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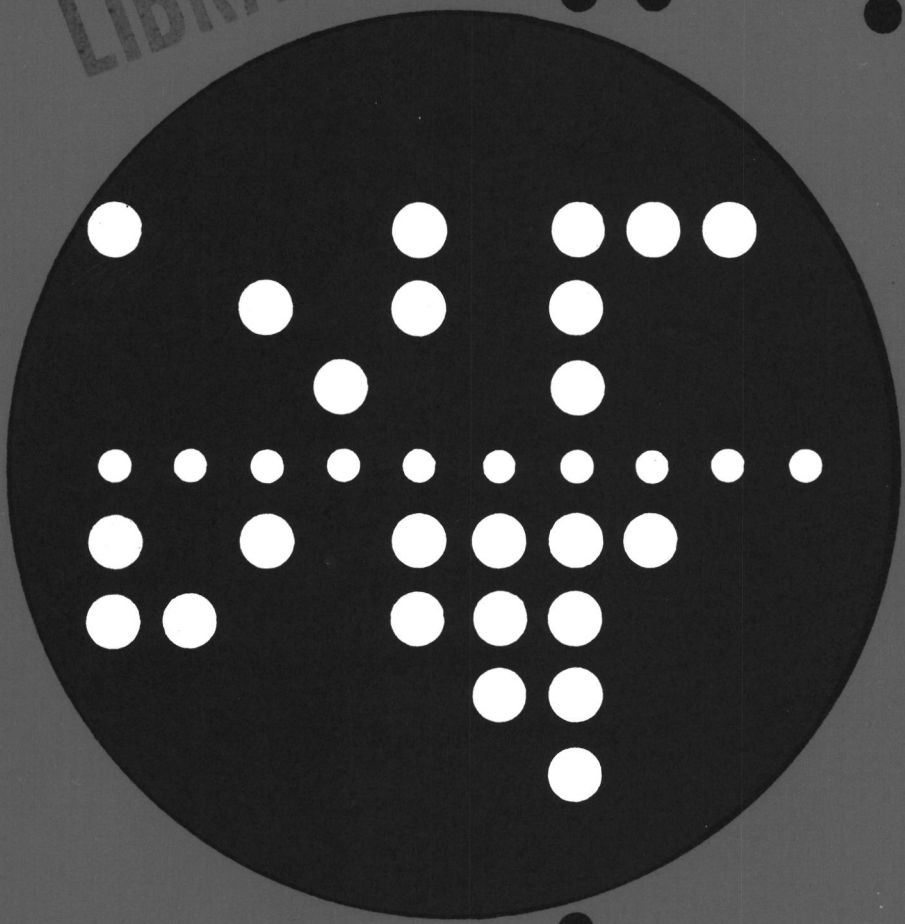

Computing Centre Newsletter

September 1977 No 14

Contents

Note of the Editor

The present Newsletter is published monthly except for August and December.

The Newsletter includes:

- Developments, changes, uses of installations
- Announcements, news and abstracts on initiatives and accomplishments.

The Editor thanks in advance those who want to contribute to the Newsletter by sending articles in English or French to one of the following persons of the Editorial Board.

Note de la Rédaction

Le présent Bulletin est publié mensuellement excepté durant les mois d'août et décembre.

Le Bulletin traite des:

- Développements, changements et emploi des des installations
- Avis, nouvelles et résumés concernant les initiatives et les réalisations.

La Rédaction remercie d'avance ceux qui veulent bien contribuer au Bulletin en envoyant des articles en anglais ou français à l'un des membres du Comité de Rédaction.

Editorial Board / Comité de Rédaction

Computing Centre References

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Graphical and Printing Workshop, JRC Ispra

The Outlines of the Computing Centre

The next pages give a schematic standard information on the Computer Centre. The material is represented mainly as tables. Some of these tables will be published in the future only in case of modifications, others will show up in each edition of this newsletter. It is advisable to file this material for reference purposes.

The second two tables specify the hardware configuration, illustrated by the schematic layout of the components. We intend to describe the specific characteristics of some of the hardware items more in detail in following editions of the newsletter.

The third table might be useful in case your terminal malfunctions; you may consult the list for an equivalent appliance close at hand.

The software components are specified very shortly in the first table. Other information about software components are recorded in Installation Notes.

The Installation Notes are produced by the computer through the execution of the described job. The notes give detailed information on specific subjects.

The statistics on computer use will be published monthly. In some cases the figures for the last years are specified too. The reader might use these data as a base for planning this computer workload to decrease turn around time and costs. The responsibles of accounts may check their situation on a monthly base.

Software Components

- *System:*

Operating System	O.S.MVT 21.8
Spool program	HASP II V.3.1
Teleprocessing	TELEUR (local system)
	IMS/DC V.2.4.1
	TSO

- *Compilers*:*

Assembler F
Assembler H V.5.0
FORTRAN G
FORTRAN H
COBOL ANS V.3.2
Sort/Merge V.1.4
PL/I Optimizing V.1.2.2
FORTRAN H extended V.2.0
FORTRAN G1 V.2.0
ALGOL

- *Special System:*

PMS IV V.1.4	Project Management System
CSMP III V.1.3	Continuous System Modelling Program
MPSX–MIP V.1.6	Mathematical Programming System
DYNAMO II V.4.6	Dynamic Modelling
SIMPL/I V.1.0	Simulation PL/I
ICES–PROJECT 1	Project Engineering Contral
ICES–STRUDL 2	Structural Design Language
GENESYS	General Engineering System
SHELTRAN	SHELL TRANSLATOR (Structure FORTRAN precompiler)
FORMAC	PL/I and FORTRAN preprocessor
IMS DB/DC V.2.4.1	Information Management System Data Base/Data Communication
STAIRS	Storage and Information Retrieval System
SIMAS	Software Information Management System
APL V.1.1	A Programming Language
SIMULA 67 V.1.2	Simulation Language

- *Service and utility programs:*

LIBRARIAN
FILEDIT–PSQ
COREA
OS/DITTO

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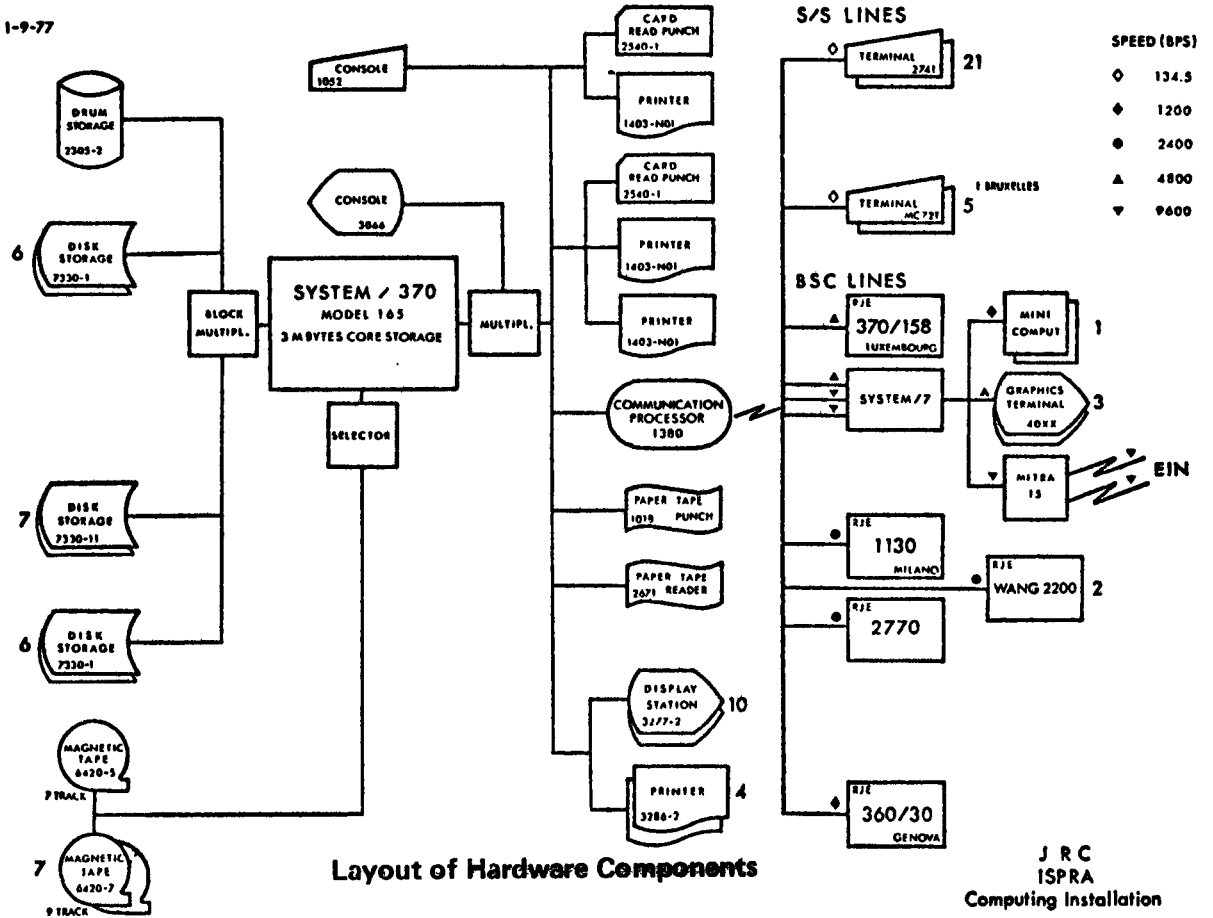
* *Libraries: The user can dispose of a library of mathematical programs (algorithm or subroutines), and of a library of problem oriented application programs).*


1-9-77
CONSOLE 1052
CARD READ PUNCH 2540-1
PRINTER 1403-N01
DRUM STORAGE 2305-2
CONSOLE 3066
CARD READ PUNCH 2540-1
6 DISK STORAGE 2330-1
PRINTER 1403-N01
BLOCK MULTIPL.
SYSTEM / 370 MODEL 165 3 M BYTES CORE STORAGE
MULTIPL.
PRINTER 1403-N01
SELECTOR
COMMUNICATION PROCESSOR 1380
7 DISK STORAGE 2330-11
PAPER TAPE 1019 PUNCH
PAPER TAPE 2671 READER
6 DISK STORAGE 2330-1
DISPLAY STATION 3277-2
10
MAGNETIC TAPE 6420-5 7 TRACK
PRINTER 3286-2
4
7 MAGNETIC TAPE 6420-7 9 TRACK
S/S LINES
TERMINAL 2741
21
TERMINAL MC 721
5
1 BRUXELLES
BSC LINES
RJE 370/158 LUXEMBOURG
MINI COMPUT
1
SYSTEM/7
GRAPHICS TERMINAL 40XX
3
MITRA 15
EIN
RJE 1130 MILANO
RJE WANG 2200
2
RJE 2770
RJE 360/30 GENOVA
SPEED (BPS)
134.5
1200
2400
4800
9600
Layout of Hardware Components
J R C
ISPRA
Computing Installation

5

COMPUTING INSTALLATION DESCRIPTION
HARDWARE COMPONENTS

N	Type	Unit	Model	Function description
1	IBM	3165	KJ	Central Processing Unit
6	TELEX	6360	5	Processing Storage Total central storage capacity 3 Megabytes
				Channels:
1	IBM	2880	2	Block multiplexor channel
1	IBM	2860	1	Selector channel
1	IBM	2870	1	Byte multiplexor channel with one selector subchannels
				Direct Access Units:
2	ITEL-	7833	2	Storage control
12	ITEL-	7330	1	Disk storage
7	ITEL-	7330	11	Disk storage Total 19 disk storage units (Track length 13030 bytes)
1	IBM	2835	2	Storage control
1	IBM	2305	2	Fixed head storage (Track length 14660 bytes)
				Magnetic Tapes:
1	TELEX	6803	1	Tape control unit
7	TELEX	6420	7	Magnetic tape unit (9 tracks density 800/1600 bpi)
1	TELEX	6420	5	Magnetic tape unit (7 tracks density 200/556/800 bpi)

				Peripheral Units:
1	IBM	2821	5	Control unit
2	IBM	1403	NO1	Printer
1	IBM	2540	1	Card reader/punch
1	IBM	2821	1	Control unit
1	IBM	1403	NO1	Printer
1	IBM	2540	1	Card reader/punch
1	IBM	2822	1	Control unit
1	IBM	2671	1	Paper tape reader
1	IBM	2826	1	Paper tape control
1	IBM	1018	1	Paper tape punch
1	IBM	1052	7	Printer keyboard (secondary console)
				Display Stations:
1	IBM	3066	1	System console (primary)
1	IBM	3272	2	Control unit
10	IBM	3277	2	Display station
4	IBM	3286	2	Printer
				Teleprocessing and RJE Network
1	MEMOREX	1380	1	Communication processor
20				BSC lines 1200 ÷ 9600 bauds
24				Start/stop lines with limited distance line adapter
8				Start/stop lines 134.5 ÷ 1200 bauds
6				Start/stop lines 1200 ÷ 9600 bauds
				Terminals:
5	IBM	MC72T		Communication terminal
21	IBM	2741	1	Communication terminal
				Concentrator:
1	IBM	S/7	E16	Computing system - EIN network connection (MITRA 15) - 3 graphic stations (TEKTRONIX 40xx) - 2 mini-computers (WANG 2200)
				Auxiliary Machines:
18	IBM	029	A22	Printing card punch
3	IBM	029	C22	Printing card punch interpreter
4	IBM	129	3	Printing card punch interpreter
1	IBM	557	1	Alphabetical interpreter
1	D-MAC			Curve-follower
1	CALCOMP	900/1136		Graphic output system

Table of Conversational Users Operating under Internal T.P. or Data/Communication System

Terminal type	Place Bldg.	User	Station Number TP	Station Number IMS	Station Address	Operating under *
MC72T C	A36	Dept. A Div. Informatics - Eurocopi	27		039	1
MC72T C	A65b	Dept. A Div. Information Analysis & Handling	12		03A	1
MC72T B	D28a	Dir. of Projects BCR	35		03B	1
MC72T B	BRX	D.G. XII BCR Bruxelles	36		03C	1
MC72T B	A36	Dept. A Div. Informatics	38		03D	1
2741 C	A65a	Dept. A Div. Systems Analysis	8		020	1
2741 C	D44	Dept. C Div. Physics	9		021	1
2741 C	E84	Dept. B Div. ESSOR	10		022	1
2741 C	B51	Dir. of the Site Div. Health Protection	11		023	1,2
2741 C	D72	Dept. B Div. Heat Transfer & Fluid Mechanics	32		024	1
2741 C	D68	Dept. B Div. Engineering	13		025	1
2741 C	A36	Dept. A Div. Informatics - E.I.N.	14		026	1,5
2741 C	A36	Dept. A Informatics - E.I.N.	15		027	1,5
2741 C	D25	Dept. B Div. Heat Transfer & Fluid Mechanics	16		028	1
2741 C	A36	Dept. A Div. Informatics	1	3	029	1,2,3
2741 C	A36	Dept. A Div. Informatics - Eurocopi	23		02A	1,3
2741 C	A2	Dept. C Div. Chemistry	24		02B	1
2741 C	D69	Dept. B Div. Heat Transfer & Fluid Mechanics	26		02C	1
2741 C	E42	Dept. B Div. Electronics	25		02D	1
2741 C	A36	Dept. A Div. Informatics			02E	4
2741 C	A36	Dept. A Div. Informatics			031	4
2741 C	A36	Dept. A Div. Informatics	5		02F	1
2741 C	A36	Dept. A Div. Informatics - Eurocopi	41		030	1

Terminal type	Place Bldg.	User	Station Number TP	IMS	Address	Operating under *
2741 P	D45	Dept. C Div. Applied Mechanics	17		034	1
2741 P	A36	Dept. A Div. Informatics	22		035	1,3
2741 P	A36	O.E.C.D. NEA Computer Progr. Libr.	34		037	1
3277/2	A36	Dept. A Library	4	5	0A0	1,2
3277/2	A36	Dept. A Div. Informatics			0A1	4
3277/2	A36	Dept. A Library	6		0A2	1
3277/2	A36	Dept. A Div. Informatics - Eurocopi	7	6	0A3	1,2
3277/2	A2	Dept. C Div. Chemistry	33	11	0A4	1,2
3277/2	A36	Dir. of the Site		7	0A5	2
3277/2	A64	Dir. of the Site Div. Adm. & Personnel		8	0A6	2
3277/2	A67	Dir. of the Site Div. Adm. & Personnel		9	0A7	2
3277/2	A36	Dir. of the Site Div. Finance & Budget		13	0A8	2
3277/2	A36	Dept. A Div. Informatics - E.I.N.			0A9	5
3286/2	A2	Dept. C Div. Chemistry	33	12	0AA	1,2
3286/2	A64	Dir. of the Site Div. Adm. & Personnel		10	0AB	2
3286/2	A36	Dir. of the Site Div. Finance & Budget		14	0AC	2
3286/2	A36	Dept. A Div. Informatics - E.I.N.			0AD	5
IBM MC72T and 2741		26 users (24 TP - 2 IMS/DC)				
IBM 3277/2		10 users (5 TP - 6 IMS/DC)				
IBM 3286/2		4 users (1 TP - 3 IMS/DC)				

*Note:
1 = Internal Teleprocessing
2 = IMS/DC
3 = APL
4 = TSO
5 = EIN

The Newsletter is available at:

Mrs. A. Cambon
Support to Computing
Bldg. 36 - Tel. 730

Des exemplaires du Bulletin sont disponibles chez:

Mme A. Cambon
Support to Computing
Bât. 36 - Tel. 730

Table of RJE station and special teleprocessing equipments

Terminal type	Place Bldg.	User	TP Line		Address	Operating under *
IBM S/7	A36	Dept. A				
		Div. Informatics			070	
TEKTR. 4002A	D27	Dept. B				
		Div. Electronics	28		070	1
TEKTR.4002A	A36	Dept. A				
		Div. Informatics	29		070	1
WANG 2002	D68	Dept. B				
		Div. Engineering	37		070	1
TEKTR.4015	A65b	Dept. A				
		Div. Information Analysis & Elaboration - ESIS	40		070	1
MITRA 15	A36	Dept. A				
		Div. Informatics - EIN			071	5
					072	5
IBM 360/30	GE	S.p.A. ERG - Genova		1	06C	
IBM 370/158	LX	D.G. IX				
		Computing Centre - Luxemburg		6	06D	
IBM 1130	MI	Università Bocconi - Milano		3	06F	
IBM 2770	E82	Dept. B				
		Div. ESSOR		2	060	
WANG 2200	A36	Dept. A				
		Div. Informatics		4	061	
WANG 2200	C63a	Dept. B				
		Div. Design office & site Service Workshop		5	062	

* *Note:*
1 : Internal Teleprocessing
2 : IMS/DC
3 : APL
4 : TSO
5 : EIN

EQUIVALENT TIME TABLE FOR ALL JOBS OF THE GENERAL SERVICES - Monthly and Cumulative Statistics

	January	February	March	April	May	June	July	August	September	October	November	December
Year 1976	84	82	101	77	57	64	73	54	61	59	36	46
accumulation	84	166	267	344	401	465	538	592	653	712	748	794
Year 1977	44	74	78	32	26	36	27	25				
accumulation	44	118	196	228	254	290	317	342				

EQUIVALENT TIME TABLE FOR THE JOBS OF ALL THE OBJECTIVES AND GENERAL SERVICES - Monthly and Cumulative Statistics

	January	February	March	April	May	June	July	August	September	October	November	December
Year 1976	206	237	270	241	229	248	249	223	233	244	159	150
accumulation	206	443	713	954	1183	1431	1680	1903	2136	2380	2539	1689
Year 1977	135	218	312	193	180	269	244	214				
accumulation	135	353	665	858	1038	1307	1551	1765				

EQUIVALENT TIME TABLE FOR THE JOBS OF THE EXTERNAL USERS - Monthly and Cumulative Statistics

	January	February	March	April	May	June	July	August	September	October	November	December
Year 1976	18	19	28	16	25	32	14	11	27	31	29	12
accumulation	18	37	65	81	106	138	152	163	190	221	250	262
Year 1977	13	14	18	16	13	22	19	18				
accumulation	13	27	45	61	74	96	115	133				

EQUIVALENT TIME TABLE FOR ALL JOBS OF ALL USERS - Monthly and Cumulative Statistics

	January	February	March	April	May	June	July	August	September	October	November	December
Year 1976	233	271	313	280	277	281	260	245	273	287	206	172
accumulation	233	504	817	1097	1374	1655	1915	2160	2433	2720	1926	3098
Year 1977	158	241	314	242	202	294	266	217				
accumulation	158	399	713	955	1157	1451	1717	1934				

Statistics of computing installation utilization

Report of computing installation exploitation for the month of July

	YEAR 1977	YEAR 1976
Number of working days	21 d	22 d
Work hours from 8.00 to 24.00 for	16.00 h	16.00 h
Duration of scheduled maintenance	19.42 h	18.59 h
Duration of unexpected maintenance	32.27 h	39.65 h
Total maintenance time	51.69 h	58.24 h
Total exploitation time	284.31 h	293.76 h
CPU time in problem mode	134.80 h	110.00 h
Conversational systems:		
CPU time	2.60 h	1.14 h
I/O number	426,000	216,000
Equivalent time	5.60 h	2.66 h
Elapsed time	278.00 h	143.00 h
Batch processing:		
Number of jobs	8,390	8,105
Number of cards read	2,309,000	2,487,000
Number of cards punched	166,000	205,000
Number of lines printed	24,854,000	24,832,000
Number of pages printed	549,000	572,000

BATCH PROCESSING DISTRIBUTION BY REQUESTED CORE MEMORY SIZE

K BYTES	100	200	300	400	600	800	1000	1400	total
Number of jobs	1902	3066	1696	1020	308	77	3	13	8085
Elapsed time (hrs)	45	179	167	175	118	39	0.2	1.2	724
CPU time (hrs)	3	23	25	30	35	14	0.2	0.4	131
Equivalent time (hrs)	15	54	58	67	50	17	0.5	0.6	262
Turn around time (hrs)	0.6	0.9	1.0	2.1	3.3	4.7	2.4	7.6	1.2

PERCENTAGE OF JOBS FINISHED IN LESS THAN

TIME	15'	30'	1h	2h	4h	8h	1D	2D	3D	6D
% year 1976	43.7	64.2	79.7	90.9	96.9	98.2	99.6	99.8	99.9	100
% year 1977	40.3	60.9	77.0	87.1	94.7	98.0	99.4	99.6	100	–

Utilisation of computer center by the objectives and appropriation accounts for the month of July

		IBM 370/165 equivalent time in hours
1.20.2	General Services - Administration - Ispra	26.01
1.20.3	General Services - Technical - Ispra	0.78
1.30.4	L.M.A.	–
1.90.0	ESSOR	11.13
1.92.0	Support to the Commission	2.26
2.10.1	Reactor Safety	151.63
2.10.2	Plutonium Fuel and Actinide Research	5.72
2.10.3	Nuclear Materials	2.33
2.20.1	Solar Energy	0.45
2.20.2	Hydrogen	0.14
2.20.4	Design Studies on Thermonuclear Fusion	1.35
2.30.0	Environment and Resources	12.46
2.40.0	METRE	2.92
2.50.1	Data Processing	26.79
2.50.3	Safeguards	0.35
	TOTAL	244.33
1.94.0	Services to External Users	18.89
	TOTAL	**263.22**

Statistics of computing installation utilization

Report of computing installation exploitation for the month of August

	YEAR 1977	YEAR 1976
Number of working days	22 d	22 d
Work hours from 8.00 to 24.00 for	16.00 h	16.00 h
Duration of scheduled maintenance	27.41 h	25.40 h
Duration of unexpected maintenance	34.51 h	18.76 h
Total maintenance time	61.92 h	44.16 h
Total exploitation time	290.08 h	307.84 h
CPU time in problem mode	102.39 h	107.62 h
Conversational systems:		
CPU time	2.00 h	1.72 h
I/O number	281,000	335,000
Equivalent time	4.00 h	4.06 h
Elapsed time	227.00 h	152.00 h
Batch processing:		
Number of jobs	7,852	7,468
Number of cards read	2,165,000	2,388,000
Number of cards punched	128,000	161,000
Number of lines printed	19,543,000	23,346,000
Number of pages printed	451,000	535,000

BATCH PROCESSING DISTRIBUTION BY REQUESTED CORE MEMORY SIZE

K BYTES	100	200	300	400	600	800	1000	1400	total
Number of jobs	2050	2611	1764	835	201	77	11	19	7568
Elapsed time (hrs)	51	126	143	120	86	24	1	2	553
CPU time (hrs)	3.1	15.1	19.8	24.9	28.5	6.7	0.5	1.3	100
Equivalent time (hrs)	18	41	48	51	40	10	0.6	1.7	210
Turn around time (hrs)	0.4	0.6	1.0		2.5	2.0	1.6	3.8	

PERCENTAGE OF JOBS FINISHED IN LESS THAN

TIME	15'	30'	1h	2h	4h	8h	1D	2D	3D	6D
% year 1976	50.2	68.8	83.0	93.8	97.9	98.9	99.3	99.4	99.5	100
% year 1977	46.8	66.6	81.2	91.5	96.8	99.1	99.6	100	–	–

Utilisation of computer center by the objectives and appropriation accounts for the month of August

		IBM 370/165 equivalent time in hours
1.20.2	General Services - Administration - Ispra	24.08
1.20.3	General Services - Technical - Ispra	0.80
1.30.4	L.M.A.	–
1.90.0	ESSOR	6.13
1.92.0	Support to the Commission	7.88
2.10.1	Reactor Safety	101.03
2.10.2	Plutonium Fuel and Actinide Research	0.46
2.10.3	Nuclear Materials	1.14
2.20.1	Solar Energy	0.92
2.20.2	Hydrogen	0.52
2.20.4	Design Studies on Thermonuclear Fusion	1.13
2.30.0	Environment and Resources	8.52
2.40.0	METRE	2.03
2.50.1	Data Processing	39.43
2.50.3	Safeguards	1.03
	TOTAL	195.10
1.94.0	Services to External Users	18.54
	TOTAL	**213.64**

IBM Time Sharing Option (TSO) – Concepts, Features and Facilities

C. Daolio, D. Koenig

This article contains major excerpts of the IBM manuals given in the list of references.

Introduction

The following article is written to give to a person who never used TSO before an indication of the possibilities TSO provides. Everyone familiar with the manuals cited in the reference list should skip the following pages. The second aim of the article is to provide a foundation which the information meeting on Sept. 26, 14:00, will be based on.

The IBM System/360 Operating System Time Sharing Option (TSO) adds general purpose time sharing to the facilities already available through MVT (see Newsletter No. 13). As a result, the system provides a number of new capabilities:

- It gives users access to the system through a *command language* which is entered at *remote terminals* (typewriter like keyboard-printer or keyboard-screen devices) connected through telephone or other communication lines to computer.
- It gives those who may not be programmers the use of data entry, editing, and retrieval facilities.
- It makes the facilities of the operating system available to programmers at remote terminals to develop, test, and execute programs conveniently, without the job turnaround delays typical of batch processing. Both terminal-oriented and batch programs can be developed at terminals.
- It creates a time-sharing environment for terminal-oriented applications. Some applications, such as problem-solving languages, terminal-oriented compilers, and text-editing facilities, are available from different software manufacturers.

A major consideration in the design of TSO is ease of use. The way in which a user communicates with the system is kept simple to encourage people who may not be programmers to take advantage of the speed and versatility of a computing system to solve their problems. There are four ways in which TSO achieves this goal:

- The physical medium is easy to use. Information is easy to enter through the terminal's typewriter-like keyboard and no complex procedures are required to obtain output from the computer on the terminal.
- The way in which a terminal user defines his work is uncomplicated. He enters commands which describe the general function he wants to accomplish. If the user chooses, he can create his own commands and command system.
- If a user doesn't know how to define his work to the system, he can type HELP and receive information pertinent to the type of operation he is trying to perform. In most cases, he doesn't need to enter detailed parameters describing every aspect of the work he is doing; the system uses default values that are appropriate for most jobs. If he fails to provide parameters the system needs to do the work he requested, the system will ask him for the missing information, item by item, by "prompting" him for it in a conversational way.
- The system keeps the terminal user aware of what is happening, so he knows what to do next. He "converses" with the system on a step-by-step basis. The system lets him know when it is ready to accept input from him, and it tells him immediately when there has been a change in the status of his program. If the user receives a message he doesn't understand, he can request more information about the situation simply by typing a question mark. The messages he receives use an uncomplicated language to describe the situation. When the messages become familiar to him, he may request the system to use the abbreviated messages that are available with some of the programming languages.

In a simple batch processing system, one job at a time has access to the resources of the system. An inherent problem with this type of processing is *turnaround time* (the elapsed time between the submission of a job to the computer centre for processing and the return of results to the programmer) and inefficient use of resources. In a multiprogramming system several jobs share the resources of the system concurrently, so the use of resources is much more efficient. However, the operator at the system console controls the system, and the programmer still must wait for results to be returned to him. A time sharing system reduces delays in receiving results. A larger number of jobs share the resources of the system concurrently, and the execution of each job is controlled primarily by a remote terminal user. Thus, *time sharing* can be defined as the shared, conversational, and concurrent use of a computing system by a number of users at remote terminals.

The system resources shared by the time sharing jobs (foreground jobs) entered from the terminals are also shared by batch jobs (background jobs) that are being processed at the same time. Each foreground main storage region handles many active foreground jobs, although only one job is actually in the region at any moment in time. A foreground job is assigned to a main storage region and has access to the system's resources for a short period of time called a time slice. The other foreground jobs assigned to that region are saved on auxiliary storage while the job being executed in main storage receives a time slice. At the end of the job's time slice, or if the job enters the wait state for terminal I/O, the main storage image of the job (that is, programs, work areas, and associated control blocks) is stored on a direct access device and another job is brought into the same region of main storage and given a time slice. TSO schedules a similar time slice for each ready foreground job.

The process of copying job images back and forth between main and auxiliary storage is called swapping. Writing an image to auxiliary storage is swap-out; reading one into main storage is swap-in.
The apportionment of slices of processing time to foreground jobs is not apparent to a terminal user. At any terminal, the response of the system to requests for action is fast enough so that he has the impression that he is the sole user. As far as the user is concerned the distinctive feature of a time-sharing system is the way in which it "converses" or interacts on a step-by-step basis with him as he does his work. He is prompted for information the system needs to execute his job, he receives immediate response to his requests for action, and he is notified immediately of errors the system detects, so that he can take corrective action at once.

In general then, a time-sharing system differs from a batch processing system in three ways:

1. A terminal user concurrently shares the resources of a computing system with other terminal users.
2. A terminal user can enter his problem statements and other input into the system as he develops them, and he receives immediate results. Thus the problem of turnaround time inherent with batch job operations is greatly reduced.
3. A terminal user is constantly aware of the progress of his job. He requests results from the system one step at a time, he is prompted for any additional information the system requires, he receives immediate notification of the status of this work and he is apprised of errors as soon as the system detects them. The terminal user can change his problem statements or correct errors immediately after entering each statement or at any time during the current terminal session. Thus, he minimizes the need for the reruns.

Using a terminal

A terminal session is designed to be an uncomplicated process for a terminal user: he identifies himself to the system and then issues commands to request work from the system. As the session progresses, the user has a variety of aids available at the therminal which he can use if he encounters any difficulties.

When the user has some work to perform with the system, he dials the system number if he has a terminal on a *switched line,* or he turns the power on if he has a terminal on a *non-switched line.* A switched line is one in which the connection between the computer and a terminal is established by dialing the system's number from the terminal. A non-switched line is one with a fixed connection between the computer and a terminal. The user identifies himself by entering "LOGON" and

- a user identification, for example the user's name or initials, which the system will use to identify his program and data sets.
- a password, assigned by the installation usually known only to the user and the system manager.
- an account number, which defines the account in which his system usage totals are to be accumulated.

The LOGON processor verifies that the user is an authorized TSO user and then checks the password and account number. The system then assigns the user's job to a time-sharing (foreground) region of main storage and allocates other resources, such as auxiliry storage space and user data sets. LOGON marks the start of a terminal session. When the user completes his work, he enters "LOGOFF" to end the session. The system then updates his job's system use totals, releases resources allocated to it, and releases the terminal from TSO.

The user enters the commands to define and execute his work at the terminal. He enters a command by typing a command name, such as EDIT and possibly some additional operands. The system finds the appropriate command processor – a load module in a command library – and brings it into the foreground region assigned to the user for execution. For example, in response to entering the EDIT command, the system brings in the EDIT command processor, the data handling routine used to create and update data sets.

If a user does not enter all the operands associated with a particular command name, default values are assumed where possible. If necessary operands are missing, the system prompts the user for them with a message such as "ENTER DATA SET NAME". The user can reply with the missing value, or enter a question mark for a further explanation of what the system needs. If the user chooses, he can specify that prompting messages be suppressed.

A terminal user can also receive assistance through the HELP facility. He can request information regarding the syntax, operands, or function of any command, subcommand, or operand. If he enters HELP followed by a command name, he receives an explanation of the command and the operands required with it. HELP followed by a subcommand name furnishes an explanation of the subcommand if the user is working with the command at that time. Entering HELP by itself returns a description of the command language, a list of the commands, and an explanation of how to use HELP to obtain further information.

During a typical session, the user enters a series of commands to define and perform his work. If the sequence is one that is used often, he can store the sequence in a data set and then execute the sequence whenever he needs it by entering the EXEC command.

The commands provided with the system handle data and program entry, program invocation in either the foreground or the background, program testing, data management. Additional products are available to support problem solving, data manipulation, and text formatting, to provide terminal-oriented language processors, and to make these processors more convenient to use from the terminal.

In addition to the foreground execution of programs, TSO allows jobs to be submitted for execution in the background, or batch, portion of the system. If his installation authorizes it, a user can submit a background job at his terminal, be notified of the job's status, and then receive results of the job at the terminal. If he chooses, he can specify that the output of his job be produced at the computing centre, rather than at the terminal.

Because time sharing is carried out within the framework of MVT job and task management, the foreground and background environment are compatible. TSO uses the same data formats, programming conventions, and access methods as the rest of the operating system. The programming languages and service programs available with TSO are compatible with their background counterparts.

Command language facilities

A TSO command is the request for work to be done by the system. It establishes the scope of the work to the system. To provide flexibility and greater ease of use the scope of some commands is subdivided into several functions each identified by a subcommand. For example in the scope of the EDIT command the user can INSERT lines of data, CHANGE data, DELETE lines of data with the corresponding subcommands. The commands and subcommands recognized by TSO form the TSO command language.

A command consists of a command name followed, usually, by or more operands. The command name is typically a familiar English word that describes the function of the command. For instance the RENAME com mand changes the name of a data set. Operands provide the specific information required for the command to perform the requested operation. For instance, operands for the RENAME command identify the data set to be renamed and specify the new name.

RENAME	OLDFILE	NEWFILE
command name	operand (old data-set-name)	operand (new name for data set)

Most operands are optional. If an optional operand is not entered with the command, the system assumes the default values and proceeds as if the user had entered the value. If the missing operand is not one that can be defaulted, for instance, a data set name, the system prompts the user for it with a message such as "ENTER DATA SET NAME". When all the operands have been either entered or defaulted, the command processor proceeds to perform the desired function. Some of the command processors, such as EDIT, accept, interpret, and perform subcommands, which follow the same syntactic rules as the general commands.

The commands and subcommands of the TSO command language can be grouped into four functional classes:

1. Control the terminal session; example are

   LOGON – to start a terminal session
   LISTBC – to display general messages available for terminal users (notices, mail, etc.)
   SEND – to send messages to other terminals or to the system operator
   TIME – to display the session time used
   HELP – to obtain help from the system
   LOGOFF – to end the terminal session

2. Enter, modify, store and retrieve data; example are

   EDIT – to create a data set
   INPUT* – to enter data into a data set
   CHANGE* – to change data in a data set
   DELETE – to delete a data set
   LIST* – to list the contents of a data set
   SAVE* – to store a data set
   LISTDS – to list information about the data sets
   LISTCAT – to list the names of all catalogued data sets (per user)
   RENAME – to rename a data set

---

* subcommands of EDIT

3. Develop programs and process data ; example are

EDIT	– to create a program and enter it into a data set
RUN	– to compile and execute a program
LOADGO	– to invoke the loader and execute a program
CALL	– to load and execute a load module
PLI	– to only compile a PL/1 program with the optimizing compiler
ASM	– to only compile an ASSEMBLER program
FORT	– to only compile a FORTRAN program
COBOL	– to only compile a COBOL program
SUBMIT	– to submit a job for batch processing
STATUS	– to display the status of a batch job at the terminal
CANCEL	– to cancel a batch job from the terminal

4. Test and debug a program; example are

TEST	– to initiate a testing session
LOAD*	– to load a load module for execution
AT*	– to set breakpoints (1) into program for inspection of the execution
GO*	– to start or restart program execution (after a breakpoint for instance)
LIST*	– to list the contence of mainstorage or registers
TIME	– to display the used CPU time

This list is not at all an exhaustive list of all the commands available under TSO and is not a complete description of the functions of the mentioned commands, but should simply provide an indication of the possibilities which are offered by the TSO command language. A detailed description of all the available commands can be found in ref. 2.

The facilities described to test and debug a program are those which are standard in TSO, and they can be used in connection with the assembler-version of a program. High level language debugging aids such as "FORTRAN Interactive Debug" or "COBOL Interactive Debug" are also available under TSO. They cannot however, be described here because this would exceed the scope of this paper.

---

* subcommands of TEST

(1) a breakpoint is a point in the program at which the execution of that program is interrupted to allow some intervention by the programmer

Programming at the terminal

The time sharing environment is especially well-suited to program development. The advantage of programming at a time sharing terminal is the reduction of job turn-around delays. The programmer can profitably devote himself to one project at a time; he does not need other projects to work on while waiting for results from a batch computing facility. TSO provides services for terminal users at each step in program development: coding, compiling or assembling, testing, implementation, documentation, and program maintenance.

Any compiler or assembler designed to run under the operating system can be invoked from a TSO terminal. Compilers can be executed in the foreground, or, via the SUBMIT command, in the background.

To have a job executed in the background, the user places the job control statement defining the job in a data set. By convention the jobname is the user identification, plua a single character to provide uniqueness. The user then enters a SUBMIT command, including the name of the data set as an operand. SUBMIT will generate a standard jobname and a JOB statement.

A new keyword has been defined for the JOB statement to allow automatic notification of the user when the job is completed. The user receives a message to his terminal when the job completes. The message is saved until he enters a LISTBC command. The OUTPUT command allows the user to display job output (SYSOUT) at his terminal, to save it in a data set, or to delete it.

The following section describes, on an introductory level, how to create a data set, input a source program and then compile and execute this source program, using a TSO-terminal. The examples assume that the user has access to an IBM 2741 communications terminal connected to the IBM 370/165 via a non switched line and that he wants to develop a PL/1 program (these assumptions are made to facilitate the description). In the following the user input will be written in lowercase letters whereas the system response will be written in uppercase letters.

The actions to be taken in the example are:

- Start the terminal session
- create an input data set and input the source program
- compile the source program and execute it
- end the terminal session.

To start a terminal session the user turns on the power at the terminal (according to an instruction sheet attached to the terminal) and presses the "carriage return" key. The system will then answer:

```
ENTER LOGON
```

Now the user should enter the logon command. Assuming the user has the user-identify "newuser", the password "topsecret" and the accound number "12345", he will answer:

```
Logon  newuser/topsecret  acc(12345) proc(pl1log)
```

The system will now answer (for instance):

```
NEWUSER LOGON IN PROGRESS AT 14:30:57 ON JULY 28, 1977
```

and after it finishes logon processing

```
READY
```

The user is now in "command mode" and may type in a command to request work to be performed by the system. The input is free format, i.e. the user can begin typing at any position on the line and he can type command names and operands in either uppercase or lowercase characters. He can continue a line by placing a hyphen as the last character on the line that is to be continued. He can use character-deletion and line-deletion characters for correcting typing errors. The default characters are

– the backspace key, to delete the preceding character on the line and
– the ATTN key, to delete the entire line (including continued lines).

In our example the user now wants to create and input a PL/1 source program; therefore he types in

```
edit  pl1prog  pli  new
```

where:

pl1prog	is the data-set name;
pli	specifies that the data set will contain PL/1 statements;
new	specifies that the data set is to be created and does not yet exist

The system answers with:

```
INPUT          (indicates to the user that he is in input mode)
00010 ....     (is a system provided line number)
          (user input, carriage return)
00020 .....
          (user input, carriage return)
00030 .....
```

To finish the input the user inputs a "null-line" (i.e. carriage return immediately after the line number) and the system answers with

```
EDIT
```

The user now certainly wants to save his input so that he can refer to it in a later terminal session*. Therefore he simply types in

```
save
```

and the system answers with

```
SAVED
```

If the user now wants to compile and execute his new program he simply types in

```
run
```

and the PL/1 Optimizing compiler will be invoked, the user will receive diagnostic messages on the terminal and if there is no error in the program it will be executed. The SYSIN (data input) and SYSPRINT (data output) files will be allocated to the terminal.

If the user now wants to finish his TSO session he types in

```
end
```

and the system answers with

```
READY
```

He types in

```
logoff
```

and the system answers with

```
NEWUSER LOGGED OFF TSO AT 14:40:01 ON JULY 28, 1977
```

for instance, and logically disconnects the terminal from the system.

It is hoped that this first description of the TSO facilities stimulates sufficient interest so that there will be many users participating in the TSO information meeting held on September 26, 14:00 in the amphitheatre of the CETIS. If there is sufficient interest it is planned to have TSO courses within the Centre. After the TSO information meeting it is planned to have a TSO demonstration for interested users.

References

(This is a list of IBM manuals which are important to the TSO user. They will be available from the manual-library of the "Support to Computing" group).

1) IBM System/360 Operating System: Time Sharing Option Terminal User's Guide GC28-6763-X
2) IBM System/360 Operating System: Time Sharing Option Command Language Reference, GC28-6732-X
3) OS/MVT and OS/VS2 TSO terminals GC28-6762-X
4) OS/360 TSO Command Language Reference Summary GX28-6781-X

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* the problem of reservation of permanent disk space is omitted in this discussion to avoid too much details; it is equally easy to do it.

IMPORTANT

Note to the Users

Due to reasons beyond the control of the involved people an information meeting on the time-sharing system TSO which was scheduled for June 29, 1977 could not take place, This meeting is now planned for monday, September 26, 14:00 h in the amphitheatre of the CETIS. All users who intend to use TSO in the future are invited to come. All users presently using the PSQ/FILEDI system are recommended to come.

Les personnes intéressées et désireuses de recevoir régulièrement "Computing Centre Newsletter" sont priées de remplir le bulletin suivant et de l'envoyer à

Mme A. Cambon
Support to Computing
Bât. 36, Tel. 730

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