations						
1998	[8]					
1999	[8]	pm				
2000	[5]	pm	pm			
2001		pm	pm	pm		
2002			pm	pm	pm	
N+5 and subs. yrs				pm	pm	
Total	[21]	pm	pm	pm	pm	pm

8. FRAUD PREVENTION MEASURES

The fraud prevention measures contained in each of the instruments which are proposed to finance the different operations will apply. These include inspections, reporting, monitoring and evaluation under Regulation 2236/95, laying down general rules for the granting of Community financial aid in the field of trans-European networks: in particular, Articles 12(4) and (5) provide for regular on-the-spot checks by Commission staff and Articles 15(5) and (7) provide for monitoring and evaluation. Similar measures exist for the other Community financial instruments involved.

9. ELEMENTS OF COST-EFFECTIVENESS ANALYSIS

9.1. Specific and quantified objectives; target population

The European contribution to the development of a GNSS requires substantial resources (see Commission communication COM(94) 248 of June 1994 on satellite navigation services). For the current GPS, US public investment has already amounted $ 10 billion and the annual cost of sustaining the constellation is estimated at $ 420 million. The Russian Federation also operates a satellite constellation which has consumed considerable sums of public money.

The level of investment by the US and Russian/Soviet governments illustrates the strategic importance they attribute to this infrastructure. Without a clear strategy and commitment in this emerging field, the EU would be dependent on their systems for safety-critical applications (aviation, maritime) without any guarantees on continuity and acceptable levels of service.

The Community strategy has the following objectives:

— improving the efficiency of the multi-modal transport system (increasing traffic capacity, reducing environmental damage caused by transport, monitoring consignments of dangerous or polluting substances, etc.) while increasing safety;

— ensuring close co-operation between Member States and institutions in order to maximise benefits and minimise costs at the Community level

and to support the development of interoperability within a global system appropriate to present day and future transport needs;

— allowing European industry to compete fairly and freely in all segments of the developing satellite navigation equipment and services market with transport and other applications;

— supporting technological development in the space sector (access to new satellite technology).

9.2. Grounds for the operation

— The Community contribution should be seen in the context of the measures to implement the guidelines for the development of the trans-European transport network, particularly the navigation and positioning network. Organising co-operation on a clear strategy using the resources available in Europe is the only means of ensuring a role for the Community in the development of a GNSS.

— Community action is allowing the establishment of space infrastructure to transmit navigation signals across a wide area for the benefit of Europe as a whole. However, to obtain the benefit, a project of considerable scale is required. Council Resolution 378/94 of 19 December 1994 called on the Commission to prepare the necessary proposals. The Council further adopted a negotiating mandate in June 1996 for an Agreement between the EU, ESA and EUROCONTROL to be concluded.

— The Commission recommended in its Communication on Space (COM(96) 617 final of 4 December 1996) the preparation of a specific action plan to develop GNSS as a key space application for European industry.

9.3. Monitoring and evaluation of the operation

The operation must be monitored and evaluated on the basis of the following criteria:

— contribution to sustainable mobility through increase in air space and other traffic capacity,

— reduction of environmental damage caused by transport and monitoring of consignments of dangerous or polluting substances;

— improved safety, leading to a reduction in the number of accidents caused by guidance system error or failure (landing/ docking, collisions between vessels, etc.)

— rationalisation and optimisation of navigation systems, leading to a more coherent and interoperable global navigation aid structure appropriate to present day and future transport needs;

— allowing European industry to compete fairly and freely in all segments of the developing satellite navigation market, including commercial transport and other applications, development and maintenance of satellite equipment, ground stations and receivers;

— supporting technological development in the space sector (access to new satellite technology).

10. ADMINISTRATIVE EXPENDITURE (PART A OF SECTION III OF THE GENERAL BUDGET)

The allocation of administrative resources for this action will depend on the annual Commission decision on allocation of resources, taking particular account of additional staff and resources granted by the budgetary authority.

10.1 Effect on the number of posts

Type of post		Staff to be assigned to managing the operation		Source		Duration
		Permanent posts	Temporary posts	Existing resources in the DG or department concerned	Additional resources	
Officials or temporary staff	A	4		2	2	3
	B	2		1	1	3
	C	1		1		3
Other resources						
Total		7		4	3	3

10.2. Total financial impact of human resources

(ECU)

	Amount	Method of calculation
Officials **Temporary agents** **Other resources** (indicate budget heading)	2 205 000	7 x 3 years x 105 000
TOTAL	2.205000	

The amounts express the total cost of the additional posts over the total duration of the operation (if fixed) or for 12 months (if indefinite).

10.3. Increase in other operating expenditure as a result of the operation

(ECU)

Budget heading (number and title)	Amount	Method of calculation
A-7010 (Missions, travel...)	105 000	30 annual missions within the Community 25 annual missions outside the Community
TOTAL	105 000	

Estimated expenditure on missions, by redeployment of existing resources: Article A-130:

Terrestrial systems

Local Area Augmentation

Ground-based augmentations systems are necessary to complement wide area systems and for specific local requirements, such as accurate positioning signals in the northernmost latitudes. Currently they are intensively deployed as differential stations for GNSS signals[1].

Local area augmentations will, in the future, re-transmit the signals provided by wide area augmentations. Unplanned proliferation of local area augmentations could lead to unnecessary expenditure by States and may prejudice interoperability (if there is a lack of continuity of service or inconsistencies between the local area signals). It is, therefore, vital that the local augmentations are developed in a network form. This issue is already being addressed in northern latitudes (where geostationary satellites located over the Equator cannot provide adequate coverage) in the creation of an integrated sub-regional network.

Differential GNSS through Loran-C

Research has demonstrated that differential satellite corrections and integrity signals can be transmitted through the Loran-C network allowing Loran-C to achieve enhanced accuracy of 10-20 metres. Known as 'Eurofix,' this approach may give wide area coverage, cost-effective use of existing infrastructure and back-up in case either system fails. Further, the low frequency of the Loran-C signal gives good penetration in areas where satellite signals may be weak (e.g. in urban environments). This factor means that Loran-C is also potentially suitable for certain specialised applications, such as tracking and tracing. These possibilities also need further investigation. ESA has provisionally endorsed the value of Loran-C in improving GNSS integrity, although more detailed research is needed to finalise the position.

However, the development of a suitable combined GNSS/Loran-C receiver will be necessary if full advantage is to be taken of these possibilities. This is currently being considered in the context of RTD activity.

Aviation Systems

For aviation, Eurocontrol's European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) is a comprehensive approach to developing a new harmonised and integrated European air traffic control system. Under the programme, several sub-groups have been established to deal with navigation. Their progress and

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[1] Differential GNSS is a means of providing corrections of basic satellite signals (GPS and GLONASS) to enhance the service available in a particular area. EGNOS is an example of wide area differential GNSS.

recommendations on future navigation system requirements for aviation need to be monitored and reflected in the development of the Community strategy. Relevant standards adopted by Eurocontrol can be incorporated into Community law through the provisions of the Directive on the harmonisation of air traffic management equipment (Directive 93/65/EEC of 16 December 1994).

Maritime Systems

For maritime transport, new harmonised and integrated European control and reporting systems are being developed. The equipment to comply with navigation requirements must be certified as in accordance with the relevant testing standards, which are laid down in Community law through the provisions of the Directive on marine equipment (Directive 96/98/EEC of 20 December 1996), which concerns, for example, receivers for both satellite and terrestrial navigation signals. Progress and recommendations in the international fora on future navigation system requirements need to be monitored and reflected in the development of the Community strategy.