# Local Area Network
# An introduction

RC Computer

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**Introduction.**
With the introduction of the technologically advanced RC LOCAL AREA NETWORK, RC COMPUTER has launched a flexible and efficient network system that can live up to today's communication expectations for high speed data transfer, internal and external communication, quality and low cost.

This report will comment the design criteria behind the RC LOCAL AREA NETWORK and illustrate examples on how the RC LOCAL AREA NETWORK can be combined with other RC products.

**Local Area Networks in general**
A Local Area Network (LAN) can be defined as

*...a privately owned, geographically restricted internal communications system that is based on high-speed cable connections to a variety of computer equipment and which incorporates services that make it potentially possible for all users of the system to get access to all the attached resources, including communication with all the other users...*

A LAN enables a physically dispersed working team with common communication and information needs, to share network facilities such as word processing, data processing, electronic mail, video- and voice media.

The workstation could be a dedicated single-user personal computer, or it could be a terminal having access to multi-user micro- or minicomputer systems. One workstation can provide a multitude of services such as access to mainframe computers, external information exchange, telex, teletex and teledata facilities, etc. The LAN accesses the relevant data sources and distributes the information to the group thereby economizing on investments in printers, data base facilities, file and disc servers and communication servers.

A LAN binds the different computer devices and facilities together into a distributed system. This architectural form is particularly renumerative, as system extension costs can be kept down. Gradual enhancement will not result in total reconfiguration or replacement of the system. Workstations, mainframes and other related equipment can be placed at the most propitious spots in order to minimize dependency on central mainframe systems and to optimize on the balance between central and local services. Centralized instruction and control is not necessary for effective and reliable communication in the LAN.

A LAN computer system is a collection of autonomous processors which each provide the user of the system with that part of the aggregate available resources which is relative to his work. If one of the processors break down, the users are cut off from utilizing the facilities furnished by that unit only, whereas the remaining resources continue to be at their disposal. A computer environment consists of a number of different activities going on simultaneously. In centralized systems equipment malfunction often stops all on-going activities, whereas the distributed system only interrupts a few.

The automated office has created the need for information exchange between multi-vendor computer systems. The LAN offers many solutions to this problem.

De-facto industrial standards and international cooperation on the standardization of interface specifications has made it possible to interconnect multivendor equipment. ISO (International Standards Organization) has worked out special guidelines for the development of communication systems, to prepare them for interconnection to other makes. The first concrete proposition for a LAN standard emerged as a joint proposition from Intel, XEROX and DEC, and is called Ethernet.

Ethernet is based on the CSMA/CD technique, unique in that it employs a passive cable media and lets all communication control be governed by the connected units. This method secures stable operation and facilitates smooth extension of the LAN.

The Ethernet proposition has resulted in an IEEE standard (802/3), and additionally in a proposition for a CSMA/CD Local Area Network in which the connected equipment is compatible with Ethernet, but which is based on a much cheaper media (Cheapernet).

The main characteristic of Ethernet and CSMA/CD systems is the technique used by each connected station to monitor the media. The expression CSMA/CD stands for Carrier Sense Multiple Access and Collision Detection and is briefly defined below:

*Carrier Sense*
A station ready to transmit first listens to see if the carrier cable is occupied by other traffic. If not it begins to transmit.

*Multiple Access*
Several stations ready to transmit can send as soon as the media is vacant.

*Collision Detection*

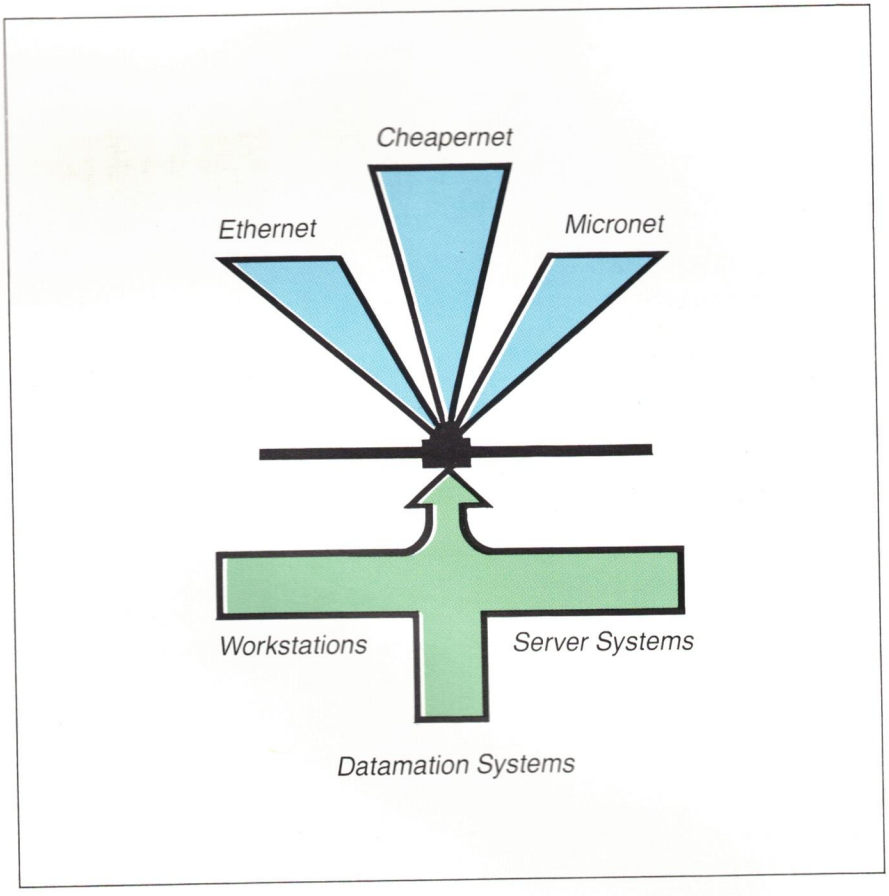
When a station begins transmission it listens to assure that the signal on the line matches the transmitted signal. If negative, another station might be transmitting simultaneously and hence a collision has been detected. All stations which detect collision on the line will cease to transmit after a few bits and wait a number of time segments before retransmission. The amount of time is randomly chosen within an interval. The interval is increased exponentially for each consecutive collision. This algorithm, called the "exponential backoff algorithm" ensures that the waiting time will differ for the stations which have simultaneously detected collision so that the congestion problem be quickly resolved.

**RC Local Area Network**

RC Computer has in the choice of its LAN concept attached great importance to the obvious advantage of a standardized local area network. The RC LOCAL AREA NETWORK is of the CSMA/CD type and conforms to the Ethernet standard (IEEE 802/3).

In recognition of the fact that costs related to cable installation and device connection fluctuate considerably according to the type of LAN-solution, RC has chosen to offer 3 alternatives:

- ETHERNET as specified by IEEE (IEEE 802/3)
- CHEAPERNET as specified by ECMA
- RC MICRONET as specified by RC




The technical specifications for these variations of the RC LAN can be found in the following chapters. It should be mentioned here, that while ETHERNET by virtue of its higher quality media can cover longer distances without amplifying equipment, CHEAPERNET can furnish the same yielding capacity, though over shorter distances and at a much lower price. CHEAPERNET and MICRONET use the same transmission media, a simple, flexible coaxial cable. MICRONET is most economical but offers a slower transmission rate. One can choose the variant of the RC LOCAL AREA NETWORK which most precisely suits the task. The RC LAN uses the CSMA/CD protocol for all three types and the same high-integrated interface circuits. (VLSI technology).

The software systems and their interfaces are therefore independent of the choice of LAN. This means reduced software development and maintenance costs. One can choose the type of LAN according to need but use the same programs on the cheaper models as for the more expensive.

MICRONET can be upgraded to CHEAPERNET, which supports a higher transmission rate, by merely exchanging the peripheral equipment. The software systems and LAN transmission media remain unchanged.

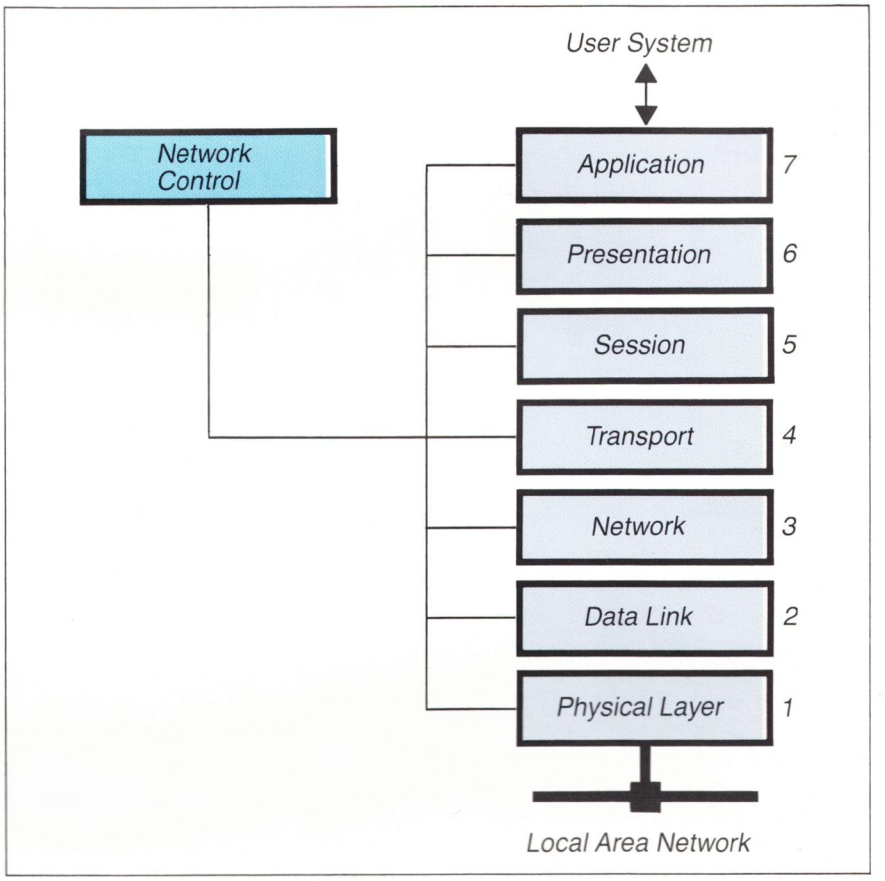
The RC LOCAL AREA NETWORK transmits on a single coaxial cable and does not require centralized electronic controls. The CHEAPERNET and MICRONET transmission lines are easy to install and uncomplicated to maintain making them particularly conducive to personal computer and terminal system applications. The cable can be installed along the walls with a number of outlets placed at present or expected workstation sites. A so-called "Transceiver" connected to the computer by a 5 or 12 m long cable facilitates connection of computer equipment. The Local Network can be extended gradually in planned steps, or terminals/mainframes can be relocated without disturbing the overall operation of the system.

To link RC's different products to the LAN a special product-oriented option (a LAN Adaptor) is required.

The standard IEEE 802/3 CSMA/CD protocol is used together with the recommended LLC-1 protocol (IEEE 802/2) to interface to the RC LOCAL AREA NETWORK.

To further enhance this technique RC has developed a distributed system architecture, DSA/IMC. DSA/IMC offers even more service options than the basic Ethernet CSMA/CD facility. DSA/IMC offers user-to-user message services, error detection + retransmission, traffic and flow control, and virtual connection service (sequence of messages). DSA/IMC can harmonize with the interconnection of differing RC products. Its enhanced architecture ensures effective operation, and regardless of network choice the user-interfaces remain the same.

The RC LOCAL AREA NETWORK is an open system which besides DSA/IMC can employ a variety of network protocols because of the direct implementation of the basic IEEE 802/3 CSMA/CD facility.




For example the RC PARTNER can use Digital Research's DR-NET. Thanks to the consequent use of the standardized interfaces, system expansion and communication with EDP-equipment from other vendors is possible.

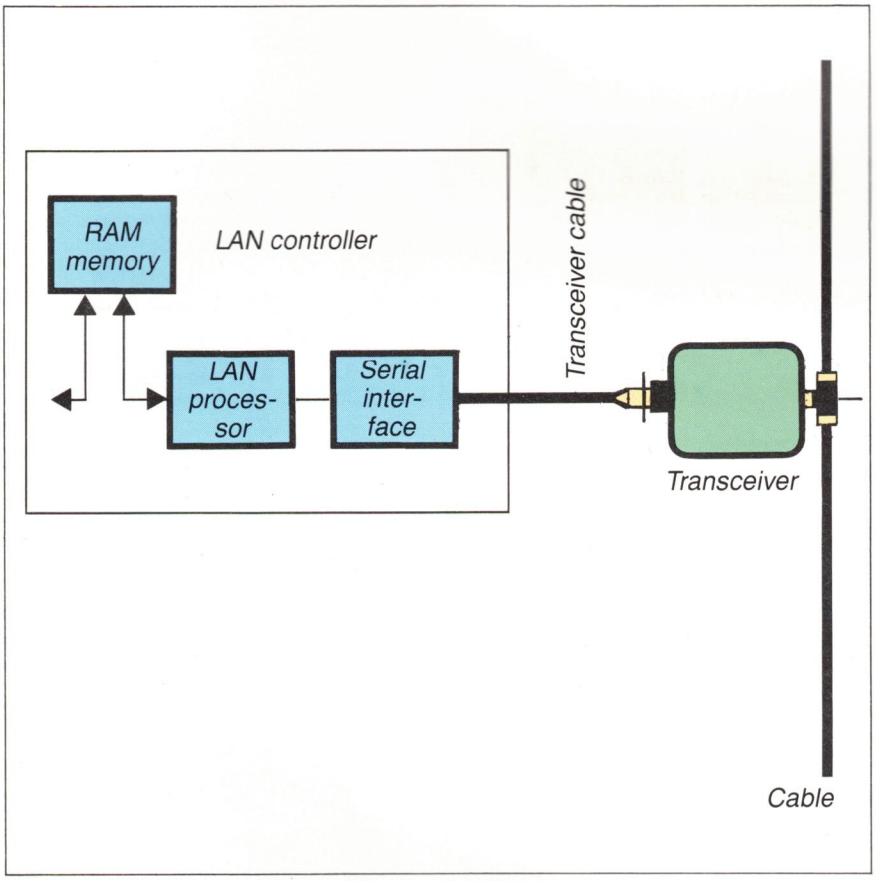
**Technology behind the RC LAN**

Prior to a detailed description of RC LAN technology, a brief resumé of the international standardization organization, ISO's architectural model for system interconnection will be given. This model sums up al the essential concepts, standards, and structures inherent to a distributed system in which incongruous EDP equipment must interchange information. ISO has endeavored to define a standardized frame of reference to be used when constructing an open network (a network in which multi-vendor EDP-equipment can concur). This model, called OSI, Open Systems Interconnection, logically classifies the standards (protocols) necessary to initiate and execute information exchange between two or more network-aligned EDP-units. The model is divided into 7 layers and is briefly described in the following:

*Physical Layer*
Defines media-types, signal levels, bit rates and method used in bit-stream coding (broadband, baseband).

*Data Link Layer*
Defines protocol to be used in transmitting through the physical media. Data block format, control sequences for media access, transmission regulations, and error detection are essential elements of the link layer.

*Network Layer*
Administrates switching and rerouting of information. As most local networks have point-to-point connection between the stations, the network layer is normally not mandatory.




*Transport Layer*
This layer offers end-to-end control and regulates the speed, sequence of data packages and security for the transport of data.

*Sessions Layer*
Administrates traffic on the network, such as allocation of addresses and logical connections.

*Presentation Layer*
Performs format and code conversion to tailor information blocks to the network's common standard.

*Application Layer*
Application layer directly supports the terminal user or the user-software with services such as file server, electronic mail, and terminal connection.

*Network Control*
Performs the overall control, monitoring and configuration of network.

The physical layer and data link layer enable the diverse EDP-units to interconnect and exchange data. The remaining layers secure that the units are able to communicate in an orderly fashion with common formats and alphabets so that the LAN functions as an integrated whole.

Ethernet was the first genuine attempt to standardize the first two layers of the OSI model. There exists a complete specification of cables, transmission rates, formats, media access protocols, and error detection schemes. IEEE and ECMA have adopted this standard (IEEE 802/3, ECMA 80-82).

As previously noted, Ethernet is based on CSMA/CD systems. This fundamental approach to multiple access on shared media has today been realised through use of high-integrated circuits (LAN-processors). The RC LOCAL AREA NETWORK adaptors are based on LAN-processors. The timing and modulator circuits can support bit rates of either 10 Mbit/s or 1 Mbit/s.

In the following, the underlying hardware architecture and the noteworthy features of each of the three above mentioned media will be discussed.

**Standard Structure**

*LAN (Local Area Network) controller*
Based upon a LAN processor (Intel 82586) and a serial interface to either the 1 Mbps Micronet or the 10 Mbps Ethernet/ Cheapernet. A LAN processor has direct access to the internal memory of the connected equipment and will therefore not burden the system's main CPU.

*Transceiver Cable*
Designed according to Ethernet standard. Length: 5 or 12 m. Can be used together with already installed Ethernet transceivers.

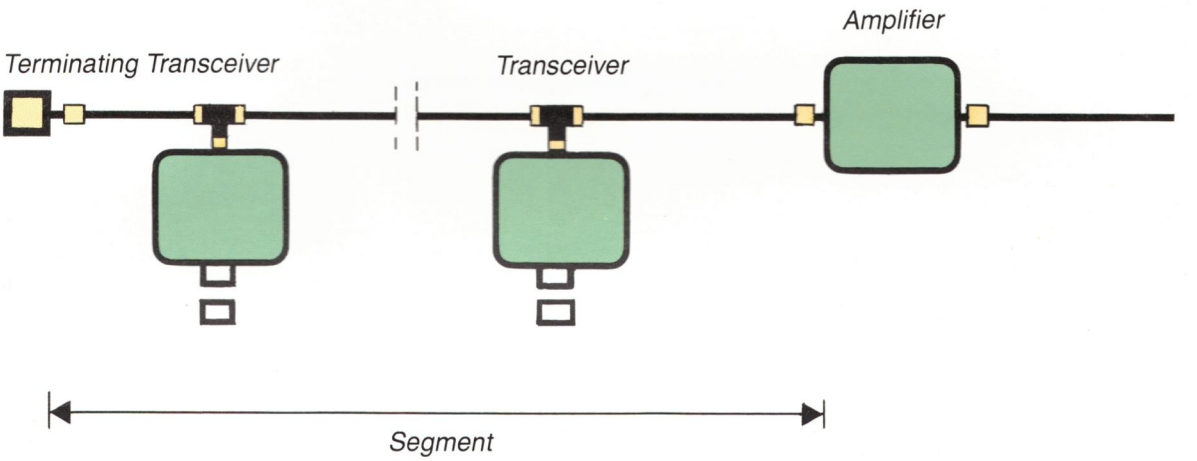
*Transceiver*
Contains transmission and receiver circuits and logic to untie collision situations.

*Local Net Cable*
For Micronet and Cheapernet a standard coaxial cable type RG223/U is used.

Ethernet uses a special cable (i.e. Belden 9880). When the cable exceeds a certain length, amplifiers must be inserted (Ethernet: 500 m, Cheapernet: 200 m, Micronet: 1000 m).

In the following table the main specifications for the three LAN types are outlined together with the relative price levels.

Specifications overview

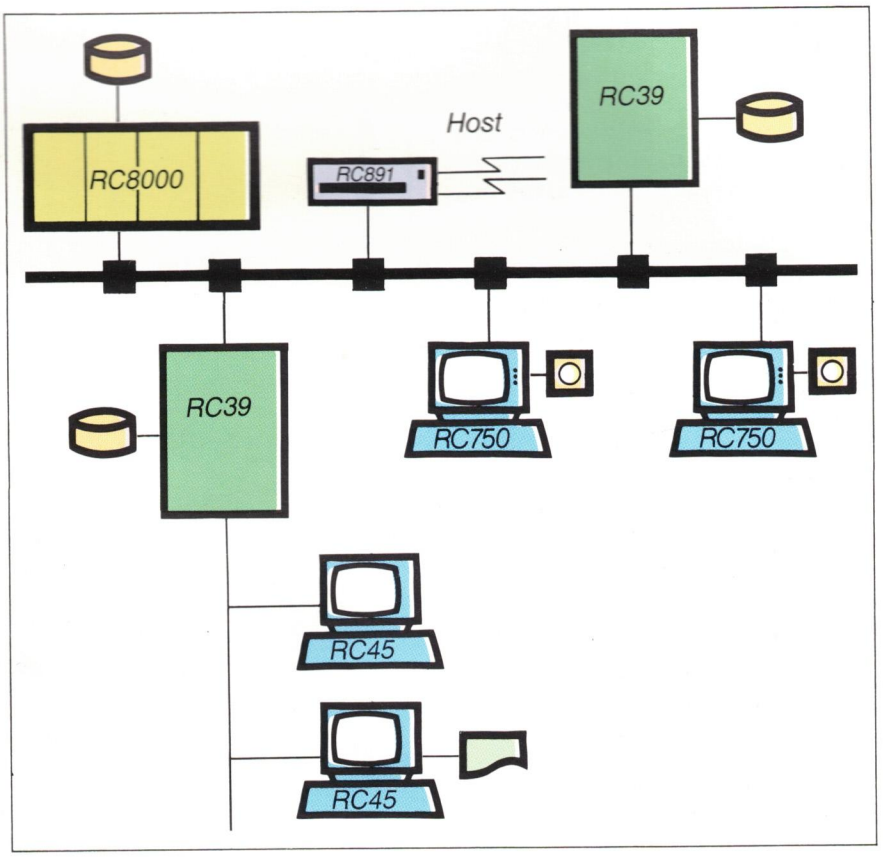



| | | RcMicronet | Cheapernet | Ethernet |
|---|---|---|---|---|
| Transmission rate | | 1 Mbit/s | 10 Mbit/s | 10 Mbit/s |
| Max. Segment Length | | 1000 m | 200 m | 500 m |
| Max. Total Length | | 3000 m | 2500 m | 2500 m |
| Cable Type | | RG223/U | RG223/U | Ethernet coax |
| | | coax | coax | ie: Belden 9880 |
| Specifications | | RC | ECMA | Intel/XEROX/DEC<br>IEEE 802.3<br>ECMA 80-82 |
| Relative Price | Cable | 0,5 | 0,5 | 1 |
| | Transceiver | 0,4 | 0,8 | 1 |
| | Amplifier | 0,4 | 0,8 | 1 |

**Examples of RC LAN applications**
The RC LOCAL AREA NETWORK makes possible the design of a distributed system architecture conducive to a wide variety of purposes.

The most notable are:
1. Multi-access to several computer systems from the same workstation.
2. Sharing of common resources, i.e. discs and printers between several physically dispersed users.
3. Sharing of the same communication lines and communication processors between many independent users.
4. Transport network for automated systems, computer based message systems (CBMS), electronic mail, etc.

The application possibilities are innumerable. The below mentioned three are some typical examples.

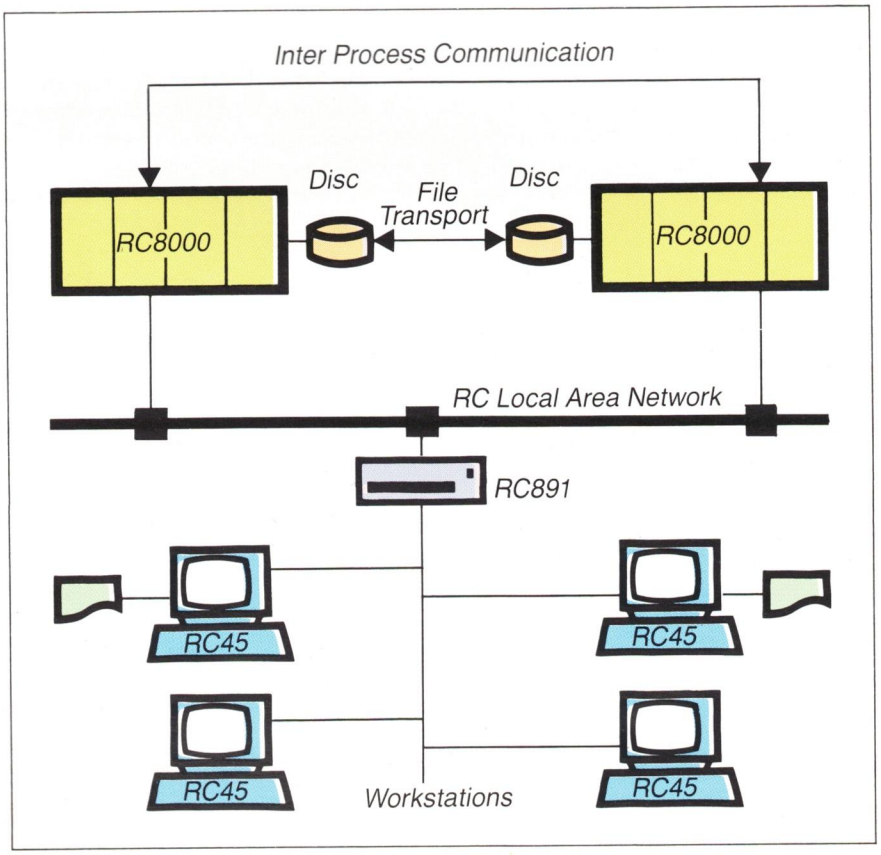



**RC45 Multi Terminal Access**
The RC45 terminal/RC750 PC-user can via an uncomplicated menu displayed on the screen, choose amongst the following services:

- IBM 3274 emulated SDLC or BSC operation to remote hosts.
- File transfer between RC750 and RC8000 or RC39.
- Terminal operation to any RC39 or RC8000 connected to the local area network.

**RC8000 Interconnection**
RC COMPUTER's RC8000 mini-computer systems can be attached to the RC LOCAL AREA NETWORK and function as an integrated though physically distributed system of autonomous processors. The user can choose:

- Inter process communication between several RC8000 processors.
- File transport between RC8000 systems.
- Optional host for connected RC terminals.



**Interconnection of Personal Computers**

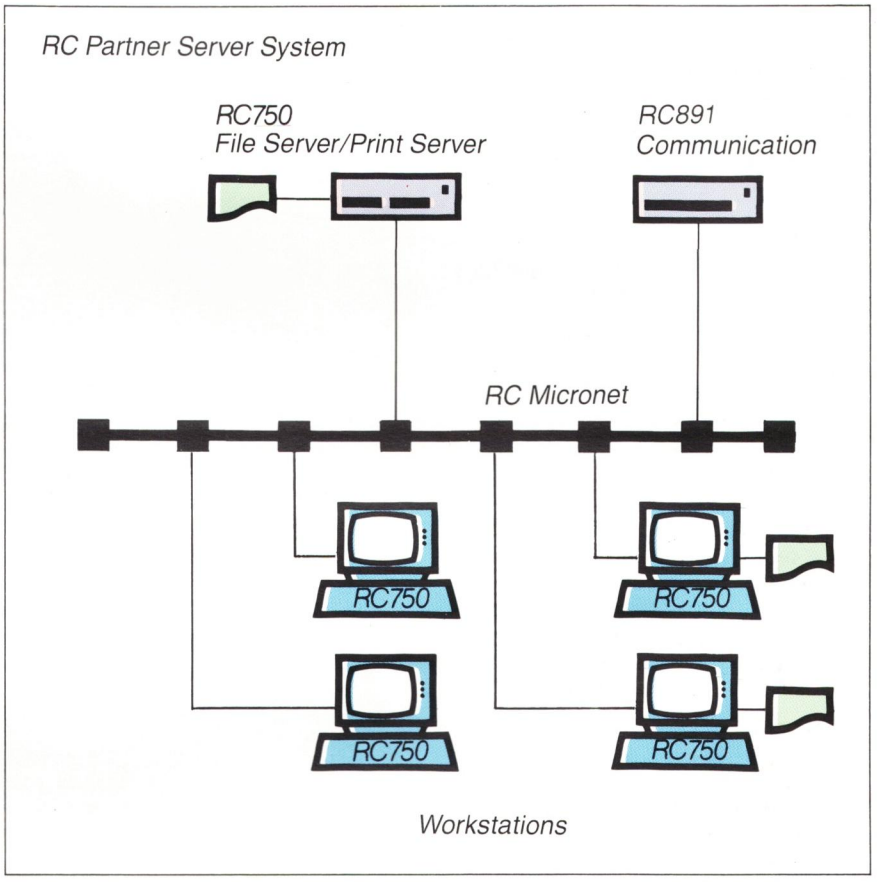
In recent years personal computers have been a tremendous success and they have become an increasing part of industry and commerce's aggregate of computer equipment.

Personal computers are very renumerative. They are extraordinarily inexpensive in light of their high yielding capacity and take up very little room. They are geared to individual data processing needs as a personal and versatile tool. Personal computers have been standardized to a great degree today and the selection of high quality software packages is both vast and comprehensive.

By connecting personal computers to a LAN, access to common data sources and user-to user information exchange are services available to all. Further comparatively expensive equipment such as fast backup storage devices and high quality printers can be shared among the attached computers.

A series of PARTNER workstations can be integrated in the RC LAN. Each station could be equipped with local discs and printers or they could base themselves exclusively on equipment attached to remote workstations (or to dedicated disk/printer servers). All the disks and printers within the network are in principle available to everyone (however, disks and printers can be dedicated to private use, reserved for one user).

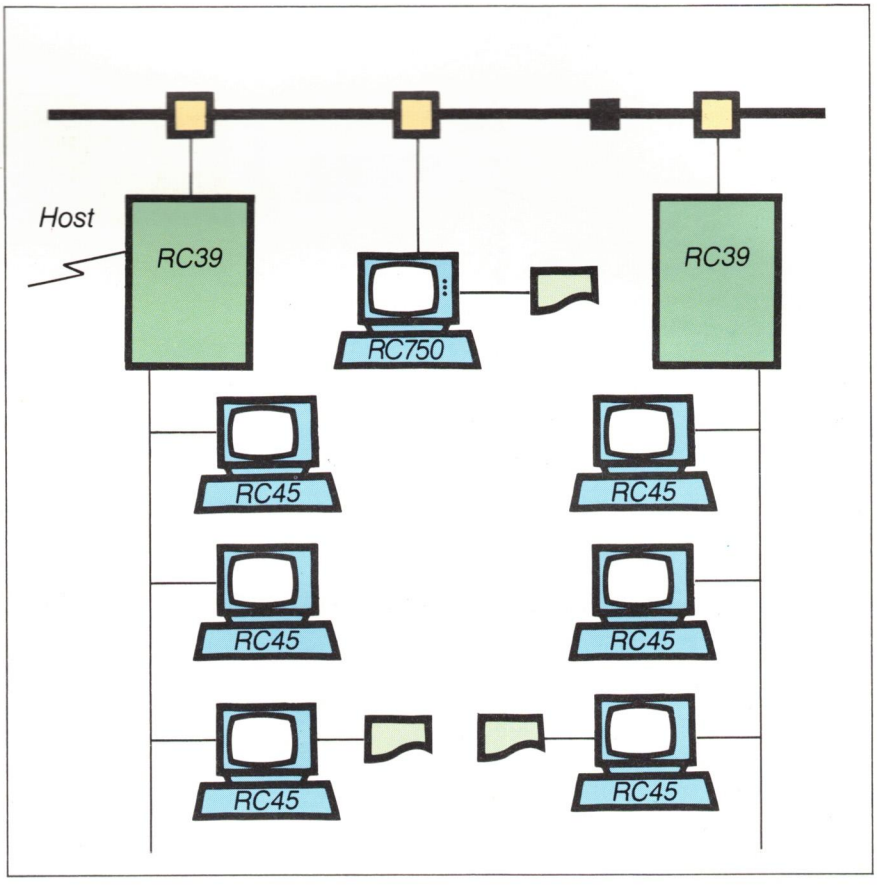
Any PARTNER can be assigned the task of disk and printer server. Where there is a need for a common external communications facility (i.e. IBM3270 communication) a communication server (controller unit) can be connected to the local network.

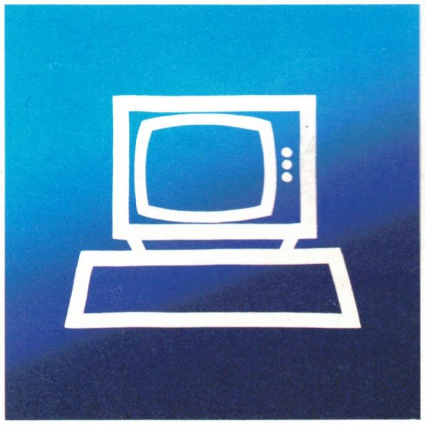



PARTNER's operating system Concurrent CP/M-86, born with LAN supportive facilities, governs the logical interaction of several workstations. User software, therefore, does not need to be adapted to the LAN. Remote units such as disks and printers are handled in the same way as locally connected equipment.

**Distributed RC39 System**
Several RC39 systems may be interconnected via the RC Local Area Network, in the same way as Partner workstations may draw on shared resources or dedicated servers. These RC39 systems offer the following facilities:

- Transparent remote file access from one computer to another.
- Log-in from any terminal to any RC39.
- Access from any terminal to the integrated communications controllers in RC39 for host communication.
- File transfer from RC39 to RC Partner microcomputers connected to the same local area network.





# RC Computer

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