

NATIONAL RESEARCH COUNCIL

CHANGE



**CNUCE**

PISA

1977

By L. Gori, D. R. Matteucci

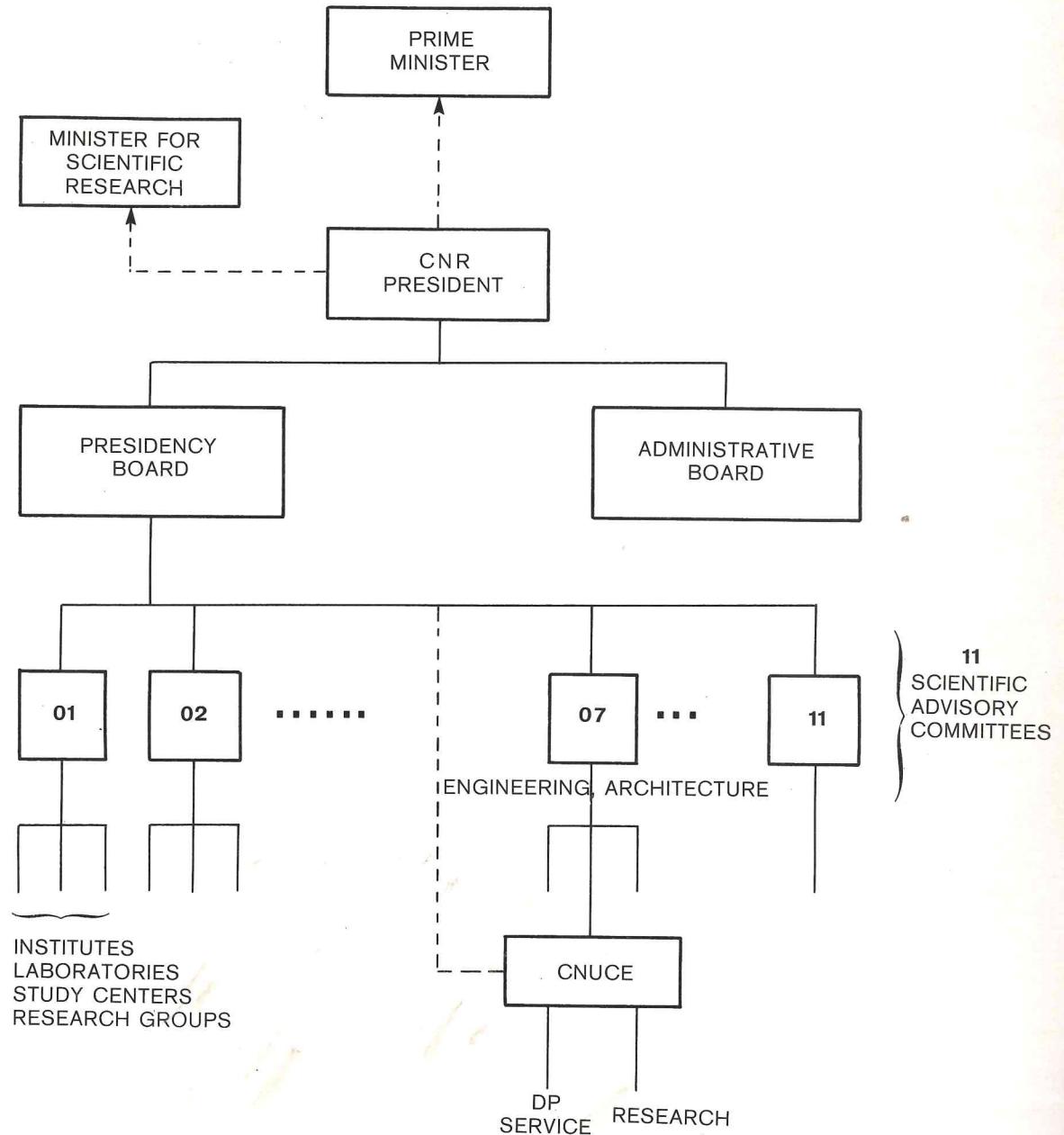
# CNUCE

Institute of the Italian National  
Research Council

Location: Via S. Maria, 36 - 56100 Pisa  
Tel. (050) 45245/9 - Telex 50371.

- Objectives:
- To supply a data processing service for scientific and technological purposes.
  - To achieve researches and studies in the sphere of applied computer sciences and data processing.
  - To provide specialist didactic activity.

Personnel: 50 researchers, 53 laboratory assistants and office staff, 12 technicians, 3 auxiliaries, 15 professors and collaborators, part time.



# CNUCE

## Institute of CNR

The National Research Council (CNR) is a Public Agency, having a corporate existence and autonomous administration, placed at the service of the Presidency of the Council of Ministers. It is encharged with promoting, coordinating and regulating scientific research in the interests of the country's scientific and technological progress. CNR coordinates and promotes nation-wide activities in the sectors of the pure and applied sciences, providing for the implementation and financing of researches of national importance: it also prepares annually, for the Government and Parliament, a general report on the state of scientific and technological research in Italy with proposals aimed at increasing research activities in the country.

In order to achieve all this, the CNR has its own research organs (Institutes or Laboratories, Study Centers and Research Groups) and grants assistance and aid to scientific institutes dependent on universities or other public or private enterprises on the basis of research conventions, agreements and contracts stipulated with the interested parties. Among the various instruments which the CNR possesses, those which are directed at the automatic processing of data are of particular importance. While the task of satisfying the CNR administrative and managerial data processing requirements has been entrusted to SELTE, a service of the Central Administration, that of satisfying the large demand for automatic processing for research activities has been given to CNUCE.

CNUCE began its life on 5 July, 1965, as the « Centro Nazionale Universitario di Calcolo Elettronico » of the University of Pisa.

From 1 November, 1973, it has become an Institute belonging to the Committee for the Engineering and Architectural Sciences of the National Research Council.

The foundation of CNUCE took place within the frame-work of a conspicuous activity in the computing field which was already underway at Pisa. In fact, in the mid '50s, following the suggestions which had been given by Enrico Fermi concerning the advisability and advantages of directing a part of the research work of the University of Pisa towards the computing sector, a group of researchers from the University designed and realised, for the first time in Europe, an electronic computer, the CEP (Calcolatrice Elettronica Pisana).

This research group consequently brought into being the « Centro Studi Calcolatrici Elettroniche » of the University of Pisa which has since become the « Istituto per l'Elaborazione dell'Informazione » of the CNR. It should, however, be stressed that the prominent position which Pisa holds in the field of informatics is due not only to the presence of CNUCE but also to that of other Institutes for scientific research: the already mentioned IEI (Istituto per l'Elaborazione dell'Informazione) of the CNR, the « Istituto di Scienze dell'Informazione » of the University, the Clinical Physiology Laboratory of the CNR, etc.

The fundamental stages in CNUCE's development are the following:

1965 — CNUCE begins to operate: the computing service is provided by a 7090 computer working in batch mode under the control of the IBSYS supervisor and supported by a 1401 system for data input-output.

- 1967 — Introduction of a second computer, the 1401, supporting the 7090, in order to increase the potentiality of the input-output data systems.
- 1968 — Acquisition of a 1130 computer and of a 1800 system integrated by an analog/digital convertor.
- 1969 — Substitution of the 1401 computer by the 360/30 system, including two printers; one with special chains for printing in Latin and Greek characters which was specifically designed to satisfy the demands of linguistic nature at CNUCE.  
In this same year, a degree course in Computer Sciences, the first in Italy, was introduced at the University of Pisa and CNUCE was given the task of providing an experimental laboratory to complement the theoretical lessons of this course.
- 1970 — Strengthening of the computing resources with the addition of the 360/67 system to the 7090. This system worked under the control of the CP supervisor using, mainly, two operating systems: the CMS (Cambridge Monitor System) for interactive computing and the OS (Operating System) for batch data-processing.  
This system was the first to introduce the time-sharing philosophy in Italy.
- 1973 — Substitution of the now obsolete 7090 by the 370/155 system and successively with the more powerful 370/158 in order to satisfy the demand for batch processing.

This central computing structure was integrated by a vast network of terminals spread through-out Italy and connected, via telephone lines and concentrators, to the Center at Pisa. By this time, the user demand had widened to embrace the whole sector of science and technology, from physics to medicine, from the humanities to mathematics, from law to engineering and to music. The existing computing structure and resources were not adequate to meet this continually growing demand. In order to be able to better respond to the demands of the vast user community, two measures were adopted.

- 1973 — Transformation of CNUCE from being an Institute of the University of Pisa to an Institute of the National Research Council.
- 1974 — Replacement of the 360/67 with the more powerful 370/168 connected by a high-speed line to the 370/158 system in a configuration which is among the most important in Europe for its design and complexity.

This progression in the computing structure has been accompanied by an even more significant development, both in quantity and in quality, as far as the Institute personnel is concerned. The first small nucleus of operators has gradually been built into a conspicuous group of researchers and technicians (more than 130), specialised in many different sectors, which, assuming the responsibility for an extremely advanced and complex service, is involved in a continuous activity of research and development directed both towards the service and the autonomous project activity.

# **Fields of Activity**

Within CNUCE two fundamental, mutually integrated, components co-exist: the data processing service in its various aspects of planning, organisation and maintenance, and the research activity directed both at the optimizing of the service and at the realising of and participation in various projects in the sector of applied informatics.

These two prime interests are supported by the didactical activity with which CNUCE plays an important rôle in the diffusion of knowledge concerning the computing techniques.

## **Service activity**

The data processing service offered to the CNUCE user community is, at the present, provided by the 370/158 and the 370/168 systems and presents the following characteristics:

- a) high flexibility and potentiality of the services and the computing techniques;
- b) accessibility to all the types of service independently of the geographical location of the user.

CNUCE is, in fact, connected, by means of a vast network of telephone lines and concentrators to numerous interactive teletype type terminals and high-speed batch terminals situated throughout Italy. These remote terminals provide service points open to one or more users, where the individual user is able to access to all the resources of the computing services. The service points where there is a concentration of users can be run by specialised CNUCE personnel who can control the operations and provide necessary advice and information. Furthermore, with the formulating of conventions with the Universities of Genoa, Padua, Florence,

Camerino, Perugia, the « Galileo Ferraris » Institute of Turin and the Astronomical Observatory of Arcetri, and through the institution of remote stations in other sites, the users of these areas have been given the possibility of obtaining the data processing services under the same conditions as the local user, at Pisa.

## **Research activity**

There are three different types of research activity within CNUCE:

- 1) Research oriented towards the service
- 2) Joint research
- 3) Autonomous research projects

The research which is oriented toward the service studies problems concerning the data processing systems and their use. It considers the design and running of the hardware, the development and maintenance of the relative basic software, and the development and maintenance of the applied software.

The research in collaboration with other entities includes researches conducted principally outside CNUCE for which CNUCE provides technical assistance and advice complementary to the specific competence of the body which is actually conducting the research.

The last category includes that research activity aimed both at promotion of and participation in specific projects in the field of applied informatics and at the design and realisation of advanced software. Mention can be made of the computer network project, the application of the computer to music and various projects in computational linguistics.

## Didactical activity

Particular mention must be made of the didactical activity conducted at CNUCE by means of:

- a) training courses;
- b) seminars and conferences.

Since CNUCE's first years of activity, many courses on programming languages and on the use and the structure of the CNUCE operating systems have been held in order to give students and researchers a suitable preparation which would quickly enable them to use the computing systems.

These courses are directed at research workers, at those working in the user institutions, and at students either from the University degree course in Computer Sciences or from other faculties. CNUCE provides an experimental teaching laboratory for the Computer Science students, integrating the lessons with the practical exercises required by the study plan for this course. For students from other faculties, the computer often provides a useful tool for the compilation of their degree theses and for practical exercises on subjects relative to data processing (numerical calculus, computing theories and applications, etc.).

The supplying of computing services to the University of Pisa for this type of teaching activity is completely free in accordance with the convention made between the CNR and the University of Pisa.

Many other courses deal with the use of the computer in different sectors; the topics treated cover a great part of the demand for computing techniques from the scientific world: simulation, statistics, data bases, etc.

Each year, a suitable calendar for these courses is determined. A greater intensity of teaching is offered during the academic year.

In addition to this established calendar, CNUCE is always willing, on request, to organize specifically designed training courses to meet particular requirements of users and other organizations. Those attending the courses are able to make use, without payment, of all the computing resources when performing the practical exercises which are an essential part of the courses. An important part of the didactical program are the lessons, seminars and conferences in which the results of the research and service activities of CNUCE are presented and also those in which both Italian and foreign researchers present their work as a contribution towards the continual up-dating of the know-how of CNUCE's personnel. These may be organised both at CNUCE or outside as required.

Special mention should be made of the International Summer School on Computational and Mathematical Linguistics, which first took place in August 1970 and, generally, occurs biennially. This initiative has aroused much interest at an international level because of its great scientific value. (At the last summer school 600 scholars, from 31 different countries, were enrolled).

In these schools, in which introductory and general courses are alternated with seminars on specialist topics, arguments and problems reflecting studies in the most avant gard research in this « typically interdisciplinary » sector are dealt with.

In the musical field, the introduction of computer music has been particularly suitable for didactic activity because of the importance giv-

en to direct immediate experience and auto-decisional power.

It is for this reason that there has been a significant development of didactical activity in the musical applications sector. For this purpose one of the CNUCE's remote terminals is installed at the « Conservatorio Musicale L. Cherubini » of Florence where, apart from the opportunity for direct experiences, experiments concerning the approach of very young students from the middle school to computer music are made.

## **CNUCE's courses**

Algol-W

APL

Musical Applications

360/370 Assembler

Cobol

Econometrics

Fortran IV

Introduction to Programming

PL/1

Linear Programming

Literary Programming

Simula 67

VM/370

VS-HASP

CPM, PERT

# The Data Processing Service

The CNUCE data processing service is based on one of the most powerful and articulated distributed computing structures. It is constituted by central computers, a group of specialised satellite centers and remote stations and by a data transmission network which connects individual user terminals or service access points, open to all users, to the central computers.

The nucleus of this distributed computing structure is actually constituted by an IBM 370/168 computer with 4 million main memory positions, controlled by the VM/370 system and by an IBM 370/158 computer, connected to the 370/168 by a highspeed line (40000 bps), having 1.5 million main memory positions and controlled by the OS/VSC system. The two computers control a number of printers, card readers/punchers, tape units and disk units constituting auxiliary memory with a total of 3.000.000.000 positions.

The 370/168 satisfies the interactive and conversational requirements, leaving the 370/158 to deal with the processing of big production jobs. The 370/168 also controls the whole of the data transmission network which is actually made up of more than 6,000 kilometers of dedicated lines and by 60 telephone numbers of the switched network used, on average, for more than 100 hours a day. As a concentration of terminals has been established in a remote, but geographically limited area, it has been decided, both for technical and economic reasons, to install concentrators capable of connecting several terminals via a single telephone line to the central computers.

By means of this network, with transmission speeds varying from 110 to 9,600 bps, systems of other centers (CDC, HP, IBM, etc.), program-

mable terminals (DEC, HP, IBM, SIEMENS, TELEMECANIQUE, etc.), high-speed, non-programmable terminals and teletype type terminals (DATAMEDIA, IBM, OLIVETTI, SELENIA, TEKTRONIX, TEXAS, TTY, etc.) can all access to the central computers in a continually expanding complex which, at the moment, consists of more than 160 units spread throughout Italy. The computing service is supported by providing the users with technical advice and assistance in order to satisfy different needs concerning the problems which may arise when using the CNUCE computing resources.

## DATA TRANSMISSION NETWORK



# System 370/158 and 370/168 characteristics

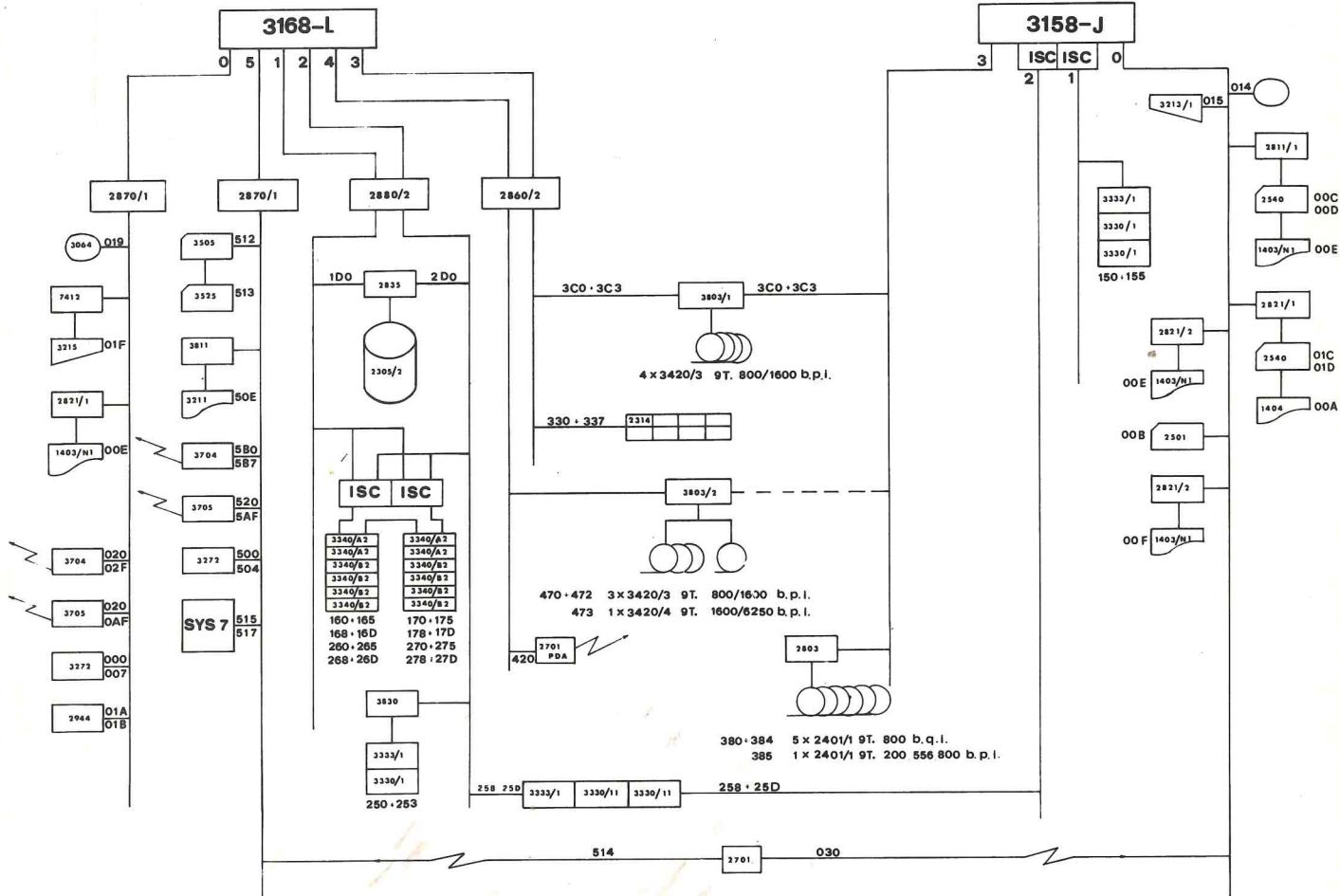
March 1977

	370/158		370/168	
CPU cycle	115 ns per 4 bytes		80 ns per 8 bytes	
Memory capacity	1.5 MB		4 MB	
High Speed Buffer capacity	8 KB		16 KB	
Memory or Buffer cycle	340 ns per 8 bytes		80 ns per 8 bytes	
Consoles	3158      Display		3066      Display	
	3213      85 ch/sec.		3215      85 ch/sec.	
Card readers/punchers	2501/B2 reader 1000 card/m 2540 reader 1000 card/m puncher 300 card/m		3505/B2 reader 1200 card/m 3525/P3 puncher 300 card/m	
Printers	3x1403/N1 1100 lines/m 1404      600 lines/m 800 card/m		1403/N1 1100 lines/m 3211      2000 lines/m	
DASD units	10x3330/1      { Capacity 100 MB Access 30 ms Transfer. 800 KB/sec.		2305/2      { Capacity 11 MB Access 5 ms Transfer. 1.5 MB/sec.  2 x 3330/1      { Capacity 100 MB Access 30 ms Transfer. 800 KB/sec.  4 x 3330/11      { Capacity 200 MB Access 30 ms Transfer. 800 KB/sec.  12 x 3340      { Capacity 35/69 MB Access 25 ms Transfer. 880 KB/sec.  8 x 2314      { Capacity 29 MB Access 75 ms Transfer. 312 KB/sec.	

	<b>370/158</b>	<b>370/168</b>
Tape units	<p>5 x 2401/2 { 9 tracks 800 Bpi transf. 60 KB/sec.</p> <p>1 x 2401/2 { 7 tracks 200/556/800 Bpi transf. 60 KB/sec.</p>	<p>7 x 3420/3 { 9 tracks 800/1600 Bpi transf. 120 KB/sec.</p> <p>2 x 3420/4 { 9 tracks 1660/6250 Bpi transf. 470 KB/sec.</p>
Video units		3277/2 3286/2
Teleprocessing units	2 x 2701	2 x 3704 2 x 3705
Operating systems	VS2 version 1.7 HASP II version 4.0	VM/CP version 3.0 plc 10 VM/CMS version 3.0 plc 10 APL VS2 version 1.7 HASP II version 4.0
Languages	<p>Fortran G, H, X Assembler F, H PL/1 - F Algol - F, W WATFIV Cobol U Sort/Merge PL 360 BMD, SPSS, MUS, MPSX SSP, SAAM, SAS CSMP, GPSS, SIMULA DPS, STAIRS, KWIC, WORDS Course Writer LISP/VIS XRAY PASCAL</p>	<p>Fortran G, H, X Assembler F, H PL/1 Algol W PL 360 Cobol U GPSS APL/CMS Gaming Dynamo LISP/CMS SCRIPT PASCAL WATFIV SIMULA SPSS, SSP</p>

## SYSTEMS 370/158 AND 370/168 CONNECTION

March 1977



System 370/158 console



System 370/168 console



Audio terminal





ISTITUTO DI ELABORAZIONE DELLA INFORMAZIONE

TAU 2

ISTITUTO DI ELABORAZIONE DELLA INFORMAZIONE

TAU 2



## Hardware multiplexers



# The Research

## Development of basic software

The activity and research directed at the development of the basic software for the systems is considered to be of great importance. In order to be able to supply an up-to-date and flexible data processing service capable of responding fully to the enormous variety of applications of the user community, it is necessary to improve, to modify and to integrate the software supplied by the manufacturers. In this way, programs to achieve the inter-connection between the 370/168 and the 370/158 systems have been designed and realised so that it is possible to exchange information, data and programs between these two systems. Other achievements have been the development of certain original procedures for the collection of data concerning the performances of the systems and a complete software for the management of the high-speed, non-programmable terminals. Furthermore, auxiliary equipment and the relative software for the realisation of systems for the automatic and optimized management of the telephone lines for the data transmission network are object of study and design.

## Development of applied software

CNUCE is making a considerable effort in order to perfect the tools designed to satisfy a continuously and rapidly expanding user demand. Side by side with an activity aimed at the development of ad hoc software for particular applications are the studies and the realisations of tools designed to make more immediate the man-computer dialog. These studies are based

on the use of conversational languages such as APL and the use of graphic terminals.

Using these conversational programs, even the user who is inexperienced in the use of the computer can sit down in front of a terminal and, by means of easily understood commands, give orders to the computer, obtain results, give further orders, etc. Within the sphere of this activity, various collaborations and experiments have been made using both students and researchers who are unfamiliar with the use of the computer.

## Information systems and data bases

Various programs have been installed at CNUCE for the management of information systems; both those of a general character and those directed at particular sectors.

Using these systems, some joint projects have been initiated in order to realise data bases. Particular attention has been given to the study and the evaluation of the methods for the organizing and the acquisition of information.

This should lead to great developments on both the research side and in the actual use of the computing resources.

Some of these activities are in the preliminary study phase, others, however, are already in an advanced stage of realization.

Among the most interesting studies relative to the organisation of data bases and the management of information services, the following initiatives should be mentioned:

- realisation of an international data bank in the field of geothermics and relative

- technologies in collaboration with CNR (I.I.R.G.), ENEL and ERDA (U.S. Energy Research Development Administration)
- standardizing and storing of information relative to the national artistic patrimony and the literary patrimony of the national and state libraries (in collaboration with the Ministry of Cultural and Environmental Heritage)
  - organisation of data bases and the relative management techniques for subjects concerning the CNR finalised projects
  - organisation and management of documentation and information relative to the economic, political and social problems of the Region of Tuscany (in collaboration with the « Istituto Regionale Programmazione Economica Toscana »)
  - organisation of information relative to the sector of normalisation and unification, in order to provide a tool for rapid access to UNI-ISO standards (collaboration CNR-UNI).

In this field CNUCE, jointly with IEI, is collaborating with GMD (Gesellschaft für Mathematik und Datenverarbeitung) in order to develop researches on the problems of data bases in the sphere of an ad hoc action promoted by the European Community (Scientific and Technological Research Committee).

## **Studies and investigations on new technologies**

In order to provide a high quality and up-to-date service to the users, and with the aim of finding more efficient and economically more ad-

vantageous technical solutions, studies and investigations are being systematically made on the new techniques and methods which are introduced on to the market. In particular, feasibility studies have been made on the most advanced data input/output systems such as the multi-station key-to-disk units which have micro-compressors with verifying and text-editing capabilities, optical readers which make it possible to enter data into the computer directly from the original documents without the necessity of first transcribing the information on to punched cards, the special high speed printers which use the LASER writing techniques or other new writing methods and, finally, the COM (Computer Output to Microfilm) recorders which convert digital data from the computer into man readable forms and record them on to microfilm. Investigations have been particularly directed towards the study of techniques for the acquisition of information related to the realisation of data bases and information systems. In order to resolve specific problems either connected to the data processing service or the research activity, various devices have been designed and realised. A first equipment for the centralised management of the telephone lines for data transmission, including interface devices and monitors, has been realised and installed in order to optimize the running of the data transmission network. A series of devices for the automatic management of the telephone connections for data transmission is now the object of study and realisation.

## The SIRIO Project

The principal aim of the SIRIO project is to develop advanced technologies in the field of space research with particular emphasis on earth/space, and vice-versa, telecommunication techniques at super high frequencies.

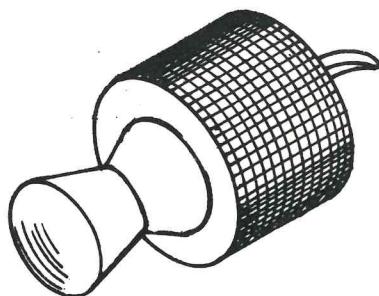
The project is run in collaboration between NASA and CNR; NASA being encharged with the providing of all the launch and mission support facilities and CNR, responsible for the entire SIRIO project, encharged with the construction of the satellite, the installation and the running of the ground control center and the control of the satellite in geostationary orbit.

The CNR has commissioned from the Compagnia Italiana Aerospaziale the construction of the satellite and from the Telespazio Company the installation of the Ground Control Center of Fucino and the running of the satellite during its geostationary phase.

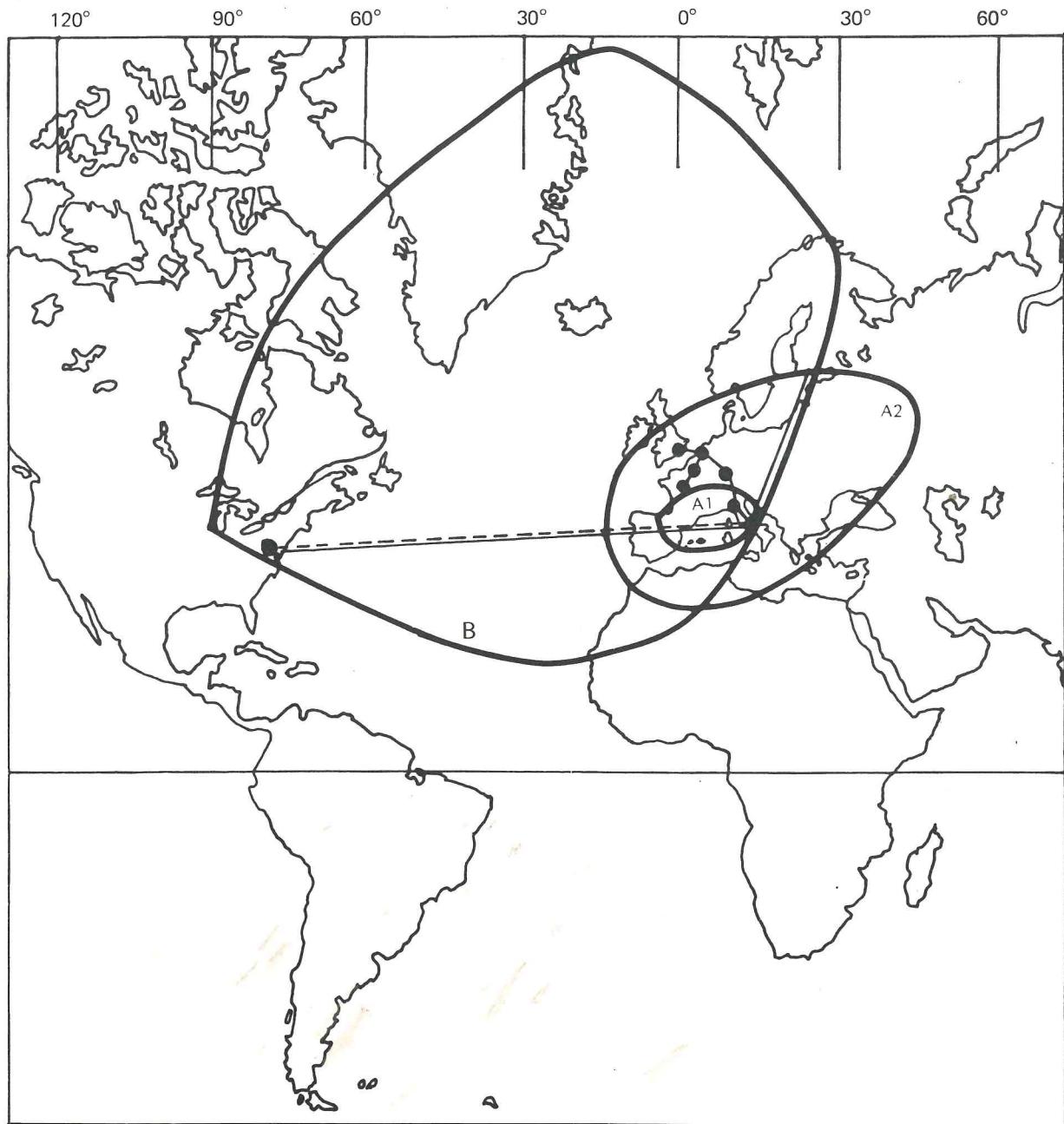
The CNR has full responsibility for the mission execution through the Mission Control Responsible (MCR), and CNUCE has been assigned with the task of assisting the MCR for the flight dynamic aspects of the mission.

CNUCE is also encharged with developing the software and providing the computing services for the project. The first phase was to analyse the techniques and the programs already used by NASA for similar missions and to plan the development of the software necessary for the SIRIO mission. This phase has been completed with the implementation, on the CNUCE computing systems, of the programs relative to orbit determination and the maneuvers for position correction and maintenance. In the geostationary phase, the satellite will be controlled.

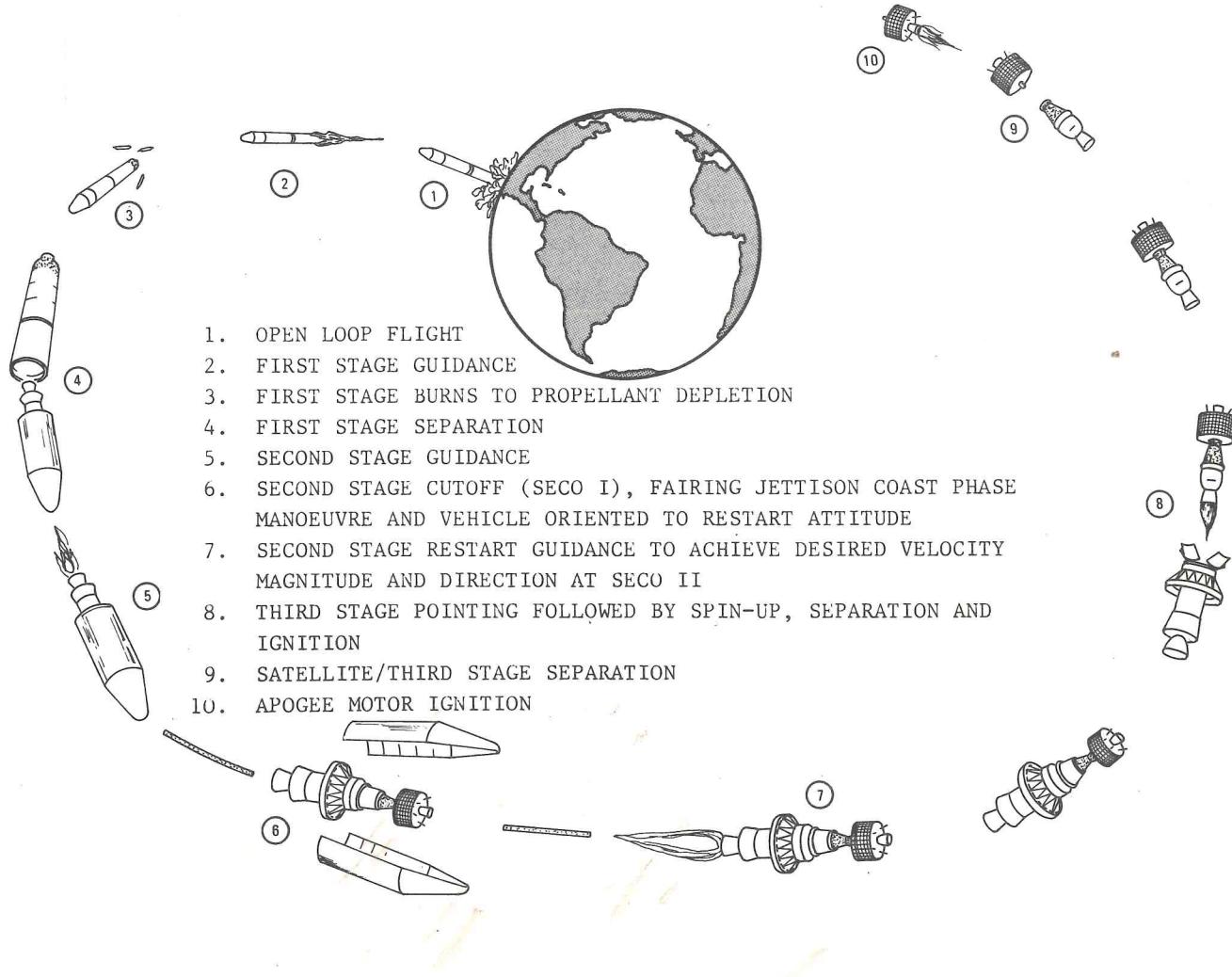
on the basis of the results of computations made at CNUCE using the above mentioned programs, by the Control Center of Fucino. Once the satellite is positioned in geostationary orbit, CNUCE will collaborate with the Milan Polytechnic for the processing of the data, relative to the experiments on the theories, models and propagation characteristics of telecommunication at frequencies of 12 to 18 GHZ, transmitted by the satellite.



## SIRIO COVERAGE AREAS



## SIRIO MISSION GUIDANCE SEQUENCE



## Linguistic Projects

Among the most important initiatives under way, promoted both by CNUCE itself or in collaboration with other Institutes, the following projects, constituting different aspects of a single activity, must be underlined:

1 — The construction of large machine dictionaries is regarded as one of the fundamental objectives in the automatic treatment of linguistic data. The different versions which have now been produced have lost the experimental and limited character of the original prototypes. In general terms, a Machine Dictionary (DM) is constituted, analogously to printed dictionaries, by an ordered series of entry terms which are used for the search, and the information relative to these terms, being registered in the memories of the computer.

The DM normally specifies, for each possible graphic form of the language under consideration, the lemma — or in the case of homograph forms, the lemmas — to which the form belongs. It gives its phonematical transcription, its grammatical and morphological code, notes concerning the etymos, the style or the linguistic recordings of use, the presence of suffixes and prefixes, indications of eventual synonyms, antonyms, etc.

In the particular case of the Italian language, the DMI project aims at realising an instrument based on lexical and grammatical descriptions inspired by the most recent linguistic theories and capable of elaborating, as automatically as possible, the large and continually expanding number of corpora available in machine-readable form.

A formal Italian grammar is now being prepared which can be transcribed in a formal structure to be applied to synthetic parsers capable of automatically analysing the structures of Italian phrases and thus contributing to the disambiguation of the homographs. The composition of a semantic component to be integrated into the parser is being studied and the elements of the definitions given for the various acceptances of the lemmas in the DMI are being organised into a semantic network.

2 — For a long time, it has been widely held that it would be of great scientific and organisational value if an international network of centers possessing the necessary skills, tools and material for an exchange of texts and programs in machine-readable form could be established. CNUCE, which has already acquired valuable experience with the constitution of a national linguistic data base, is playing an important part in this initiative which is aimed at achieving a complete and efficient cooperation between those centers which, in various countries, are working in the text processing sector.

3 — Lexicographical documentation for the editing of large historical dictionaries of a language;

4 — Lexicographical documentation for the editing of historical dictionaries of particular levels of a language;

5 — Lexicographical documentation for indexes and concordances of the entire works of an author;

6 — Processing of works of single authors for different studies (meter, grammar, style, theme, etc.) mostly on a lexical and statistical basis;

7 — Philological elaborating for the processing of manuscript codes and for the insertion of critical notation into the indexes and the concordances;

8 — Historical linguistics: definition of procedures for the comparative study of lexicons and etimologies of ancient languages;

9 — Dialettology: automation of archives of dialettic data, and compilation of diagrams and maps.

10 — Historical disciplines: procedures for the establishing of historical data banks for the processing of historical texts and documentation.

A fundamental and integrating part of this research activity are the studies and experiments directed at the developing and management of methods, programs and procedures designed to offer a complete, efficient and qualitatively advanced service to the many users who use the computing systems for researches in the linguistic field.

A series of generalised procedures and programs have been realised for lexical analyses, consultation of automatic lexicons, phonetic analyses and statistical processing. The importance and the peculiarity of this activity which is on an international level with the participation in specialised bodies and the organisation of meetings and schools such as the already mentioned International Summer School in Linguistics has been a motivation for the determination to make this sector into an autonomous organ of the CNR.

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Beginning of the list  
of more frequently used lemmas  
(from U. Bartolini, C. Tagliavini, A. Zampolli,  
LESSICO DI FREQUENZA LINGUA ITALIANA  
CONTEMPORANEA - CNUCE 1971)

## **Computer Network Project (REEL)**

The project is being conducted by CNUCE in collaboration with the following scientific institutions:

CNEN, Divisione Gestione Sistema Informativo, Bologna.

CSATA, Centro Studi Applicazioni Tecnologie Avanzate, Bari.

IBM, Centro Scientifico di Pisa.

Università di Padova, Centro di Calcolo.

Università di Torino, Centro di Calcolo.

The implementation of RPCNET (Reel Project Computer Network) provides computing centers in the area of Education and Research with a sensible way of sharing their computational resources i.e. application programs, data sets, compilers and programming subsystems.

The specific requirements of the various partners have determined the precise technical characteristics of the network. i.e.

- the transmission subnetwork (Common Network) is of the distributed control type so that participating nodes can dynamically connect to and disconnect from the network;
- a network node is configurated from network functions residing on one, or possibly more than one, separate computer (Front End Processor and HOST) as desired by the individual partner;
- single leased telephone lines are used as connections among nodes;
- non-homogeneous operating systems in the various nodes of the network are considered.

In view of the requirements outlined above,

REEL project activities can be grouped under three fundamental areas:

1 — Study and implementation of a generalized Communication System.

2 — Definition and realisation of an access method to the Communication System, know as RNAM (REEL Network Access Method).

3 — Implementation of some applications such as spool to spool file exchange between any combination of OS and VM systems and interactive access from a terminal in one node to an application in another node.

In addition to these generalized facilities, RNAM, implemented on OS, VM and NCS/7, allows the user to write his own application to application dialog.

The computers available to the partners in the project are the System/370, models 158 and 168, operating under the control of the OS/VS and VM/370 systems; the Front End Processor, available at some partner locations, is the System/7, operating under the control of an independent system know as NCS/7 (Network Control System for System/7).

## REEL PROJECT NETWORK



## Computer Music

The nucleus of the research in this sector is constituted by the study of the use of the computer in the production of sound structures beyond the physical and human boundaries which limit the production of sounds by means of traditional methods.

Fruitful experiences made at research centers in various countries have led to the formulation of fascinating work hypotheses concerning the employment of the computer for musical purposes.

The musical research under way at CNUCE since 1969 has led to the realisation of the DCMP (Digital Computer Music Program) and the PLAY 1800 programs, designed to perform the functions of:

- a) reading, decoding and playing of musical pieces or autogeneration of sound structures;
- b) processing, either controlled or automatic, of musical texts with control of pitch, length, timbre and volume;
- c) management of the musical archive stored in digital form on the peripheral memory of the computer;
- d) playing of musical pieces directly by the digital computer or by means of a digital/analog convertor.

The operating philosophy used is that of working in real time, conversational mode and fully automatic processing. The use of the DCMP program on the 360/67 system for the playing of pieces of music required the system to be dedicated. In order to overcome this obstacle, the « Istituto per l'Elaborazione dell'informazione » of Pisa designed and built the TAU2 audio

terminal which, controlled by the management program TAUMUS, realised at CNUCE, can be used in connection with the 370/168 in time-sharing. The most significant functional characteristic of this terminal consists in the playing of musical pieces in which the poliphony can include up to 12 voices, independent with regard to pitch and duration, via three channels widely controllable in timbre. As a result of the development of the CNUCE computing structure and the particular functional characteristics of the software realised for musical studies, it is now possible to utilise, simultaneously and independently of each other, the programs DCMP, via IBM system/7, and TAUMUS, for didactical, creative, research and production purposes, throughout the entire day, by means of the 370/168 system working in time-sharing.

## **Collateral Activities**

CNUCE plays an important part in the cultural life of the scientific community. It is well represented both in National and International Associations and at Meetings and Congresses in the data processing field and also promotes and organises, either on its own initiative or in collaboration, seminars, schools and meetings at a high scientific level. It also offers specific technical assistance and advice for various Institutes and bodies and produces, either directly or in collaboration, a wide range of publications of many different types: scientific articles, proceedings of congresses and seminars, reports on its activities, technical and operating manuals, etc.

CNUCE is represented on the directive and scientific committees of the most highly qualified international bodies working in the data-processing field e.g.

- European Economic Community - Committee for Scientific and Technical Research (CREST): Sub-committee for the research and development of Informatics.
- European Economic Community-Euronet: Technical Aspects Group (TAG) of the Committee for Scientific and Technical Information and Documentation (CIDST).
- Ministry for Scientific Research: European Center Computing Network (CREI).
- Association for Literary and Linguistic Computing (ALLC).
- SHARE European Association (SEAS).
- Italian Association for Automatic Computing (AICA).

Among the many Meetings and Congresses promoted or organized by CNUCE at Pisa the following are particularly worthy of mention:

- the « International Meeting on Simulation Languages » (1966),
- the « National Meeting on the Use of the Computer in Regional Economic Planning » (1967),
- the « University Computing Centers' Managers Meeting » (1967),
- the « International Seminar on the Latin Machine Dictionary » (1968),
- the seminar on « Concepts and Applications of Process Control and Data Systems Acquisition » (1969),
- the « International Summer School on Computational and Mathematical Linguistics » (1970, 1972, 1974),
- the « XVI SEAS Annual Congress » (1971),
- the « International Symposium on Time-sharing: techniques and experiences » (1971),
- the « 5th International Conference on Computational Linguistics » (1973),
- the « Workshop on Content Analysis in the Social Sciences » (1974),
- the « APL 75 International Congress » (1975).

During 1976, in collaboration with the project partners, the presentation of the « Reel Network Project » was organised in Venice.

# **Index**

<b>CNUCE - Institute of CNR</b>	<b>Page</b>
<b>FIELDS OF ACTIVITY</b>	5
Service activity	» 7
Research activity	» 7
Didactical activity	» 8
<b>THE DATA PROCESSING SERVICE</b>	» 10
<b>THE RESEARCH</b>	» 15
Development of basic software	» 15
Development of applied software	» 15
Information systems and data bases	» 15
Studies and investigations on new technologies	» 16
The SIRIO Project	» 17
Linguistic projects	» 20
Computer Network Project (RE EL)	» 22
Computational Music Computer Music	» 24
Collateral Activities	» 25

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STAMPA: GRAFICHE FAVILLINI LIVORNO

