RC BACKROUND

RC Computer A/S (Regnecentralen) was founded in 1947 as an institute under the Danish Academy of Applied Sciences. In 1955 RC Computer was made an independent organisation, and the name Regnecentralen was introduced.

In 1955-56 RC Computer developed the first Danish computer, DASK, short for Danish Arithmetic Sequence Calculator. DASK was based on tubes - a rather old-fashioned technology, but DASK was the world's most advanced computer in terms of utilising indexation of programs and data. It is best known for its accurate prediction for the Danish television forecast of the results of the general elections in 1960.

In 1960 RC Computer took part in the committee which defined the Algol language in the Algol-60 report. Since then, RC Computer has installed Algol compilers on its high-end computers. Today it is used in computerised telephone directory assistance systems, library systems and case handling systems in public administration, all of which require a large number of transactions and short response times.

Also in 1960, RC Computer introduced GIER, a fully transistorised computer developed in cooperation with the Danish Geodetic Institute. From 1963 onwards RC Computer created a number of products with special emphasis on conversion and communication; the world's fastest ever paper-tape reader, RC2000, was sold in large quantities internationally. In the late sixties and seventies RC Computer developed a number of computers, RC4000, RC3600, RC6000, RC7000, RC3500 and RC8000, giving RC Computer a reputation as a highly qualified supplier of computers for data base management and communications.

In 1964 RC Computer was converted into a limited company with a share capital of 10.5 million kroner. Soon offices were opened all over Denmark and distribution channels were established in West Germany, the United Kingdom, Sweden, Norway, Finland and Kuwait.

Since the beginning of the seventies RC Computer has been active in the data communications field. Virtually all types of remote batch protocols have been developed. In addition to this, RC Computer has implemented packet switching networks; the first was installed in the late seventies by the Association of German Tax Auditors. The net, called DATEV, is still the largest private network in Europe with 28,000 terminals connected. Today this experience has resulted in a fully built-up X.25 network complying with the ISO Standard for open system interconnection. The project PAXNET was developed in cooperation with the Danish telephone companies.

The network is constantly being improved, and new standards are incorporated as soon as they have been defined in the standardisaion organisations, whose work is closely monitored by RC Computer. RC Computer is also involved in EEC-projects incorporating X.25 equipment.

RC TODAY

RC Computer A/S is a limited company owned by the following parties: The Danish Telephone Companies, The National Bank, Standard Electric Kirk, Post & Telegraph Administration, Danish Pension Fund Organisation and others, including members of the staff. The share capital amounts to 130 million kroner, approx. $16 million.

At RC Computer in Denmark there are approx. 625 employees (1985) in locations in Ballerup, Herlev, Aarhus, Glostrup and Praestoe. About 170 are engaged in development, 125 in technical service, 200 in production, and 130 in administration and sales. In addition there are dealers in Denmark, as well as subsidiaries and distributors in other countries. The total number of RC employees is approx. 800.

For several years microcomputers have constituted a steadily increasing part of RC Computer's product range, and today they account for a substantial percentage of the turnover.

The minicomputer RC8000 is to a large extent used for processing bulk quantities of information, e.g. in connection with telephone directory assistance systems, integrated systems for libraries and complex administrative data processing systems.

RC890 and RC3502 are communication processors for data networks and X.25 switching respectively.

The professional 16-bit microcomputer RC750 Partner is sold in a quantity that exceeds 10.000, making it one of the most sold micros in Denmark.

The data terminal RC45 offers flexibility with respect to both communication protocols and interfaces which makes it possible to combine several types of functions in one and the same terminal.

RC39 is a Xenix-based supermicro for office automation.

The educational microcomputer RC759 PICCOLINE is the computer most commonly chosen for use in Danish schools - more than 7,000 have been installed.

The RC computer A/S is the no. 2 overall supplier of data equipment in Denmark after IBM. In special sectors like education and networking, RC is a strong leader. In the PC market RC is no. 2 after IBM but with a larger market share than Olivetti.

Approx. 30% of the total sales are related to the Danish government.

RC8000 MINICOMPUTER

The RC8000 minicomputer is the latest element in a series of medium-sized computers developed by RC Computer during the past ten years. Although RC8000 has been in existence for several years, the versions supplied today have been updated with new technology, both with regard to cpu-capacity and peripheral units.

RC8000 is a 24-bit processor with a proprietary operating system especially suited for searching and processing of large amounts of data.

In 1985 the most up-to-date version of RC8000 was released; it is a multiprocessor version which doubled the data processing capacity to 3 MIPS.

The fields of application include searching and processing of the large files of subscribers of the tele-administrations, processing of the membersnip files of the unemployment funds, and a complete library system with cataloguing, search files, circulation control etc. The library system has been awarded a prize by the Swedish organisation of libraries.

The information system for telephone companies in Denmark is known as the "telephone key": You call and receive the number of an indicated name, or vice versa. The system was originally developed in cooperation with Jutland Telephone Company, and it is now used by all Danish tele-administrations.

The system is also used by New York Telephone, Michigan Bell, Televerket in Norway, the Ministry of Communications in Kuwait and ETISALT in the United Arab Emirates.

The ability of the system to handle Arabic as well as Latin alphabets assures an excellent competitive edge in the rapidly growing Arabic market.

Special information retrieval systems have been installed by the Danish police authorities and in Pentagon, Washington D.C.

The total sales of RC8000 amount to approx. 350 units of which approx. 100 are installed outside Denmark.

The systems are used for a number of different applications; 27% for telephone directory assistance, 20% for government administration, 17% for financial applications and the remaining are used in service bureaux, pension funds, libraries, universities, hospitals and trade unions.

RC8000 is going to be further updated and will become an integrated part of the new RC high-end computer.

RC3502 COMMUNICATIONS PROCESSOR

RC3502 is an RC COMPUTER developed processor specially designed for high speed switching and is used in the implementation of PAXNET.

PAXNET is a value added packet switched network developed by RC Computer and the Danish Telephone Administrations in a joint venture. The PAXNET has been in operation internally at the Telephone Administrations since 1983 supporting several applications. A number of computers (hosts) from different manufacturers are connected as well as terminals. Digital exchanges are also connected for operation and maintenance. The Danish Universities have solved their data communications problems via PAXNET since 1984. This solution has been in public operation since 1984 when the "Alarm Transmission Service" for banks, industry and personal security applications became available all over Denmark. In 1987 the PAXNET X.25 service will be publically available in Denmark and Greenland.

The seven layer Open System Interconnection model, OSI, from ISO is the basis for data communications standards. The ISO standards for the lower 5 layers are today relatively stable, but for a number of areas, the ISO standards have not been finished yet. Therefore, PAXNET also relies on other standardisation organisations: CCITT and ECMA. PAXNET is under continuous development just as the standards are. Today PAXNET offers a seven layer service along with an X.25 layer three service. Shortly, this service may be characterised as follows:

- Data is sent in packets with a maximum length. Default 128 octets.
- Transport of data takes place on Virtual Circuits (Switched or permanent).
- Data transport is safe.
- Speed conversion and flow control are included.
- Physical lines are utilised effectively as data streams are multiplexed.

PAXNET provides the X.25 service. Furthermore, PAXNET observes all recommendations belonging to the "X.25 family": X.1, X.2, X.75, X.3, X.28, X.29, etc. Thus PAXNET fulfils the CCITT demands of a public network.

Perhaps the most important task for a data communication network is the ability of connecting user terminals and host computers. Usually, a terminal connected to one host cannot access another host, because the hosts use different terminal protocols, eg, an IBM terminal cannot usually access a CDC host. The solution to this problem is a very important part of the PAXNET services.

Each terminal type which is able to connect to PAXNET may, with a single command, choose among the connected hosts. Currently the following terminal protocols are supported:

- 3270 BSC
- ECMA 48 (including VT100)
- Asynchronous ("Triple X" and a simple Virtual Terminal Protocol),

- thus covering a very high percentage of existing terminals. Hosts and PC's obeying these protocols or X.25 may be connected. Furthermore, specific host interfaces have been implemented for:

- IBM 43XX and 308X
- CDC Cyber
- Honeywell Bull DPS8
- RC8000

Terminals and the specific host interfaces are connected at layer seven of PAXNET, if not using the X.25 service. From a terminal user's point of view it looks as if he has a dedicated physical connection to the host. The terminal user may create more than one connection at a time in order to retrieve data at one host or application and use this data on another host or application.

The RC3502 is a strategic product and more than 1,000 have been installed.

RC750 PARTNER MICRO

In 1984 RC Computer introduced a 16-bit microcomputer based on INTEL 80186, the RC750 Partner.

Partner is a professional microcomputer which can be used as a PC, providing the data power in small user systems and can also be linked up with a local network with many workstations. Furthermore, Partner can be used for most types of communication.

The RC750 Partner uses concurrent CP/M and DOS and can be programmed in basic, Fortran, Pascal, C, PL/1, Cobol and Assembler.

Special attention has been given to the display unit which is controlled by its own microprocessor. A high degree of legibility has been achieved, both in the design of the characters on the screen and the physical appearance of the screen itself. The screen has been designed with high resolution graphics and there are colour as well as monochrome displays.

Partner addresses itself to the professional market's need for personal computers (PC), small administrative systems and office automation equipment.

In the Scandinavian countries where the RC750 is marketed local language has been adopted for user documentation, menu texts and application software.

More than 10,000 RC750 Partners have been installed. It is a strategic product and a new product version is scheduled for release in 1987.

RC45 TERMINAL SYSTEM

The RC45 terminal has been developed to meet advanced demands of function, ergonomic design and economy. RC45 workstations overcome a number of problems ranging from simple terminal communication with a host computer to complex dialogues with both local and central data processing units.

The large suppliers of mainframes and minicomputers have been setting the standards for terminial communication with the computer. The most well-known are probably IBM's BSC and SNA/SDLC protocols, and DEC's VT100 protocol. However, the protocol itself does not solve any problems for the user. The interesting part is the application to which the user may get access.

Most terminals are designed for one specific communication protocol, and may thus only give access to the applications on one single type of computer. However, the user often needs access to several computer systems.

RC45 has been designed for communication with several different computer systems to offer the user the required functionality. Additionally, RC45 can function as a VT100 terminal and an IBM 3270 terminal at the same time.

RC45's VT100 communication means that the terminal may be used with many different computers. The vast majority of UNIX/XENIX systems are now supporting VT100 terminals, and RC45 incorporates 7 bit as well as 8 bit communication, as do DEC'S latest VT200 terminal series.

RC45 consists of a number of systems components which may be combined in various configurations. The basic systems components of the RC45 concept are the display unit, the control logic and the keyboard.

Terminals may appear as stand-alone workstations or as several workstations grouped together, in both cases in connection with communication to host computers. RC45 can input control programmes from a cluster control unit, and in this way the workstation can perform a wide variety of functions.

RC45 can be supplied with yellow characters on a dark background (amber), with dark characters on a light background (paper-white) or with a colour screen. The screen may be swivelled and tilted, to obtain the best possible working position.

The keyboard is light and easily moved around. It is completely flat and very low, so that there is no need for wrist support and it can be tilted to a suitable angle. The keys have been set out in groups of logically connected functions making the keyboard easy to work with.

More than 4,500 RC45 terminals have been installed in Scandinavia. Although the terminal is not a strategic product, it might prove to be important to RC's high quality image.

RC39 SUPER-MICRO

RC39 is a multi-user system for information processing, suitable for both office work and administrative tasks. It is supplied with word processing, spreadsheet and administrative data processing facilities.

RC39 is based on industrial standards. The main processor is the INTEL 80286 16-bit processor with the XENIX control system (a version of UNIX). The system may be provided with a main storage of up to 160 MB.

RC39 is based on terminals with simultaneous operation of a larger number of work stations. The terminals may be in active connection with the XENIX system, or they may communicate directly with one or more host computers.

The basic version of the RC39 was designed for small businesses, universities and higher education establishments. When equipped with the integrated communications processor the product can be used in public administration and other large organisations. RC39 has primarily been designed for office automation and administrative duties where it is a local, independent multi-user unit and a supplement to large central host computers.

RC39 uses the RC45 terminal - 32 may be connected to the same terminal network. When the RC39 is equipped with an integrated communications processor, each RC45 can be used simultaneously as an RC39 and as an IBM 3270 terminal due to its dual session capacity. The IBM 3270 is transparent to the RC39 so it is not over-loaded when it performs interactive host communication.

The product is going to be integrated into the new RC750 product family - so far a little more than 100 systems have been installed.

RC759 PICCOLINE - THE EDUCATIONAL MICRO

Since the early seventies RC Computer has been the major supplier of data equipment to Danish schools. The equipment is used for training in computer programming and for computer-aided instruction and learning. In 1980 RC Computer introduced RC700 PICCOLO, an 8-bit microcomputer, to the educational sector. It was replaced by PICCOLINE, a 16-bit microcomputer, in 1984.

PICCOLINE is equipped with up-to-date technology within microtechnique and benefitted from experience gained in the development of the Partner microcomputer. Many of the circuits are the same although the computers differ in other respects.

The product has been specially developed for use in the educational sector with adequate data capacity and access to large quantities of data resources. It can be connected to any external unit and can be incorporated into a local network or other communications systems.

PICCOLINE, which is marketed in Denmark only, is the most commonly used microcomputer in Danish schools - more than 7,000 have been installed. However, the product is going to be replaced by the new RC750 product family.

RC MIKRONET

RC Mikronet is a baseband LAN following Ethernet protocols.

Introduced in 1984, RC Mikronet has gained a market share of 37% of the total Danish LAN market which makes it the most commonly used LAN in Denmark.

RC TELEPHONE DIRECTORY ASSISTANCE

A telephone subscriber is used to high standards. Calls are expected to be serviced immediately and technical failures hardly ever occur. A directory service is almost a must.

A directory service involves the issuing and updating of directories and the maintenance of the directory assistance service. RC Computer has evolved the Computerised Directory System and with this product one of the leading system suppliers. The Computerised Directory Assistance System (CDAS) has been designed to meet the subscribers' expectations as well as the requirements for rational directory services from the telephone companies. The Directory Assistance Service must be fast, able to accept inaccurate inquiries and available 24 hours a day.

RC Computer has first-hand knowledge of the design and implementation of the first two computerised directory assistance systems in the world. The first of these systems was designed for and installed at Jutland Telephone Company, Denmark; the second designed for the American Bell telephone companies. Today this system is in use at Michigan Bell and New York Telephone. Dual language versions (Arabic/English) have been installed at the Ministry of Communications in Kuwait and at ETISALAT in the United Arab Emirates.

The nationwide Danish system comprises two databases placed at the Jutland Telephone and the Copenhagen Telephone companies, respectively. Approximately 350 terminals are connected to the databases via a high speed data network which will automatically route the transactions to the correct database. The nationwide system has about 2.5 million subscribers today, and the number of enquiries amounts to about 30-35 million per year with a response time of less than 2 seconds. The system has proved extraordinarily reliable with an actual operational efficiency of 100%.

The system for Michigan Bell was supplied in 1979/80 and comprises 17 RC8000 database processors with a total of about 3 million subscribers divided on 6 main sites. The number of working positions is 1,100 which are connected to the 6 main sites data centres via 80 RC3502 terminal concentrators. The working positions are divided among 22 remote offices, and the average number of enquiries is 129,000 per hour and 217,000 during a busy hour.

The system for New York Telephone was supplied in 1981/82 and comprises 20 RC8000 database processors with a total number of 5.2 million subscribers divided on two data centres. The number of working positions is 1,850 which are connected to the 2 data centres via 87 RC3502 terminal concentrators.

The working positions are divided among 33 remote offices and the average number of enquiries per hour is approximately 216,000. The number of enquiries during a busy hour is 360,000 - i.e. 100 per second.

During 1979 RC received a contract covering the development, delivery and installation of a dual-language Arabic/English Directory Assistance system for the Kuwait Ministry of Communications. The specifications called for multi-parameter system with a demand for extremely fast response times. In addition, the customer requested many new features including:

- search on any element in the database
- Arabic or English as input or output
- complete parameter flexibility
- facilities for phonetisation, synonymisation and acronym handling
- secondary/related listings.

The result of the development effort is the most advanced dual-language system in the world. The system incorporates the RC8000, the RC3502 and 150 RC853 terminals. Main Site hardware is duplicated to assure 24 hour availability. The RC853 contains a dual input/output module which automactically determines available channel to Main Site. The RC853 is also equipped with RC's unique motorised positioning feature.

The Arabic character generator used in the system has been developed in cooperation with Arab nationals and is said to be excellent.

In a report from ITT Advanced Technology Center made by J.P. Startes dated July 31st, 1986 the diretory assistance system from RC was compared to those of CCI, IBM and Lockheed. The following are direct quotes from the reports:

"

"Vendor	DA Functions	Data Transport	Yellow Pages
CCI	Strong US Limited other	Limited	Limited caption lookups Extensive plans
IBM	Strong US	Limited	No capability
Lockheed	Strong US	Extensive	Strong caption lookups
RC	Strong in many environments	Extensive & flexible	Strong caption lookups Extensive plans

The RC system was originally developed in 1978 for use in Denmark. It has been revised and updated many times since then. Indeed, the system upgrades have been more gracefully integrated in this system than in the others considered.

"Significant observations on the RC system:

* It supports a wide variety of national environments. RC is comfortable with the modification of its system to meet the requirements imposed by these environments.

* The system has strong data export capability. Many users of the system produce typeset output for the white pages directly from the DA system. RC has committed to an interface with DOS for the system in Turkey.

* The strong relational nature of the database structure allows a wide variety of lookup strategies. The ability to retrieve listings by business classification is already supported in Denmark. RC would like to show yellow pages lookup at Telecom '87.

* RC has successfully installed and maintained (since 1980) several systems in remote sites. They provide extensive training and logistics support for local maintenance personnel.

Test recommends that WD establish a business arrangement with RC for the provision of DA systems and its extension to electronic yellow pages. This recommendation is based on the following conclusions:

* All systems currently available are optimized to reduce the average work time for a DA call. All of them require complete restructure and reload of the database for update.

* Bellcore has issued a new requirements specification for DA which includes many of the functions that might be described as electronic yellow pages. The implementation of finished systems with these features and functions and features of this specification are not compatible with World Directories' requirements. However, the RC system is capable of extensive caption lookups and RC is willing to add yellow pages functions prior to Telecom '87

* The systems from CCI and Regencentralen both use special computer equipment provided by the DA system vendor. The use of such limited issue equipment may present a maintenance exposure, particularly with regard to installation in a variety of countries. RC has, however, successfully installed and maintained their systems in a variety of remote sites (Kuwait, Oman, United Arab Emirates).

* Only the RC product of those currently available is recommended for use by World Directories as part of its product and service offering. Other products currently under development will offer no time advantage to World Directories.

* World Directories could consider the offering of DA services on ots present hardware and software base, that is DEC VAX and ADM DRS. There are a number of riskes inherent in this approach:

  - The development and support of WD system would require the establishment of a development organization not presenlty extant. A minimum of ten developers over eighteen months is estimated to provide minimally acceptable DA functinality.

  - Selection of DA vendors is historically based more on reputation than price. WD would be at significant disadvantage.

  - Such a development is outside the mainstream of the WD business."

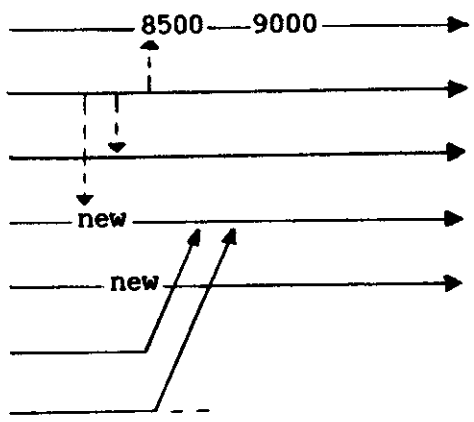
The Telephone Directory Assistance System is currently the strategic software product for the international market.

CURRENT RC PRODUCT-LINE

NAME	DESCRIPTION	INTRODUCED	TOTAL NO. INSTALLED	PRICE RANGE K $
Hardware:				
RC8000	Minicomputer	1975	350	150 - 1,000
RC890	Comm. Processor	1980	700	5.0 - 10.0
RC 3502	Comm. Processor, X.25	1980	1,000	8.0 - 12.0
RC PARTNER	Multi-user micro, conc.DOS	1984	10,000	6.5 - 10.0
RC45	Terminal	1983	4,500	1.5 - 3.0
RC39	Supermicro	1982	110	20 - 40
RC PICCOLINE	Educational micro	1984	7,000	2.5 - 4.0
Software:				
Directory	Info. retrieval, dir. assist.	1977	15	40
General info.	Info. retrieval, gen. purpose	1986	2	
Library	Info. retrieval, libraries	1981	45	
Net:				
RC MICRONET	Baseband LAN	1984		

RC PRODUCT STRATEGY

NAME	STRATEGIC PRODUCT	YEAR 87 88 89 90 91	REMARKS
Hardware:			
RC8000	Yes	8500 → 9000	G.P. Computer
RC890	Yes		Data Networking
RC3502	Yes		Data Switching
RC750 PARTNER	Yes	new	O.A. system
RC45	No	new	G.P. terminal
RC39	No		
RC759 PICCOLINE	No		
Software:			
DIRECTORY	Yes		Telephone Dir.
GENERAL INFO.	Yes		Info. retrieval
LIBRARY	No		
Net:			
RC MIKRONET	No		Baseband LAN



RC PRODUCT STRATEGY

NEW PRODUCTS:

RC9000

New fault-tolerant, 32-bit UNIX-based RISC processor, 10-15 MIPS range. First customer shipment targeted Q.1, 1989. Hardware to be developed by RC, while the fault-tolerant UNIX is sourced from Tolerant Inc. of USA. The development cost is expected to be approx. 7M $.

RC8500

An updated version of RC8000 with enhanced performance and communication facilities. To be integrated in RC9000. Planned release is Q.3, 1988.

RC750 PARTNER

Will be replaced by a 32-bit, UNIX-based multiprocessor. First customer shipment target early 1988.

RC45

Enhanced functionality and up-to-date technology, but still a high-end sophisticated data terminal. Introduction target early 1988.

VERTICAL APPLICATION PACKAGE

Total systems solution for the transportation sector. First customer shipments targeted for mid 1989.