



Christian Roving A/S



Company Background

Christian Rovsing A/S is Denmark's fastest growing, high-technology computer and aerospace electronics company. Founded 1963, CRA and its subsidiaries currently employ over 800 people. In recent years, the company's growth rate has approached 40% annually, due in large measure to its advanced, high-technology "CR80 Computer" product line and the excellence of its design and systems oriented technical staff. The company offers a wide spectrum of office- and technical systems and supply high-reliable electronics.

Around 1970, a deliberate commitment was made by the company to devote its resources to the European Space Programme. It has since participated in most of the major ESA programmes. A synopsis of the company's involvement in these programmes is given later in this brochure. Successful participation in these programmes has broadened the company's resources. The high degree of performance which these programmes demand has been met by applying up-to-date technology, specialised hardware and software engineering expertise, and modern management methods.

The experience gained from engagement in the European Space Pro-

gramme was an important factor in winning a contract with Delco Electronics Inc. to co-produce their Fire Control Computer as part of the 4-nation European F-16 Programme. The Fire Control Computer is the only "end-item" co-produced in Denmark and is delivered directly to the F-16 assembly lines in Europe or the U.S.A.

From the design and production of switching power supplies for the European Space Programme we have developed an advanced technology and sophisticated design philosophy which can be applied to the solution of complex power supply problems. Several patents are held by the company relating to power supply circuit design.

In the mid-seventies the company decided to enter the Defence Computer Communication market. It has since participated in critical communications-oriented programmes undertaken by NATO/SHAPE/NICSMA and various national defence, tri-service communications agencies. The company's involvement in some of these programmes is detailed in the last part of this brochure.

CRA believes that it has available exceptional, professional talent dedicated to advanced electronic techniques. Furthermore, the company excels in applying current technology to modular equipment design, and has no out-

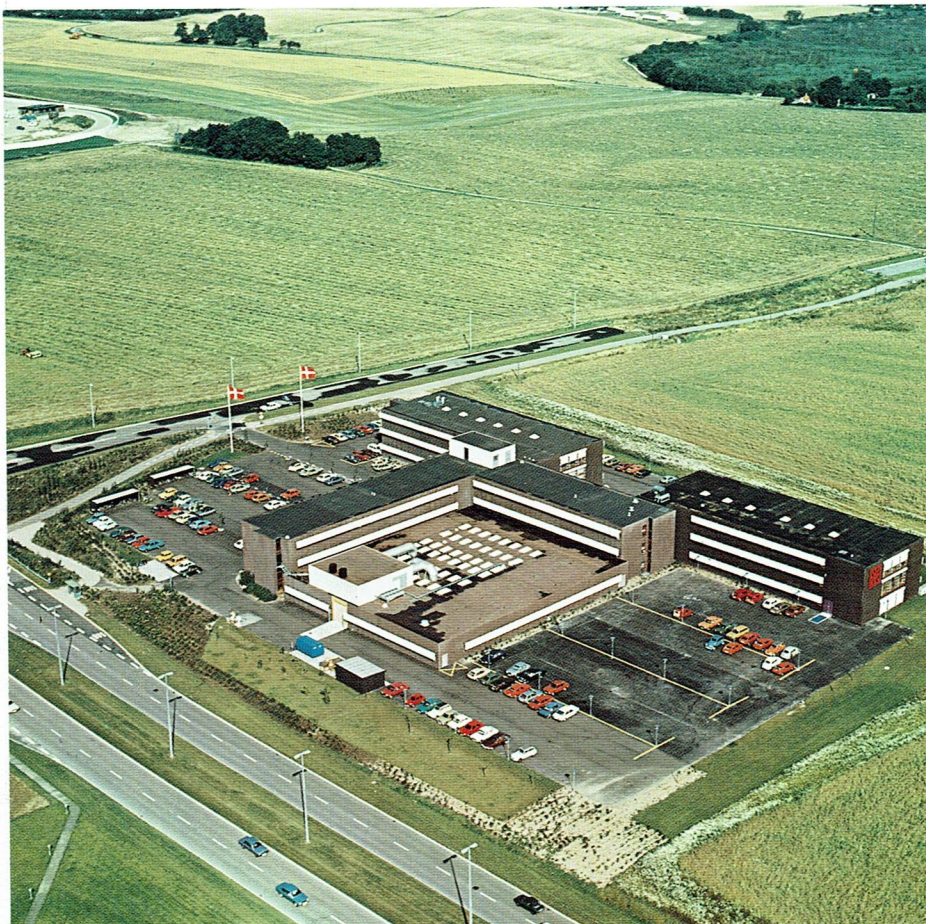
dated product lines to support.

In short, Christian Rovsing A/S has now acquired extensive experience in the design, development and manufacture of Aerospace and Defence Electronics.

The information given in these pages will demonstrate the breadth of our knowledge and experience which can be focussed on similar programmes.

Captain Hans Hesdorf
Marketing Executive
Government and Military Liaison

1982



Christian Rovsing A/S
Administration and General Management
Copenhagen - Denmark

Company Organisation

Christian Rovsing A/S was founded in 1963. In the first year the company worked mainly in a consulting and advisory capacity within the EDP field. Activities developed strongly in the first year, and the business gradually changed character from consultant to supplier of EDP systems.

Around 1970, with 70 employees, the company was organised into an EDP Division and an Electronics Division. Today, the company employs over 800 people and has an annual turnover of approx. 225 million Dkr. (\$ 30 mio).

Christian Rovsing A/S is wholly owned by Danish nationals and conducts its business without the aid of public funds and is independent of foreign capital. For information, the company annual report is available on request.

Management of the company is in the hands of Messrs. Christian Rovsing, Claus Jepsen and Lars Stig Nielsen.

Mr. Rovsing is the President and the founder of the company. He is a member of many government and industrial committees as well as professional societies related to research and data processing.

Christian Rovsing A/S has a plan of organisation corresponding to the two main fields in which the company operates:

- Data Processing
- Electronics

As can be seen from the organisation chart there are today five major divisions within the company:

- Data Processing Division
- Electronics Division
- Systems Division

- Production Division
 - Development Division.
- and three wholly owned subsidiaries:

- Christian Rovsing Corporation in Los Angeles, California supports the mother company in major contracts with U.S. customers and has its own software development centre.
- Christian Rovsing International A/S located in Copenhagen employs appr. 150 people and delivers computer systems for communication nets and process control, and contract staff to large international customers.
- CR Card System A/S located in Copenhagen delivers electronic credit card systems for the automation of gas (petrol) stations.

The Data Processing Division is located in 5,000 sq. metre leased facility in Herlev, near Copenhagen.

The Electronics, Production, Development and Systems Divisions are based in a newly constructed 12.000 sq. metre main facility in Ballerup, also near Copenhagen.

The Administration and General Management are located in the Ballerup facility.

The Ballerup location houses development laboratories, the main production and test department, a model shop and special "clean room" facilities for the production of space qualified hardware.

A separate dedicated facility has also been established for the co-production of the airborne FCC computer for the European F-16 programme, and is located about 10 Km from the main Ballerup facility.

Space Systems

Since the early seventies Christian Rovsing A/S has been actively involved in many of the major European Space Programmes and is a qualified supplier of flight hardware to the European Space Agency. Production and testing of space qualified hardware are carried out in our own "clean room" facility.

Space activities include:

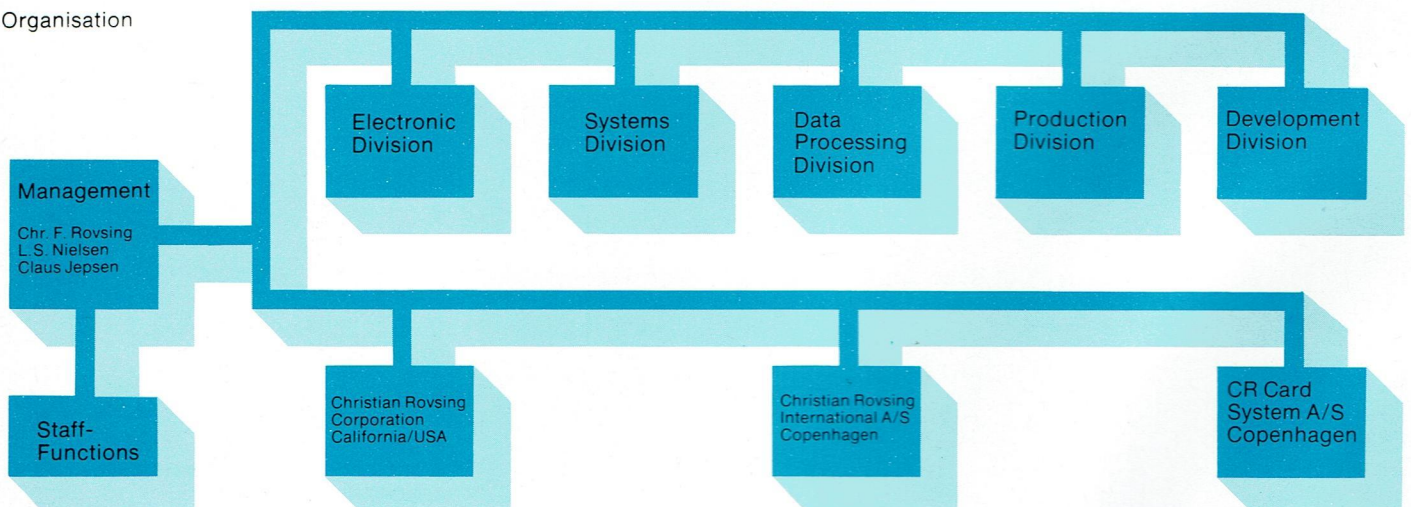
- System Studies
- Electronics for Satellite & Launchers
- Check-out Software Systems for Spacecraft & Groundstations
- Electrical Ground Support Equipment
- Computer Systems for Groundstations.

For the OTS satellite, launched in 1978, we designed and manufactured the Priority Select & Interface Unit for the TT & C sub-system.

For the ECS, MARECS and TELECOM-1 satellites we have designed and developed the Priority Select & Interface Unit and a HIGH EFFICIENCY DC/DC POWER CONVERTER. These 2 units are today in series production in our clean rooms for a total of 11 spacecraft.

For the European launcher ARIANE, we are producing a servoamplifier for each of the three stages of the launcher. The current rate of production is 12 p.a., soon to be increased to 18 p.a. The Servo-Amplifiers form part of the guidance control system and constitute the interface between the autopilot on top of the third stage and the servo-valves and servo-motors which control the position of each rocket motor and hence the direction of flight.

Organisation



For GROUNDSTATIONS we supply computerised IMAGE-DATA HANDLING systems for Meteorological and Remote Sensing Satellites.

Complete systems for the acquisition, pre-processing, rectification and archiving of METEOSAT image-data have been supplied to the ESA Operations Control Centre in Darmstadt, West Germany and to the CEMS groundstation in Lannion, France.

In connection with the European Remote Sensing Programme our company was responsible for the definition of the ground segment in the Phase A study for LASS (Land Application Satellite System). Over the last two years we have been awarded a number of critical study contracts by ESA and the EARTHNET office in relation to the ground segment of this programme.

On the pages 13, 14, 15 and 16 can be found a synopsis of our Space Systems experience and of our Remote Sensing activities.

Avionics

A dedicated facility has been established for the production of the Fire Control Computer for the F-16 multi-national fighter programme.

In partnership with another Danish company, Christian Rovsing A/S has entered into an agreement with Delco Electronics Inc. for the co-production of this computer.

Christian Rovsing A/S has been responsible for management in the proposal and preproduction phase and for overall Quality Assurance, Final Assembly and Testing of the computers throughout the total programme.

The co-production programme includes manufacture and delivery of 433 computers which are shipped directly to the F-16 assembly lines in the U.S.A. as well as in Holland. The FCC is the only Avionics "end-item" produced in Denmark under the F-16 co-production programme.

The value of the contract is approx. 300 million Dkr., which corresponds to a production of 10 computers a month.

The basic contract runs for 6 years, but with additional orders as well as repairs a contract period of 10-12 years is anticipated.

The Fire Control Computer is a modular, microprogrammed, general purpose stored programme computer capable of installation in a lightweight, high speed, air superiority fighter, and is supportable in primitive forward operating base areas where skilled maintenance technicians are unavailable. The computer provides the performance capability required to implement computations for F-16 weapon delivery, energy management, serial digital bus control and navigation related functions such as steering and route point sequencing.

Our engagement in the F-16 program-

me has involved the implementation and maintenance of a MIL-Q-9858A Quality Assurance programme requiring quality management and planning, trend analysis & follow-up, quality audits, and the procurement & testing of MIL-qualified parts.

Software for testing MIL-M-38510 microcircuits has been developed and is utilised during inspection. Sample techniques per MIL-STD-1050 are used in testing passive components.

The production programme has required familiarisation with manufacturing procedures such as wavesoldering, pulse soldering of flatpacks, ultra-sonic lead tinning, and conformal coating.

The handling, segregation and disposition of non-conforming material to MIL-STD-1520 requirements is now a well tried routine.

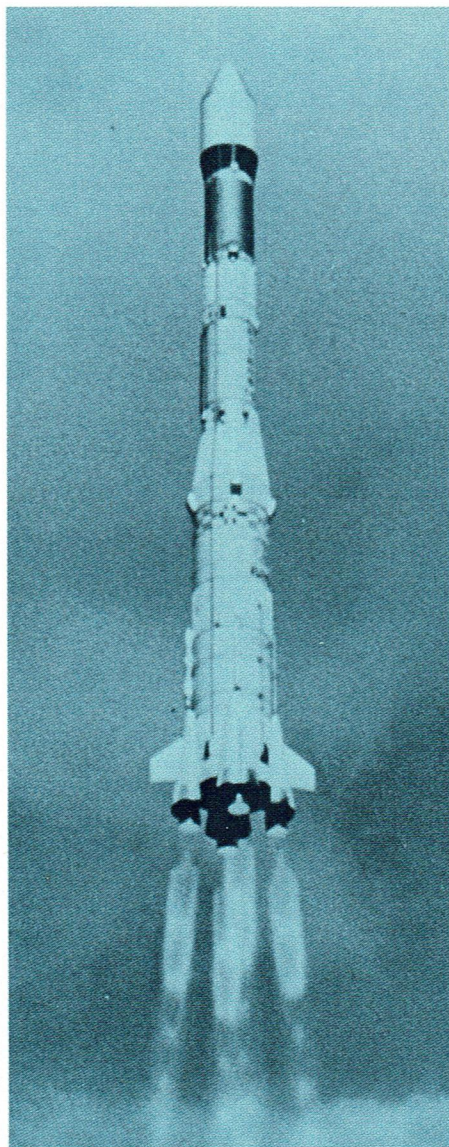
A closed loop system for registration and corrective action for end-item failures has been implemented as part of the reliability programme requirements.

Experience has been gained in the Management and Conduct of environmental testing during production verification testing and reliability qualification testing.

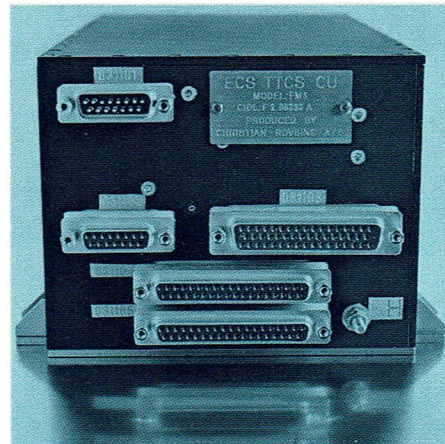
Responsibility for Final Assembly, Testing and Programme Quality Assurance has required a detailed knowledge and understanding of the computer on the part of Christian Rovsing A/S personnel. The experience gained from the F-16 co-production programme is now widely applied to other programmes within the company.

In spring 1980 Christian Rovsing A/S acquired an interest in Arianespace, the company responsible for marketing, production and launching of Ariane, the European launching vehicle. Components supplied by our company include servo amplifiers for each of the rocket's three stages.

This power supply will be delivered to three French Telecommunications - ECS - satellites and to the Swedish scientific Viking satellite. The power supplies designed and marketed by the company's aerospace department are acknowledged for their high efficiency and low weight.



European Satellite Launcher ARIANE.
CRA supply Servo-Amplifiers for each of the three stages.



Airbus

A series of DC/DC converters for the Autopilot in the European Airbus aircraft has been developed and are now in production. Deliveries will exceed 1000 units during 1982.

Switching Power Supplies

From the design and production of switching power supplies for European Space Programme and for our CR80 Mini Computer, Christian Rovsing A/S has developed an advanced technology and sophisticated design philosophy which can be applied to the solution of complex power supply problems.

Several patents are held by Christian Rovsing A/S relating to power supply circuit design.

Christian Rovsing A/S supplies design "know-how" to meet special customer requirements particular when high performance, high power to volume, ratio and low mass are major design criteria.

Our new administrative minicomputer, the CR801, is a result of cooperation between the EDP and Electronics Divisions. The CR801 was developed on the basis of the sophisticated hardware and software of the CR80 computer. The CRMINI programme package accommodates administrative routine requirements, and special programmes are written in COBOL.

CR80 and CR801 Computer

The CR80 Computer has been specifically developed and designed to meet the ever growing requirements in Data Communications, for reliability and speed.

The CR80 Computer has been designed with built-in fault tolerance. If a CR80 module should break down, a second module takes over without loss of data. The fault tolerance of the CR80 Computer enables an ultra-reliable system to be created.

The memory and processors provide incremental processing power up to 30 million instructions per second (MIPS).

In Data Communications, networking is a feature of many manufacturers computers, enabling the mutual interchange of data. The CR80 Computer can communicate with any manufacturers computer, because of the development of a large family of hardware and software modules for the purpose.

Up to date, more than 600 CR80 Computers have been on order mainly for Data Communication. The CR80 configuration also found a use in administrative EDP.

From mid 1981 Christian Rovsing A/S

have introduced a complete new computer for administrative purpose designated the CR801.

The CR801 has been developed in co-operation with CR80 experts and engineers with a comprehensive knowledge and experience in applications of EDP in administration.

The long line of standard program to facilitate administrative functions are contained in the program package designated CRMINI.

The programs concerned are as follows:

- Invoicing
- Debitor/Creditor
- Stock control
- Sales promotion statistics
- Financing

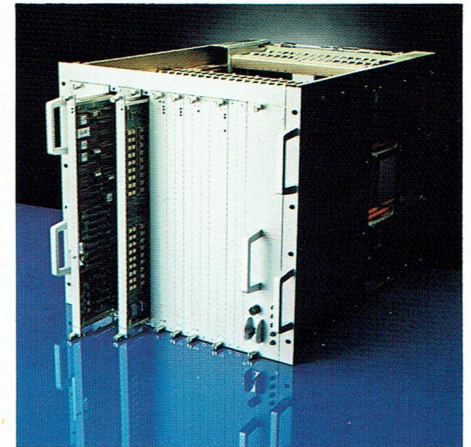
The CRMINI program package exist in an English language version.

All the programs are developed in COBOL for on-line purposes on the CR801. The COBOL is also applied in programing of specific systems.

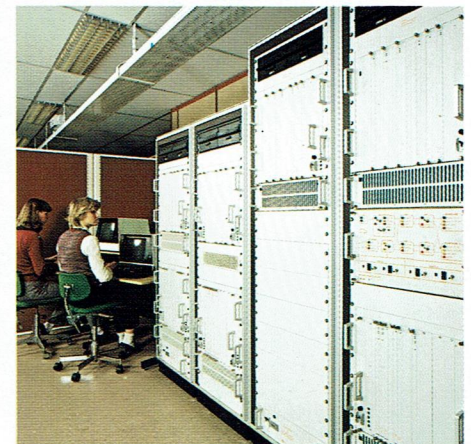
The CR801 Computer is easy to operate, requires no specific operator training and may be installed in normal office facilities.



CR80 Computer with built-in fault tolerance



CR80 Multiprocessorsystem



PAM line of products

The PAM products form a complete line of general purpose, wide area, data acquisition and control systems and provides high performance solutions for centralized and decentralized environments.

The unique design gives cost effective solutions even for small scale systems with only a few process data points. By adding extra hardware, not replacements, a small scale system can be expanded to cover an almost unlimited area with thousands of process points.

Data acquisition and control is performed by distributed process interface modules, the so-called PAM modules. The PAM modules are sited right where the data is available, thus eliminating cabling and costly instrumentation problems.

All process data is available in a user-friendly way by use of Central Micro-processor Unit(s), i.e. CMU's. Highly efficient software tools and standard software package provide optimal solutions for the fulfilment of advanced man/machine interface requirements.

Communications between the CMU and the PAM modules is achieved via a two wire cable, up to 4 km long. Power is superimposed on the data bus,

whereby central power back-up of the whole system is achieved. The CMU controls all data exchange to and from the PAM modules by a highly sophisticated polling procedure. The polling procedure provides extensive on-line supervision and fault detection of all components and interconnecting wire. A defective PAM module or cable stretch is detected automatically and identified.

The PAM line of products has been developed to meet a broad range of system application requirements. Common to all systems: They support the individual solution. Turnkey. Easy to install, maintain and expand without ever reaching system expansion limitations.

The PAM Products are available as:

- Building and Energy Management System
- Sewage Treatment and Water Supply System
- Production Supervision and Control System
- Process Monitoring and Industrial Control System
- Security and Surveillance System

Applications

The first PAM system was announced in 1979 and the system has since then proved its strength as one of the most flexible and user-friendly systems on the market, meeting or exceeding all requirements on time of installation and fulfilling expansion requirements.

Below, a few PAM applications are explained.

Security and Surveillance System

- Fire alarm
- Intruder alarm
- Access control
- Site surveillance
- Closed circuit television

Building and Energy Management System

- Preventive maintenance
- Energy savings
- Optimal use of technical installation
- Improved indoor comfort
- Burglar and fire alarm
- Reduction in working expenses

Sewage Treatment and Water Supply System

- Supervision of water levels, pressure, oxygen, pH, etc.

PAM System



- Control of pumps, valves, boosters, etc.
- Process optimization
- Effective control of technical installations
- Reduced risk of environmental pollution.

Production Supervision and Control System

- Operation safety
- Material handling
- Preventive maintenance
- Blending machinery control
- Energy savings.

Process Monitoring and Industrial Control System

- Measuring and alarm
- Regulators
- Sequence controllers
- Preventive maintenance
- Energy savings
- Process optimization.

X-NET Multiplexed Local Area Network

X-Net is a local data network for connecting up to several hundred terminals (VDU, printers etc.) with each other, and one or more small and large computers. X-Net eliminates the presently used separate circuits and cables to each terminal and replaces these with a single pair of cables, which is common to all data equipment: terminals, computers, text processing equipment etc. attached to the X-net.

This makes it possible, within one or more buildings, to place X-Net outlets on the walls of every room, as presently done for telephone and power installations. It is therefore not necessary to have fixed distribution and placement of data equipment, all these can be moved freely between all rooms.

Another important aspect of the X-net is the capability for one terminal to work with any computer or other data equipment connected to the X-net, instead of being able only to work with a single computer in the traditional direct connection scheme.

The X-net also allows for future extensions and changes in the terminal and computer installation, without having to move and install new cables to terminals.

Installations of X-net cable pairs and terminal outlets in new or old buildings

is very simple and comparable with installation of telephone outlets.

General Description

X-Net (multiplexed local terminal NET) is an extremely fast digital link between terminals (VDU's printers, etc.) and other terminals or a number of small and large computers.

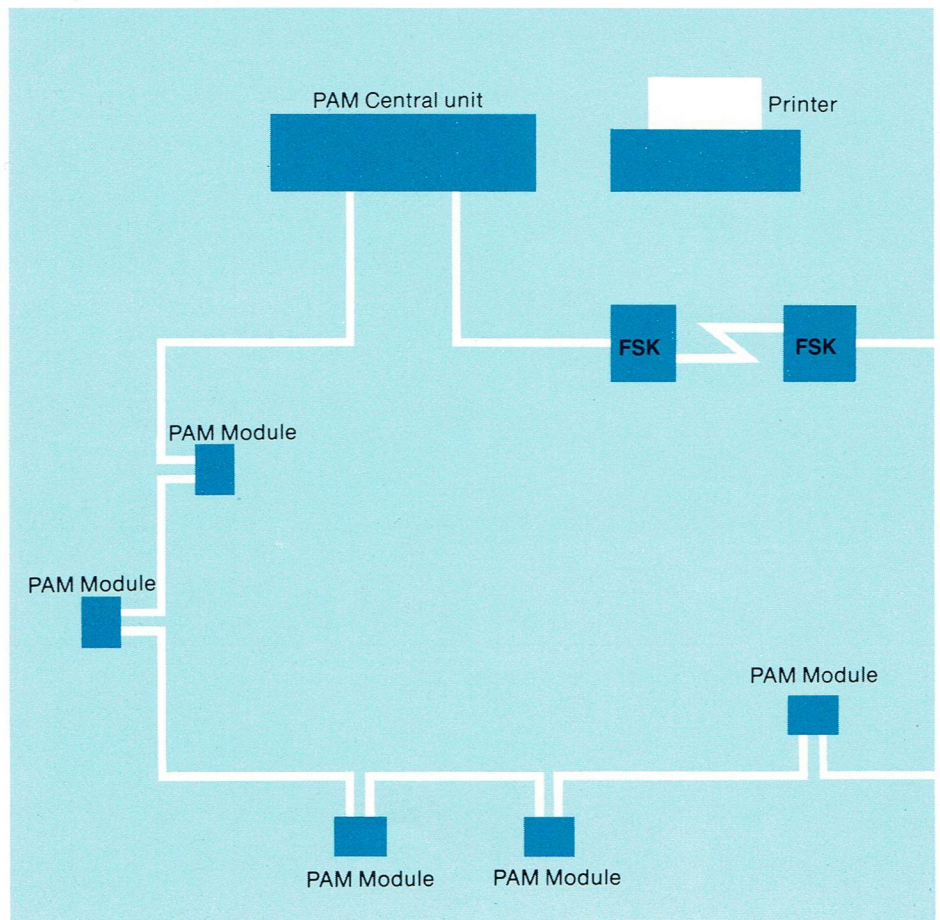
The X-Net supports both simple, low cost applications as well as very sophisticated, dynamically reconfigurable in real-time applications. This has been accomplished by implementing the design with standard LSI's and microcomputers.

The design has been especially aimed at ensuring very high immunity to electrical interferences and low generation of interference itself. It can therefore safely be used in electrically noisy locations where conventional data transmission could be unreliable as well as where it is essential to restrict radiated noise to a low level.

X-Net consists of one or a dualized set of controllers, X-Net cable, terminal outlets, terminal adapters, concentrators and computer port interfaces. Standard interfaces are available for asynchronous protocols.

Utilizing two screened twisted pair cables, one for data transport to the terminals (lower bus), and the other for data transport from terminals (upper

PAM System – Principal layout



bus), data is transported in packets between terminals and host computers at a clock rate of 1,8432 Megabit, divided into 6400 timeslots each second of each 288 bit, of which 128 (16 bytes) are utilized for data to or from terminals, and the remaining for routing, control, automatic error detection and correction (CRC check).

Full packet protocol with error detection and correction is implemented in the X-Net for data integrity.

The terminal adapters make it possible to attach existing terminals and printers.

The terminal adapter is connected to, and communicates via the existing serial line interface of the terminal equipment, so no modification of the terminals are necessary, as well as the installation of the adapter can be done in a few minutes.

A terminal is allocated a number of timeslots each second on the TDX Bus, corresponding to its baudrate. The timeslots allocated to each terminal does not overlap, whereby it is possible for many terminals to use the common cables (Time divisioned multiplex).

The data rate of a terminal can dynamically be changed by request from the terminal adapters thereby allowing high speed transfer of complete VDU-screen and return to low data rate for input from the keyboard, etc.

From all terminals appended to the X-Net it is possible to create a log-on channel to all other terminals or to one of the serial I/O channels of a PORT interfacing to a computer thus leaving a real dynamic network configuration to the user.

Physical Specification

- Single X-Net
 - bit rate: 1.8432 Mbit/sec.
 - Max. inter Station distance
 - with Amplifier/branching unit: 4 km
 - without Amplifier/branching unit: 2.0 km.
 - Maximum number of attached X-Net Interface Units (XNIU): 255
 - Maximum number of attached Terminals: 1020
 - Maximum number of attached Ports 255
 - Maximum number of attached Nodes & Gateways 14.
- Multiple X-Nets (up to 8 nets coupled via Supergateways and S-Net) bit rate: 16 Mbit/sec and 1.8432 Mbit
 - Max. inter Station distance
 - with Amplifier branching unit: 8 km
 - without Amplifier branching unit: 4 km.
 - Maximum number of attached X-Net Interface Units (XNIU): 2040
 - Maximum number of attached Terminals: 8160
 - Maximum number of attached Ports: 2040
 - Maximum number of attached Super Ports 112.
- Up to 256 Single and Multiple X-Net combine via Nodes and Gateways into a Region.
- A Maximum Network comprises up to 256 regions.
- Medium: Shielded twisted pair coaxial cable, base band signalling.
- Topology: Branching rooted tree.

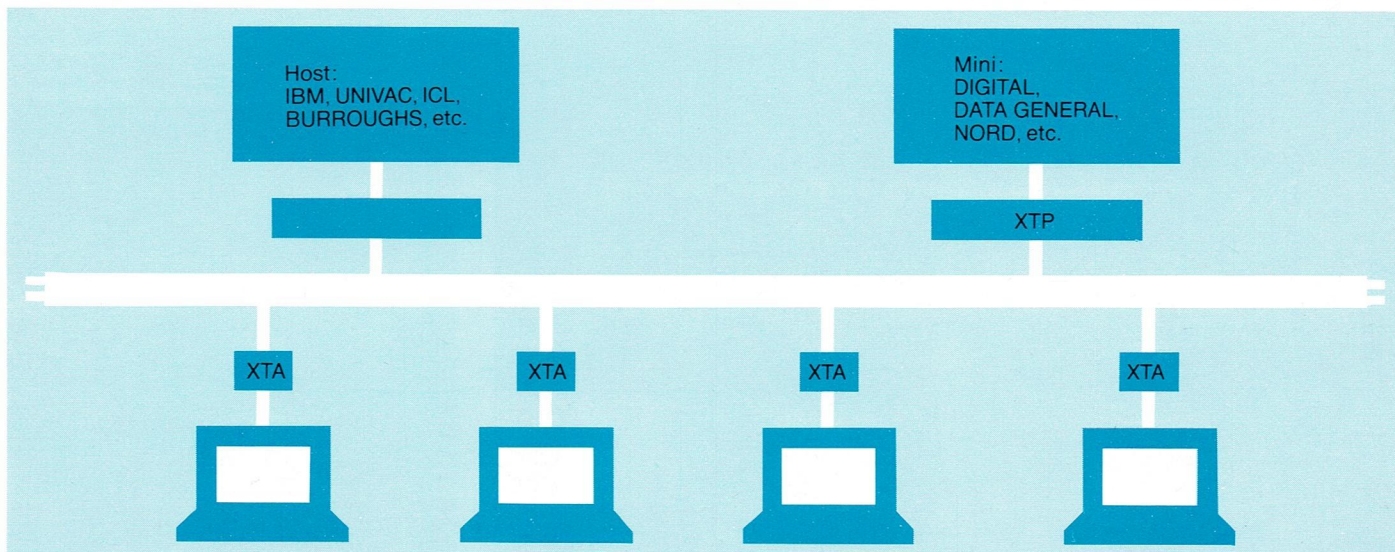
- Data link layer
 - Distributed duplex HDLC like protocol an all links with Adaptive/ Dynamic allocation of physical X-Net station bandwidth.
- Packet Protocol
 - Variable sized packets (0-64 kbyte), guaranteed delivery.
- Fault tolerance
 - As standard option, part or all of an X-Net may be dualized.

X-NET Local Network

XTA: X-Net Terminal Adapter. Standard asynchronous serial workstation interface for terminals, microcomputer and wordprocessing equipment.

XTP: X-Net Transparent Port. Standard asynchronous serial interface, 4-12 lines, for attachment to microcomputer.

XEP: X-Net Emulator super Port. Standard async./synchronous serial interface for mainframe attachment. Emulates and maps up to 64 terminals.



Data Communications

Christian Rovsing A/S has gained significant experience in computerised telecommunication and data switching networks which places it among the top ranking European companies in this field.

We believe that we have available exceptional professional talent totally dedicated to advanced computerised information techniques. Furthermore, the company excels in applying current technology to modular equipment design. It has no outdated product lines to support, its hardware is not 1960 vintage but second-generation LSI technology.

Systems are configured around the company's "CR80 Computer" which has proven itself particularly suited to this type of application.

System contracts won by the company are typically worth several millions of dollars and demonstrate the company's ability to manage large projects.

A summary of the company's overall related experience is presented overleaf. One side of the table lists the communications disciplines in which the company has considerable expertise, the other lists major programmes either proposed, in-process, or completed which demonstrate our data communications capabilities.

On the following pages on-going military data communication programmes are described in sufficient detail to permit the reader to assess the company's qualifications and competence. A summary of other completed programmes is also given.

Summary of related experience

Communication disciplines

Message Switching

- Preparation and Distribution
- Format Conversion (ACP127/128)
- Protocols (LITSYNC, CCITT X.25)
- Storage and Retrieval

Line Switching

- Signalling and Supervision
- Routing Algorithm
- Synchronisation and Timing
- Multiplexing and Trunking

Dualised Systems

- Configuration Control
- Switchover and Recovery
- Reliability Performance
- V24/V28 Interfaces
- TEMPEST

Security

- Access Control
- SPECAT Handling
- Red/Black Interfaces
- Crypto Interface (DOLCE)
- Privileged User State

Major Programmes

Message Switching

- NICS-TARE
- FIKS
- CAMPS

Front-End Processor

- ICL-CAMELOT
- ESCOM
- METEOSAT
- I-HAWK

Data Networks

- TOSCA
- RITZAUS BUREAU

Line Switching

- LME Network
- CRISP
- DK-Digital Exchange
- FELT TELEFON
- KTAS – Toll Ticketing

Command and Control

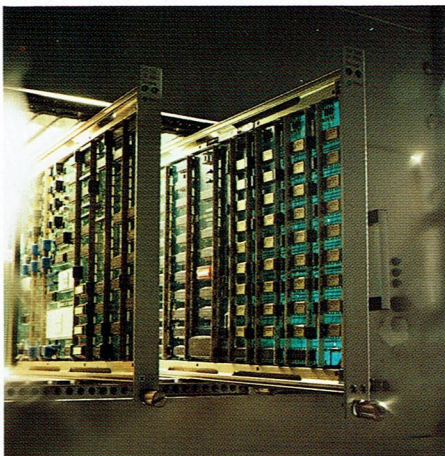
- ACE-CCIS*
- ACBA-CCIS*
- AFNORTH-CCIS*

Avionics

- F-16 Fire Control Computer

* CCIS = Command and Control Information System.

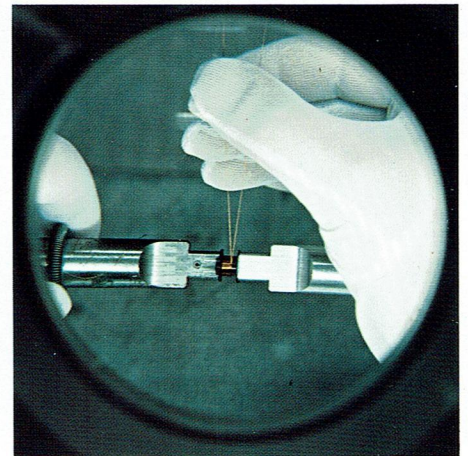
CR80 Crate with module pulled out



Production



Production. Magnified view



Principle Contracts Summary

- **Project: NICS-TARE**
Communications Front-end Processors for Message Switching Network
Customer:
NATO Integrated Communications System Management Agency, Brussels, Belgium
Prime Contractor:
Litton Data Systems Inc. Van Nuys, California
CRA sub-contract Value:
Approx. \$ 6 Mio.
Programme Duration: 36 months
- **Project: FIKS**
Defence Integrated Communications System
Customer:
Danish Ministry of Defence
Prime Contractor:
Christian Rovsing A/S
Contract Value: Approx. \$ 7 Mio.
Programme Duration: 48 months
- **Project: CAMPS**
Computer Aided Message Processing System
Customer: NATO-SHAPE
Prime Contractor:
Christian Rovsing A/S
Contract Value: Approx. \$ 30 Mio.
Programme Duration: 46 months.

■ NICS/TARE

The NICS/TARE Project comprises design, manufacture, and installation of 20 CR80 communication processors interconnected in a nodal network. In each node, the CR80 communication processor interfaces to a Litton L3050 message processor.

The contract consists of hardware as well as software integrated in a turnkey system, one for each node.

Each system has two redundant CR80 computer systems which each contain two central processor units. Microprocessor controlled "Line Interface Units" will handle the connections to the communication lines as well as the protocol. A maximum of 163 duplex lines will interface to each node and can be programmed to transfer data at various transmission speed.

As a result of this programme, the CR80 computer has been approved by NATO. This implies contractual requirements in regard to reliability and quality control. Furthermore, the CR80 communication processor system must have an availability of 99.9996%.

■ FIKS

Christian Rovsing A/S has been awarded a contract by the Danish Armed Forces to supply a communication network system.

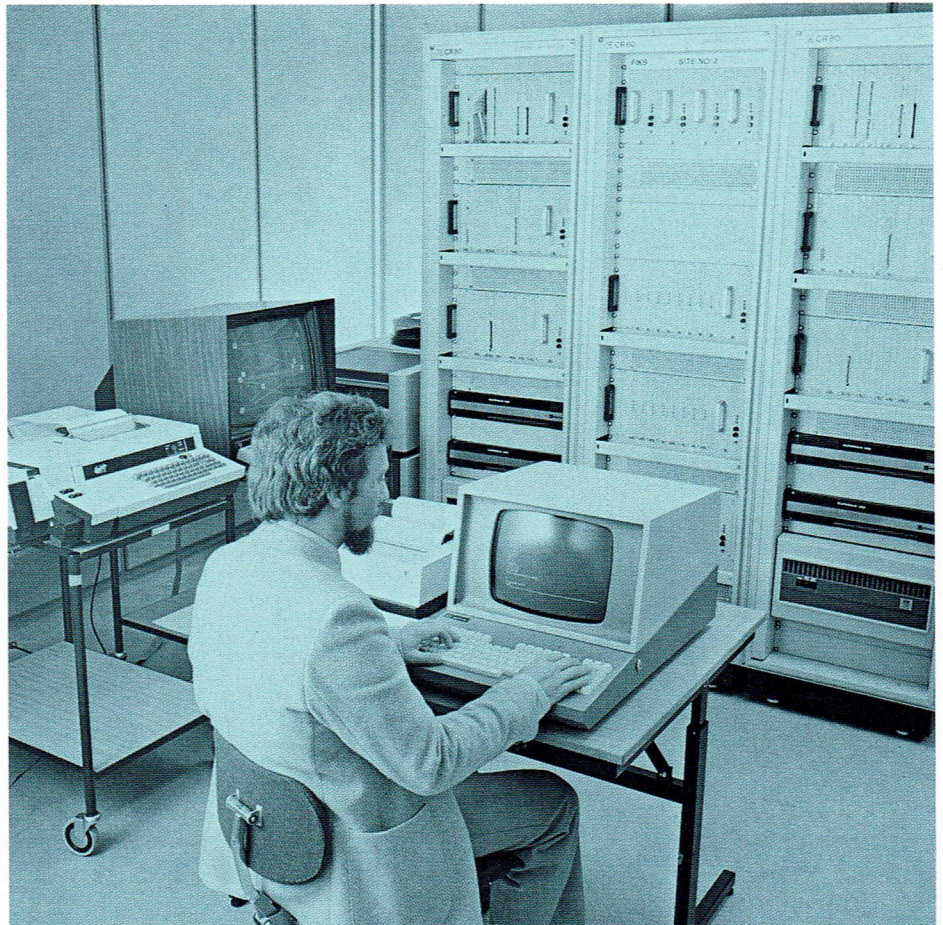
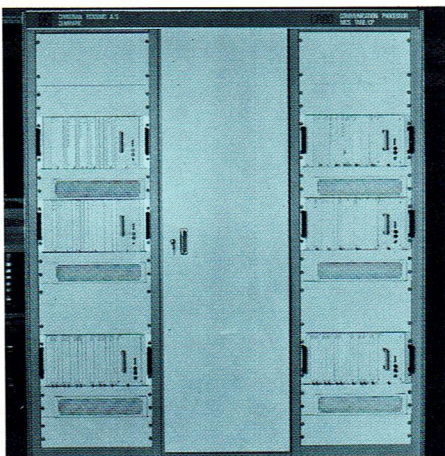
This network will when fully implemented be capable of:

- Message switching
- Packet switching
- Line switching

The nodes will contain dual CR80 systems. The network will be fully code transparent and will interface to a large number of greatly different types of terminals. Among the features of the system can be mentioned an automatic re-routing of signals in case of transmission line malfunction. Also the nodes which all are unattended have automatic switching to standby processors in case of malfunctions. In addition the nodes have automatic recovery and restart without loss of data.

FIKS – A typical installation

NICS-TARE
Doppel CR80 – Frontend for
Communication-Network



The network utilizes HDLC corresponding to X-25 level 2 between the nodes.

As additional backup, the possibility exists to connect to another Scandinavian data switching network through use of X-s1 (X-25 level 1) protocol.

At the Node level data communication lines connect remotely located terminals to the system.

The overall system specification for the network emphasizes two aspects:

- Reliability
- Data Security

The reliability is achieved by means of redundancy on the computer level as well as transmission line level. Furthermore, only MIL qualified components are being used. The CR80 system will therefore exhibit reliability not experienced with conventional, commercial computer hardware.

The data security is achieved by means of cryptography.

The FIKS system will be one of the first data transmission networks adhering to the CCITT X – series of recommendations calling for packet switching, message switching, and line switching on the same network.

■ CAMPS

Christian Rovsing A/S has contracted with NATO (SHAPE) to deliver CAMPS, the Computer Aided Message Processing System, on a turn-key basis to a number of sites within the NATO theatre.

CAMPS has two essential functions:

- CAMPS assists the user in message handling, that is, preparation, dispatch and receipt of messages, and
- CAMPS communicates with data networks, and other systems such as SCARS II (Strategic Command and Alert Reporting System) and ACE CCIS (Command Control Information System).

There are naturally high demands for reliability and security in a system like CAMPS. These demands are met by the hardware and software as an entity.

The hardware system is based upon the company's CR80 computer. In designing this computer new proven technology has been employed. Reliability is further secured by using MIL quality components and by subjecting all electronic modules to a burn-in cycle.

The CAMPS software consists of

system programmes and application programmes. The software engineering profits from the many experiences the company has obtained through the participation in other complex message processing and communication systems.

CAMPS will exchange data with other computer-assisted handling and communication systems. Interface systems which exist or are being developed include NATO-TARE and Tape Relay Centers plus SCARS II and ACE CCIS.

The interface design is structured to permit the accommodation of newly evolved systems as they are introduced.

The primary format for messages will conform to ACP-127 NATO SUPP-3 for all interfaces.

CCIS and SCARS II will utilize the X-25 data communication protocol (CCITT) when interfacing with CAMPS.

CAMPS – A typical installation



A typical CAMPS installation consists of the following elements:

- Processors and Mass Storage (3-bay Rack)
- Line Interface Equipment (3-bay Rack)
- Supervisory Console (varying from site to site)
- Software Maintenance Equipment
- Spares/Tools Cabinet

Above equipment complement, which does not include the terminal option for remote locations will be installed in a secure area dedicated CAMPS.

The computer equipment is installed in multi-bay EMI-racks with front and rear doors to allow normal maintenance. The shielding effectiveness of the EMI-racks is approved by COMSEC.

Other Programme

Brief descriptions of a number of other programmes, commercial and military, undertaken by the company in recent years are given here to illustrate the company's involvement in complete communications systems and to demonstrate its accumulated experience in related applications.

■ LME NET

The L. M. Ericsson Data Network is being developed as a private data communication network, to cover the need within the organisation with regard to data communication between data centres and terminal users.

LME NET is based on the CR80 computer and the first phase consists of (ref. fig. below):

LME NET CONFIGURATION (phase 1)

- a network centre,
- a host interface processor system for connection of IBM and UNIVAC computers,
- 10 switching nodes where traffic is collected and directed to the receiver,
- a number of leased lines between the nodes, eight of which are in Sweden, one in Copenhagen and one in Madrid.

In the later phases, the network will be enlarged with:

- more network control centres, which will enable certain distributed control parts of the network,
- more geographically distributed host

interface processors, perhaps with interfaces to other machine types (e.g. ICL),

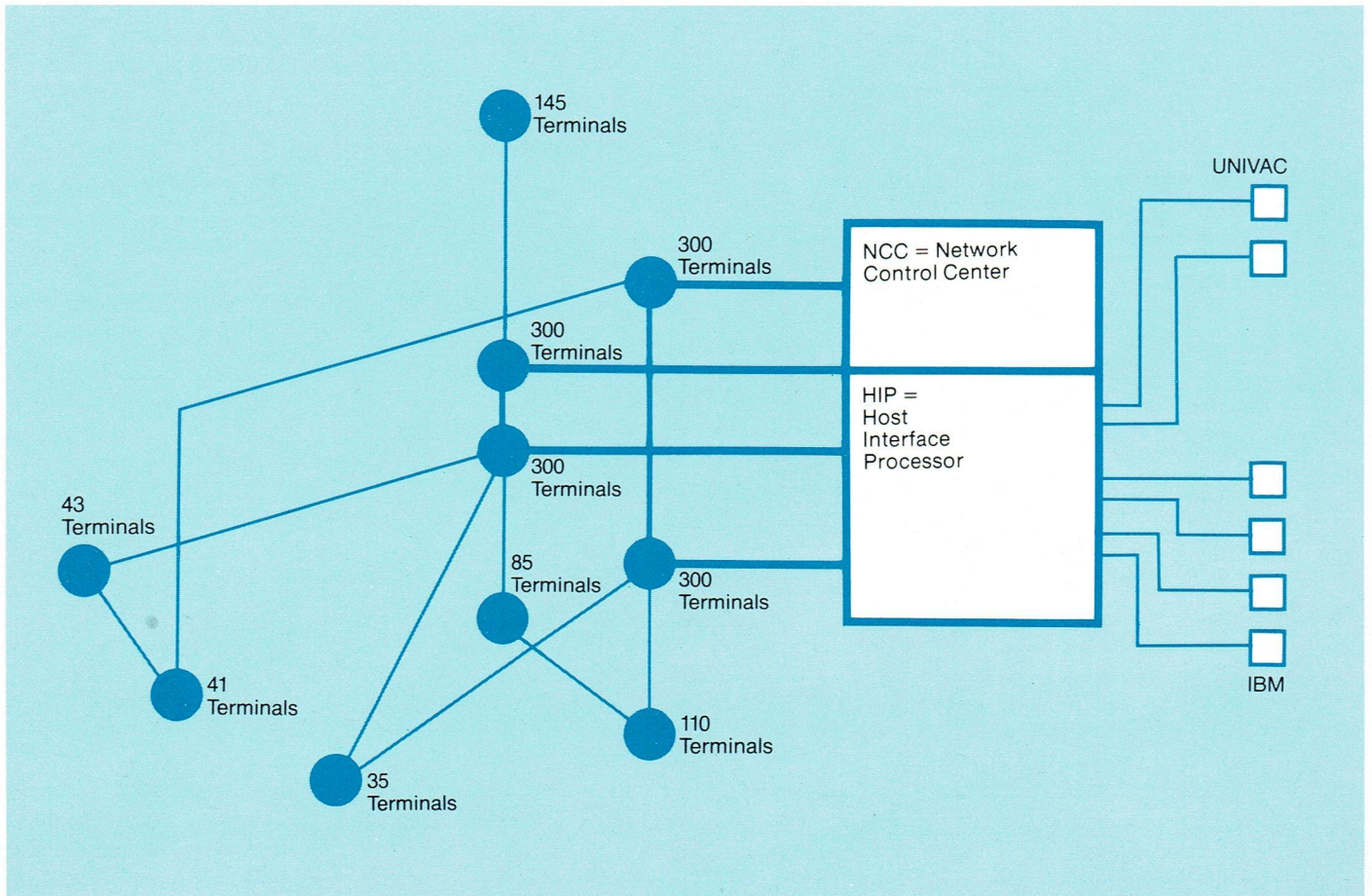
- connection via satellite to new nodes (e.g. in Brazil).

The LME NET architecture is based on the following concept:

- A general standardised transport facility is provided. The network will follow international standards for packet switch data networks, as defined by CCITT in the recommendation X.25. This shall enable a later connection to public networks and ensure the adaption of LME NET to future standards.
- Existing makes of computers and terminals will be connected to the general network by means of mechanisms in the network which do not require modifications of the existing system.

The above concept will enable a layered construction of LME NET following recognised principles of system construction in general, and network constructions in particular (acc. to ISO's seven-layer model for network: Open Systems Interconnection Reference Model).

LME NET Configuration



LME NET has the following functions:

- a complete monitoring and control of the network independent of host computers connected,
- emulation of a network, complying with IBM's Systems Network Architecture (SNA) in order to establish communication between the IBM user programmes and the SNA terminals and certain non-SNA terminals,
- emulation of a network complying with UNIVAC's Distributed Communication Architecture (DCA) which enables a communication between UNIVAC user programmes and terminals,
- direct programme to programme communication,
- different traffic types with different resource requirements,
 - dialogue traffic
 - batch traffic
 - transparent traffic

■ **TOSCA**

TOSCA is a data communication system delivered to the Royal Danish Airforce in 1972. The system consists of a number of computer controlled nodes configured in a ring structure. The network at the nodes is connected to special purpose CRT terminals. Alphanumeric data appearing in a tabular form are constantly being updated throughout the network.

At each node 4 types of terminals can be connected via the communication lines.

The system has since its installation been operating round the clock with a high degree of reliability.

■ **RITZAUS BUREAU**

A telegraphic news distribution network consisting of 130 terminals located throughout Denmark. The network, used 24 hours a day, is computer controlled and operates in a 8-bit ASCII code via dedicated public telephone lines and 300-baud asynchronous modems.

News, compiled at the main office in Copenhagen, is converted to ASCII-code, before transmission on a multi-dropped network. At the user, data received in ASCII code is converted into TTY-code used directly to control the type-setting machine. The systems features automatic selection of users for each message as well as remote control of printers of tape punch for the type-setting machine.

■ **CAMELOT**

A CR80 front-end processing system interfacing 20 ICL host computers to more than 5000 intelligent terminals. The initial configuration was successfully tested at the Regional Computing Center in Edingburgh in July, 1978.

Ultimately, a network comprised of 15 nodal switches using CR80's as communications front-end processors will computerise the entire social security service throughout the U. K. The network will feature the use of CCITT recommendation X.25.

■ **METEOSAT**

A ground computer system installed at the European Satellite Control Center at Darmstadt, Germany. It consists of a dual main frame computer interfacing with a series of special purpose computers. Christian Rovsing's participation in this programme included the delivery of preprocessing and rectification subsystems. Each subsystem employs CR80 computer configured as an array processor. The CR80 computers have been in continuous 24-hour service since the installation in 1975, so far without a single interruption of the operation.

Christian Rovsing A/S was also responsible for the archiving subsystem where satellite image data is stored on high density tape recorders and can be output to a real-time laser based photo-plotting equipment which produces pictures of the cloud formations over the earth frequently shown on television. The complete subsystem is controlled by a CR80 computer system.



NASA Photo

■ I-HAWK Protocol Converter

A CR80 configuration to convert from ATDL tracking format of I-HAWK to the MBDL format of existing TSQ-38 battery operating centers. The CR80 will also keep an updated track file. The CR80 protocol converter can after the introduction of the new ATDL-based BOC, TSQ-73, be reprogrammed to act as a converter between ATDL and LINK-1 protocols and thus interface directly with the existing NADGE.

Customer List

Christian Rovsing A/S has acquired considerable experience in the Defence and Aerospace field. This is a result of close co-operation on a wide variety of programmes with major, international companies and organisations on a subcontractor or co-contractor basis.

A list is presented below of European, U.S. and international companies and organisations with whom our company has co-operated.

■ European Companies

Aerospatiale, France
 Avions Marcel Dassault, France
 British Aerospace Dynamics Group, U.K.
 ERNO (VFW-Fokker), W. Germany
 Hawker Siddeley Dynamics, U.K.
 Kongsberg Vaapenfabrik, Norway
 L. M. Ericsson, Sweden
 Marconi Space & Defence Systems, U.K.
 Matra, France
 Messerschmidt-Bölkow-Blohm, W. Germany
 Saab-Scandia, Sweden
 Lufthansa Airlines, W. Germany

■ European Organisations

Centre Météorologie Spatiale, France
 CNES = Centre Nationale d'Etude Spatiale, France –
 ARIANE launcher Program.
 Institute of Meteorology, Denmark
 Danish Roadtraffic Research Organisation
 Danish Ministry of Defence

Flyvevejtjenesten – (The Weather Service for the Danish Civil Aviation Authority)
 Förenade Fabriksverken (Supplier of Defence Equipment to the Royal Swedish Army)
 ICL for Ministry of Health and Social Security, U.K.
 The Royal Danish Airforce
 The Royal Danish Navy
 Radio Denmark – Data-assisted recording, editing and transmission system.
 European Economic Community
 Software Studies.

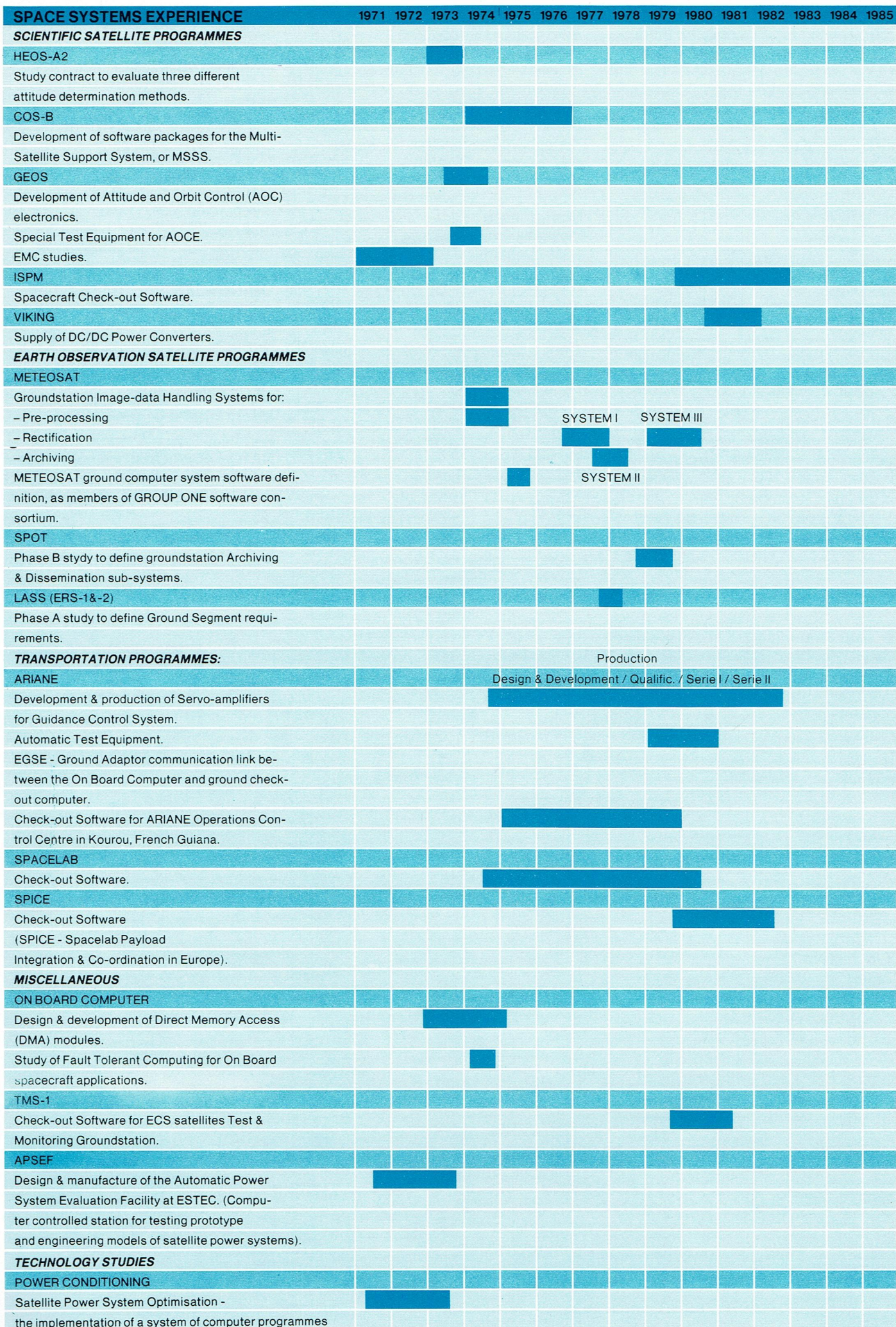
■ US-Companies & Organisations

Delco Electronics Inc.
 Hughes Aircraft Company
 JET Propulsion Laboratories
 Litton Data Systems Inc.
 TRW Systems Inc.

■ International Organisations

European Space Agency (ESA)
 NATO – HAWK Management Office
 – NICSMA
 – SHAPE

SPACE SYSTEMS EXPERIENCE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
COMMUNICATION SATELLITE PROGRAMMES															
OTS															
Member of Phase B study team.															
Design, development & production of Priority Select & Interface Unit.															
Electrical Ground Support Equipment for TT & C sub-system.															
EMC studies.															
MAROTS															
Payload Ground Support Equipment.															
ECS															
Design, development & production of:															
– Priority Select & Interface Unit															
– DC/DC Power Converter															
Automatic Test Equipment.															
MARECS															
Design, development & production of:															
– Priority Select & Interface Unit															
– DC/DC Power Converter															
Automatic Test Equipment.															
H-SAT															
Member of Phase A study team.															
NORDSAT															
Member of Phase A study team.															
TELECOM-1															
Design, development & production of:															
– Priority Select & Interface Unit															
– DC/DC Power Converter															
Automatic Test Equipment.															
L-SAT															
Member of Phase B study team for Power Sub-system and in particular: AC-Power to Essential & Auxiliary Loads.															



SPACE SYSTEMS EXPERIENCE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
for the optimisation of power systems in satellites.															
Power Converter Modelling.															
AC Power Distribution in satellites - the study of a low power AC-Bus system for use on board satellites.															
GENERAL SATELLITE ELECTRONICS															
Electromagnetic Cleanliness in Satellites.															
Fault Tolerant Computing for On Board Space-craft Applications.															
RADIATION Protection & Hardening of Satellite Electronics.															
SATELLITE DATA ACQUISITION															
Frame Synchronisation - analysis of the performance of optimum & sub-optimum methods of frame synchronisation of satellite data.															
Bit Synchronisation - analysis of methods for bit synchronisation of satellite data and the parameters which affect performance.															
High Density Digital Tape Recording Techniques.															
REMOTE SENSING IMAGE-DATA HANDLING															
Future Groundstations - analysis of critical areas of processing due to very high data rates typical of future satellites.															
Survey of Technology Available for Very High Speed Data Recording & Handling of Very Large Data Archives.															
End-to-end Trade-off Analysis of a Data Dissemination System (participation as subcontractor).															
Precision Pre-processing of Remote Sensing Data.															
SAR Processing - analysis & development of algorithms for Look Summation & Post Processing.															
Operational Aspects of SAR Data Acquisition & Processing.															
DATA COMMUNICATIONS EXPERIENCE															
DEFENCE PROGRAMMES															
Royal Danish Airforce															
TOSCA															
Information distribution & display system															
LITTON Data Systems (NATO-NICSMA)															
NICS-TARE															
NATO integrated communications system.															
Supply of front end processors.															
Royal Danish Airforce															
FIKS															
Defence integrated communications system - prime contractor.															
NATO HAWK Management Office															
ATDL/MBDL converter for I-HAWK															
Performance improvement programme. (HAWK-NADG Data Link)															
NATO SHAPE CAMPS															
Computer aided message processing system - Prime Contractor.															
MoD (UK) CRISP															
X-25 Packet switched data distribution network (Subcontractor).															
COMMERCIAL PROGRAMMES															
Ritzaus Bureau															
Computerised news distribution network															
European Space METEOSAT															
Groundstation image data															
Handling systems for pre-processing rectification and archiving															
L. M. Ericson															

DATA COMMUNICATIONS EXPERIENCE

1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985

LME-NET														
Packet-switched network for inter-company use between locations in Europe and S. America														
ICL CAMELOT														
Supply of front end processors for data network for U.K. Department of Health & Social Security.														
ESCOM														
Supply of front end processors for data network for control of Electricity supply & distribution.														

Abbreviations and Acronyms.

ACBA Allied Command Baltic Approaches
 ACE Allied Command Europe
 ACP 127/ Allied Communication Procedure 127/128
 AOCE Attitude and Orbit Control Electronics
 APSEF Automatic Power System Evaluation Facility
 ASCII American Society and Communication Information Interchange
 ATDL/ Army Tactical Data Link/
 MBDL Missile Battery Data Link
 CAMELOT Name for Department of Health and Social Security Computer System in England
 CAMPS Computer Aided Message Processing System
 CCIS Command Control Information System
 CCITT Comité Consultatif International Téléphone et Télégraphique
 CEMS Centre d'Etude Météorologique Spatiale
 COMSEC Communications Security
 COS-B Cosmic Observation Satellite - B
 CRA Christian Rovsing A/S
 CRDS Christian Rovsing Data Systems
 DOLCE Digital on-line Cryptographic Equipment
 DORA Danmarks Radio's Optage, Redigering og Afspilnings-system
 ECS European Communication Satellite

EMC Electromagnetic Compatibility
 ESA European Space Agency
 ESCOM Electricity Supply Commission
 FIKS Forsvarets Integrerede Kommunikations System
 GEOS Geostationary Observation Satellite
 HAWK-NADGE Homing All the Way Killer NATO Air Defence Ground Environment
 HDLC High-level Data Link Control
 HEOS-A2 Helios Observation Satellite
 H-SAT Heavy Satellite
 I-HAWK Improved HAWK
 ISPM International Solar Polar Mission
 KTAS Københavns Telefon Aktieselskab
 LANDSAT Land Satellite
 LASS ERS Land Application Satellite System -1 & -2
 LINK-1 Air Defence Data Link
 LITSYNC Litton Synchronous Protocol
 LME L. M. Ericsson Network
 L-SAT Large Satellite
 LSI Large Scale Integration
 MARECS Maritime European Communication Satellite
 MAROTS Maritime Orbital Test Satellite
 MBDL Missile Battery Data Link
 METEO-SAT Meteorological Satellite
 MIL-M- Military Standard

38510 Military Standard
 MIL-Q-9858A Military Standard
 MIL-STD-1520 Military Standard
 MSS-Images Multi Spectro Scanning Images
 MSSS Multiple Satellite Support System
 NADGE NATO Air Defence Ground Environment System
 NIC SMA NATO Integrated Communication System Management Agency
 NICS-TARE NATO Integrated Communication System/Telegraph Automatic Relay Equipment
 NORDSAT Nordic Satellite
 OEM Original Equipment Manufacturer
 OTS Orbital Test Satellite
 PS&I Priority Select and Interface Equipment
 SCARS II Status, Control, Alerting, Reporting System
 SPECAT Special Category
 SPICE SPACELAB Payload Integration and Coordination in Europe
 SPOT Satellite Probatoire d'Observation de la Terre
 TELE-COM-1 French Telecommunication Satellite
 TMS-1 Test & Monitoring Station-1
 TOSCA Tote System
 TSQ-73 Computer Assisted Name of Battalion Operating Centre Facility
 TTY-Code Teletype Code
 VIKING Swedish Scientific Satellite

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