1. Introduction

This RC9000 Product Handbook is intended as a short form handbook for RC9000 sales- and support engineers and for customers that wish to know more about their RC9000 system.
Most of the RC9000 Product Handbook consists of datasheets on every major module in the RC9000 Computer System, each giving detailed information about the specific module. In order to introduce to the RC9000 Computer System the RC9000 Product Handbook contains a breif desription of the system properties and architecture.

Chapter 2, System Properties describes the functional characteristics of the RC9000 Computer System and their relationship with a series of factors being an essential part of the on-going development in companies and industry, and - in RC Computers's opinion - influencing the commercial computer equipment in the future.

Chapter 3, System Architecture contains a short introduction to the RC9000 Computer System and describes the main components of the system. Each of the main system components and its functional characteristics is related to the other components of the entire system. The description of the RC9000 System Architecture is divided into 5 sections:

- RC9000 System Architecture
- Hardware Architecture
- TX Operating System
- Data Base Management Systems
- Compilers for TX
- RC9000-10 Software

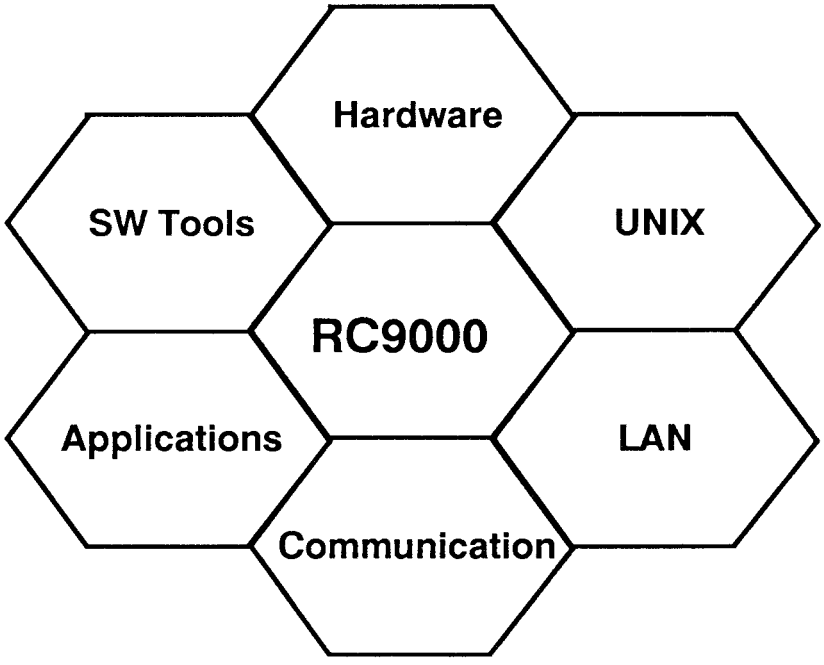
Chapter 4 consists of a complete product list, giving an overview of the entire RC9000 product program. This list includes all hardware and software products available and the nessesary accesories such as cables, transceivers etc.

Chapter 5 and 6, named Hardware and Software Components respectively contain datasheets on every major module in the RC9000 Computer System.

Chapter 7, System Configuration holds information on how to configure the RC9000 components into a high performing computer system. The chapter has guidelines for configuration on the following topics:

- RC9000 models
- General topics
- Processing units
- I/O Channel
- Local area network
- Local attached devices
- Remote attached devices
- Host communication

At last, **chapter 8** contains information about RC Computer and how to get in touch with us!



Editor
Lars Lolk Nielsen

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2. System Properties

The launch of the RC9000 supermini from RC Computer is not just an attempt to upgrade RC Computer's previous top model RC8000. It is the result of a thorough analysis and a decise evaluation of the future demands of data power, as well as a clear and precise profiling of the product directed towards different specifically chosen markets.
The following paragraphs enlighten a series of factors being an essential part of the on going development in companies and industries, and - in RC Computer's opinion - influencing the development of the commercial computer equipment, particularly within the group of superminis to which RC9000 belongs.
The development contains an obvious trend. An increase in the use of interactive information systems to improve and expand customer service is seen clearly. The complexity of such an information system increases consecutively due to the above-mentioned continous increase in demands such as obtaining the most recent and up-dated information and having solutions, covering all aspects and functions of the company. Such integrated information systems will intensify a series of trends within the development of computers. At RC Computer we have the oppinion that the trends will lead to a significant increase in demands for commercial computer systems with the following properties:

- Interactivity
- Availability
- Integration
- Expandability

In the sections below the reasons for focusing on these four properties will be outlined, and the way these properties are implemented on the RC9000 System will be described.

2.1 Interactive Systems

When information systems are to be used in an interactive way with the costumer, which is typical for service based companies, it is absolutely nessesary that the system is capable of supply ing up to date information - without significant responsetime! The consequence is that a growing number of information systems must be able to handle a new dimension: *Time*.
Up-to-date information is not simply a question of online access, as much as it is a question of enough capacity to handle transactions real-time. Booking systems are typical examples of information systems needing real-time response - the costumers expect to get their booking confirmed immediately, and the company will avoid double booking to take place.

Due to the above mentioned reasons the market for Online Transaction Processing (OLTP) will grow rapidly - in fact this market is one of the fastest growing of the computer trade. The Gartner Group Inc. - an American market research company - expects that the capacity in an average mainframe/mini site will grow 40% annually. This growth rate covers quite a large difference between batch and online applications, the online applications having a growth rate 2-3 times the rate of batch applications.(Figure 1)

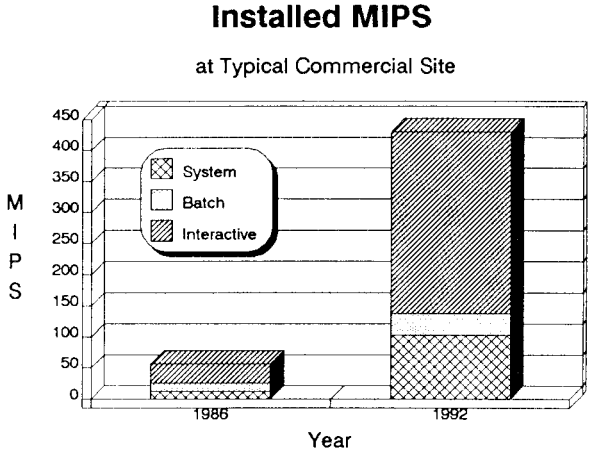


Fig. 1. Processing Capacity

Gartner Group further expects that smaller, distributed systems - mainly minies - will play a far greater role in handling the needs of online transaction processing applications. The principal reason for this is a superior price/performance compared to mainframes. The limited use of minicomputers until now in many OLTP applications has largely been due to their inability of handling high transaction rates, but strength of this argument has been reduced a lot, with the release of multiprocessor superminies.

The RC9000 Computer System is dedicated to Online Transaction Processing. A transaction is a sequence of steps, usually performed on behalf of a single user. From the user's point-of- view, the transaction forms a whole, even if it from the programming point-of-view consists of a number of clearly distinct operations.
The transaction interacts with a database, and each step within the transaction may involve reading from and writing to this database. Yet the steps form a logical whole and must only cause permanent change to the database if *all* steps are performed correct.

A typical example is the above-mentioned booking system. The transaction may, seen from a programming point-of-view, consist of several transactions, for example reservations, invoice and other financial transactions. The example names the demand for **data integrity**. There are two problems to concider: the exclusion of the possibility for an aborted transaction to corrupt the contents of the database, and the exclusion of the possibility for several terminal users to update the same records simultaneously. The RC9000 Transaction Executive operating system (TX) provides means for overcomming both problems.

The trans system call

The trans system call is the key to achieve data integrity under TX. By means of this call, an application programmer can define the elements of her code that should be conceived as a logical and coherent whole by the system. When *trans_begin* has been issued, TX automatically logs the following events. If *trans_commit* is reached, then the changes to file contents that where part of the transaction are made permanent. IF, on the other hand, the transaction fails, i.e. it aborts, without reaching the commit, then the changes are rolled out, and the system deletes all knowledge of the transaction.

Concurrency control

The *trans* call itself does not solve all of the problems in the typical OLTP environment. There may be a huge terminal population, interacting simultaneously with the database. Steps must be taken to prevent users from relying on data that are already serving as the basis of transactions on behalf of other users.
On the other hand, it must also be possible to allow access for non-update operations, e.g. simple quering, from several user simultaneously, especially since TX accomodates varey large files. To put the same amount of concurrency control undiscriminatingly on all file operations would slow down the performance of the system conciderably.
Therefore TX provides a hirarchy of *lock*, both on file an on block level. By carefull allocating the amount of locking that each process requires, a combination of highest possible security and the highest possible performance can be reached.

2.2 System Availability

As information systems become a more vital part of the companies' production facility - because it is used for producing costumer services - the demands for availability of the information systems are growing fast. Previous information systems mainly served as an internal service for the employees at the company.
Hence companies get increasingly dependent on the availability of their information system in order to keep the production going, and many companies have to calculate with losses if the system does not operate.

Decentralization of information and communication are prerequisites in order to use information systems at customer services in an interactive manner. In stead of processing all information at a central site, it is more often advantageous to distribute the information and process it locally. This reflects the organization's structure even more and increases data availability. Another advantage is better flexibility in the size and processing power of the computer, specifically adjusted to the local demands. The development of distributed information systems which can ensure the consistency and flow of information, is a prime task for many manufacturers of information systems.

The RC9000 Computer System has ability to continue processing user processes after a single-point of failure. This ability is base, both on the distributed architecture with several processing units and features in the TX operating system.
TX is able to reconfigurate a system after a failure - i.e. TX provides continued availability even after the following situations:

- Disk failure
- Processing Unit failure

and users are outomatically migrated from failing to functioning parts of the system.
It follows that a system for continous availability must contain duplicate units, e.g. processing units and disks - but RC9000 is not a system that simply is duplicated, and thus very expensive because large parts of the hardware during normal operation does not contribute at all to the processing of user applications.
In a TX based RC9000 system, *all* modules contribute to the processing tasks. Should a module fail, then the automatic reconfiguration enables the processing to continue with the remaining modules alone. When failing modules are again operationable, then they are brougth back into the system.

2.3 System Integration

The demands for different information system facilities are in creasing strongly. Companies want to use information systems to develop new services and gain competitive advantages - this results in many companies needing of integrated information from more and more domains the company. At the top of this the companies demand a tighter schedule for the development of these information systems due to the companies' wish and need to follow the frequent changes, characteristic for many markets of today.

The development of information systems is even today a heavy task and only few companies will have the capacity and financial foundation to carry trough such a project - the tight schedule born in mind. This is the reason why the use of standard information systems will increase and the development of these systems will bring more advanced but also more flexible products to the market.

In those areas where standard information systems do not fulfil the requirements of the system, highlevel application development tools will become vital. An increase in the use of information systems will primarily happen as a consequence of the availability of relational DBMS (Data Base Management Systems) and 4.generation languages, suitable for high performing production environments. IDC a market research company expects that the use of distributed DBMS will grow 31% annually until 1991. The distributed DBMS will mainly be the relational type due to its better user interface and with regards to expectations for better performance.

In the development of information systems there will evolve a market for system integrators in Europe - as well as it has happened in the US - who will undertake the task to develop, implement, and integrate information systems. Companies will rather concentrate at their prime tasks and let the professional system integrator make the information system, than try to make the system themselves. This will probably happen because many companies have the experience that they still is unable to udertake all the tasks they would like to, in terms of integration and real-time processing, despite expensive investments in computer equipment.
In many cases information systems will consist of more individually developed systems and because of this there will be a demand for integration of such heterogenous environments. This demand for integration will create requirements of connectivity and use of standard interfaces. There have already been examples, showing that standardization has become a key criteria for selecting supplier of computer equipment.
The use of UNIX™ has been extensively growing as well, also in such areas, usually not related to UNIX. UNIX's posibilities in respect of standardization is the cause for this. The recent years has expanded the repertoire of commercial applications for use on UNIX based computers, and concepts like X-OPEN, SVID (System V Interface Definition), POSIX and Open Software Foundation (OSF) show that the suppliers of computer equipment take an extremly great interest in this standardization effort.

The TX operating system is derived from UNIX developed originally at AT&T Bell Laboratories. TX extends the set of UNIX system calls for features like transaction processing, but maintain compatibility with both major versions of UNIX today: BSD 4.2 and System V.
The compatibilty opens up the fast growing body of applications and application development tools for UNIX-based systems. It is important to note that TX's online transaction facilities augument rather than replace the standard UNIX facilities, so that no compatibility is compromised for the sake of functionality.
While Standard versions of UNIX have many useful attributes, they also have many apparent weaknesses. The design of TX resolves those weaknesses deemed detrimental to the performance of online transaction processsing systems, including inefficient disk allocation, low-integrity file systems an inadequate concurrency control.

2.4 Expandability

The on-going search for competitive advantages and new business areas will create demands for flexible computer systems that can change along with the business. Although the lifetime for computers - seen from a economical view point - is decreasing rapidly and the price/performance ratio is increasing, the investment in new computer equipment is a large investment for most companies. The price for some new equipment is only a part of the investment. One must also concider the nessary investment in application development, education, installation, test and planing.
Instead of replacing the computer equipment the trend goes towards computer systems which has the capability of modular expansion. Any computer system manufacturer will claim that his system has expansion capabilities, but most systems has "bottle necks" that will limit the expansion. In order to have a real benefit from a computer system with modular expandability, the system must have a distributed architecture in such a way that additional modules reduces the work load for all components of the original system. If this is not the case the additional module will create new "bottle necks" that pops up some other place in the system.
Future computer systems for commercial applications will have a distributed architecture and become more modular, which are the criteria for a true *linear growth* capability. Systems with a linear growth capability gives the user the opportunity to start with a small system and expand the system step by step simply by adding one module at each step - without changing the system software or having to port the applications etc.

The RC9000 Computer System is a fully distributed system where processing units, backing storage and communication controlles may be added in order to meet individual requirement from the users. The TX operating system is the same on a system with a single processing unit as it is on a system with two, three or more processing units. This modular design means that the RC9000 Computer System has a very large span in performance, from the entry-point single processing units models, to mainframe size for systems which may consist of beyond a dusin of processing units.

2.5 RC9000 Profile

The design of the RC9000 high-end minicomputer is optimized for support of the four key criteria discused above: Interaction, availability, integration, and expandability, which will characterize the information systems in the future. In order to fulfil these key criteria the RC9000 benefits from the newest and most advanced hardware and software components on the market. One

of the unique features of the RC9000 supermini is the ability to offer a solution to all these key criteria in a flexible manner. The RC9000 gives the opportunity to combine some or all the features without loss of others. From very the begining the RC9000 was designed with these key criteria in mind, and that is why, it is not "just another UNIX- box" with some later added features - you do not get a sports car by making a van and adding some features! - The RC9000 was designed for fault tolerant, online transaction processing, distribution and linear growth from the start.

3. RC9000 System Architecture

The RC9000 system is the designation of RC Computer's new series of high performing computers. RC9000 is based on the newest hardware technology available and employs the leading RISC architecture from MIPS Computer Systems. Together with a greatly enhanced UNIX operating system - the Transaction Executive TX - featuring multi-processor support, linear growth and fault tolerance the RC9000 system offers high functionality, reliability, and high-performance at a very competive level. The system is targeted towards performance demanding online transaction processing business applications and other environments requiring large transaction capacity, data integrity or continuous availability.

The design approach has been to offer a very capable high-end system with modular expandability, ensuring the user optimal price/performance ratio and nearly unlimited linear growth potential. The linear growth capability and the superior price/performance ratio are obtained by a highly modular design. The RC9000 Computer System consists of a large number of high- performing modules and any need for raising the system performance may be obtained by adding modules, no matter if the need is processing power, disk capacity or even fault tolerant operation.

The modules of the RC9000 Computer System fall into three major categories:

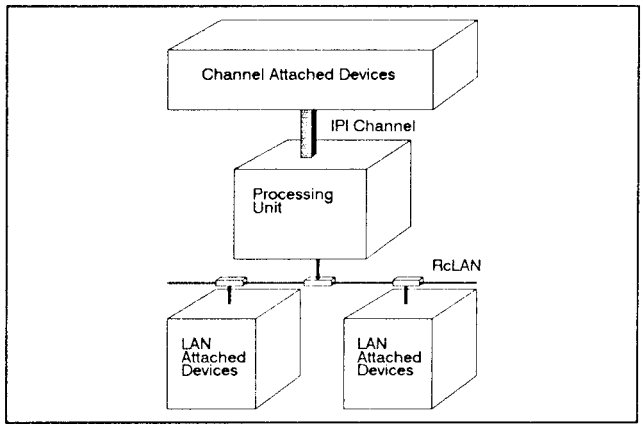


Fig. 3.1: System Components

Processing units
The processing units (PUs) are the basic components of the system and consist of a subrack with slots for 16 boards. These boards hold the CPU, main memory, I/O channel controllers, Local Area Network Controllers and the System Support Processor.
In systems consisting of more than one processing unit the workload is distributed among the available processing units via the high-speed channel called the System Interconnect Bus (SIB). The loosely coupled processing units give a high reliability and allow easy upgrading of processing power by simply adding processing units.

Channel attached devices
One of the boards in the processing unit - the Input/Output Controller - is a controller for a parallel I/O channel conforming to the IPI-III (ANSI X3T9) standard. This channel is used for attaching the backing storage devices.
The channel attached devices are tape and disk control modules, disk drives and tape stations. The control modules are connected to the parallel I/O channel and one or more disk drives or tape stations. All interfaces are conforming to industry standards, securing easy incorporation of new types of storage devices like optical disks and digital tape stations.

LAN attached devices
Terminals, printers and communication devices gain access to the RC9000 processing units via RcLAN. Analogous with the I/O channel one of the boards in the PU is dedicated as Local Area Network controller. This RcLAN Controller conforms to the IEEE802.3 standard and supports RcLAN networks of either Ethernet, Thin- Ethernet or Micronet type.

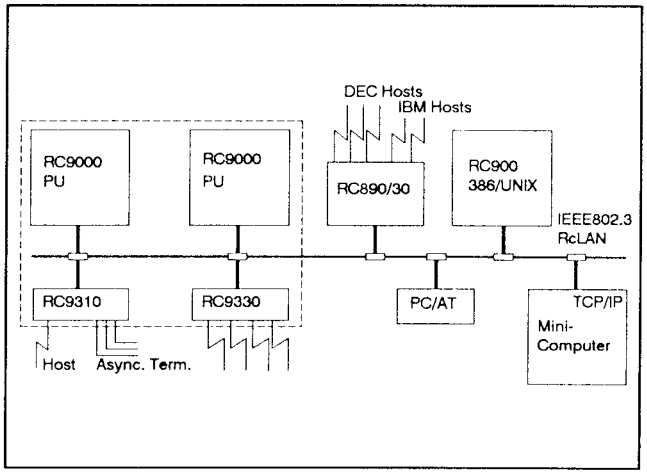


Fig. 3.2: RcLAN Devices

The LAN attached devices include a number of RC products: the RC900 Workstation, the RC890 Control Unit, and high- performing communication frontends. The RC9000 supports the TCP/IP protocols on LAN whivh enables connectivity to equipment from other vendors.
The following sections contain a more detailed description of the above mentioned categories in the RC9000 Computer System.

3.1 Hardware Architecture

Processing Units

The processing units in the RC9000 Computer System fall into two categories: One, which provides RC8000 compatibility, and one with a RISC processor, which runs the TX operating system. Only the CPU boards of the processing units differ. All other processing unit elements are the same. The processing unit with the RC8000 compatible CPU is called RC9000-10 and the processing units with RISC processors are called either RC9000-30 or RC9000- 40.

The processing unit consist of the following types of boards:

- CPU boards
  RC8000 compatible or RISC based CPU
- Memory
- RcLAN Controller
- Input/Output Controller
- System Interconnect Bus Controller
- System Support Processor

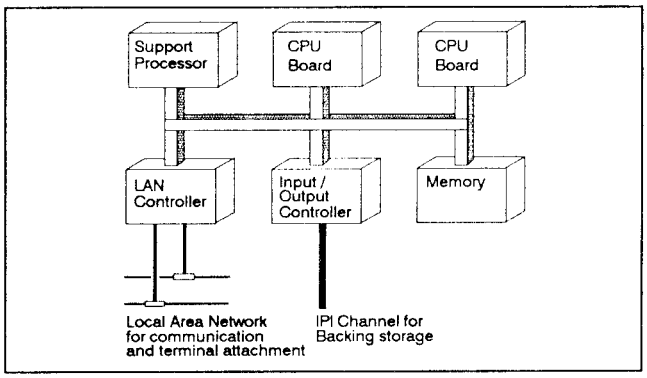


Fig. 3.3: Processing Unit Modules

These boards are all connected to the system bus, which is a 64- bit wide, 10 MHz synchronous, pipelined bus with single word and block mode operation. The system bus has a transfer rate up to 80 Mbyts/sec.

RC8500: The RC8000 compatible CPU/FPU
The RC8500 CPU is compatible with the existing line of RC8000 CPUs. The RC8500 CPU consists of two boards: The CPU board and a Floating Point Unit board (FPU). The two boards are interconnected via a high-speed bus. The 24 bit CPU uses a 125 nS cycle time and is implemented by means of CMOS gate array technique combined with LSI and MSI TTL-logic. The CPU has separate data and instruction caches with a size of 12 Kbytes each. These cache memories are direct mapped and use store-through updating.

RC9010: The MIPS R2000 based RISC CPU
The RISC CPU board is built around the 32 bit R2000 RISC processor from MIPS Computer Systems. The processor board is standard equipped with the R2010 floating Point unit and separate 64 Kb instruction and data caches.
At a clockspeed of 16.67 MHz, each of the CPU boards yields a performance of approximately 11 native Mips.

RC9110 and RC9112 Memory modules
The memory boards are available in 8 and 16 MByte versions - RC9110 and RC9112 respectively. Both modules are using 1MBit Dynamic RAMs, and have an on-board semaphore function. An ECC logic detects and corrects single-bit errors and detects and flags double-bit errors. Depending on the block size, data transfer rates range from 16 MBytes/sec. to 64 MByte/sec.

A Processing Unit may contain up to 8 memory modules; i.e., 128 MBytes of RAM. However, the RC9000-10 is only capable of using 16 MByte of memory.

RC9120 Input/Output Controller
The Input/Output Controller - frequently referred to as the IOC - controls the channel which is used for disk and tape storage devices.
The channel conforms to the IPI-III (ANSI X3T9) standard.The IOC architecture is optimized, with fast Direct Memory Access channels between the main memory and the channel, providing a transfer rate of 10 MBytes/second.
The device specific controllers are attached to the channel as slaves. Eight such controllers may be attached to one channel and each PU may contain at most 4 IOCs, i.e., 4 channels, and hence 32 disk or tape controllers per PU.
The Input/Output Controller is equipped with a 10 MHz Intel 80286 microprocessor and 256 KByte local memory.

RC9130 RcLAN Controller
The RcLAN Controller is basically a dual port CSMA/CD controller conforming to IEEE802.3. The controller is capable of handling a 10 Mbps LAN network located on two separate cables or on one cable with both ports connected. The controller is default equipped for Thin-Ethernet operation but may be upgraded to Ethernet - both ports must use the same type of operation.
It has 1 Mbyte local memory for protocol handling purposes, and there is Direct Memory Access transfer between the Local Area Network and the main memory in the PU.

The RcLAN network is used for all kinds of input/output operations to terminals, workstations, printers and communication devices.

RC9135 System Interconnect Bus Module
The System Interconnect Bus Module uses the same Dual port LAN Controller board (DLC) as the RcLAN controller. As a controller for the System Interconnect Bus the DLC controls inter-PU communication in a system configuration with multiple Processing Units. The dual port feature is important here, since dualizing the SIB not only provides security against physical damage to one of the SIB cables, but also yields a higher SIB bandwidth.

RC9140 System Support Processor
The final module of the processing unit is the System Support Processor - frequently referred to as the SSP.
The SSP is a self-contained module with its own power supply, local memory and a microprocessor. It is equipped with a flexible disk drive (RC9142) and a port for the system console, which is the only terminal in an RC9000 system that is not attached across the RcLAN.
The SSP takes care of the boot phase, i.e., the SSP downloads the initial software of all other PU modules from the flexible disk drive. During initialization, it controls the self-test program and the boot-strap from the system disk. When the operating system takes over control, the SSP console serves as system console, i.e., a privileged terminal, where administrative communication with the operating system takes place.
During normal operation conditions, the SSP performs healthiness monitoring of the PU. It monitors the temperature in the cabinet by means of heat sensors, it monitors the power supplies of the other modules and it monitors the system bus. If anything abnormal happens, the SSP is able to isolate the error stricken unit from the remaining system. If the PU no longer contains enough operationable modules to constitute a valid configuration, the SSP can take over control from the operating system, and let an operator intervene.

The modules described above may be combined individually in order to optimize the processing unit to the actual application, but in most cases the following standard compositions will be either sufficient or a good starting point.

RC9000-10 Processing Unit
This processing unit is compatible with the RC8000 and is equipped with one RC8500 CPU. The RC9000-10 contains the following modules:

- RC8500 CPU/FPU
- RC9110 6 (8) MB Main Memory
- RC9140 System Support Processor
- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller

The RC9000-10 performs about 4 times better than the RC8000-55. The RC9000-10 can **not** be equipped with

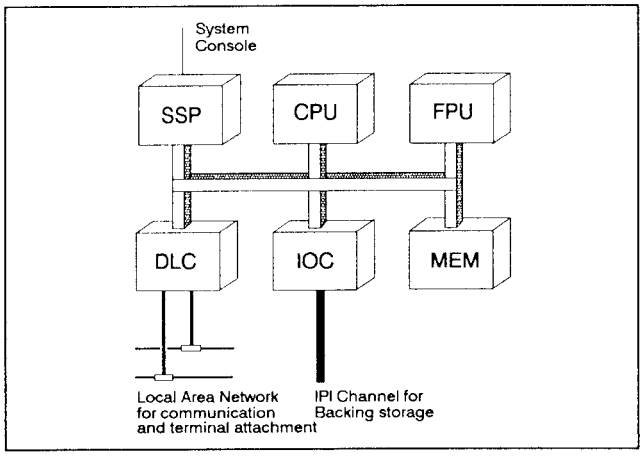


Fig. 3.4: RC9000-10 Processing Unit

the System Interconnect Bus (SIB) but may be used in multiprocessor configurations with up to four RC8500 CPU/FPUs in a RC9000-10 processing unit. Each added RC8500 will increase the processing power of the system with 50% of its own capability, i.e., the maximum performance will be approximately 10 times the performance of an RC8000-55.

RC9000-30 Processing Unit
The RC9000-30 processing unit contains two RC9010 RISC CPU
boards, each equipped with a MIPS R2000 CPU and a R2010 FPU. One is called the *User Processing Unit* (UPU), and is dedicated to user applications and some of the (user-oriented) outer layers of the TX operating system.
The other board is called the *Real-Time Processing Unit* (RPU). The RPU creates a real-time environment, in wich the innermost parts of the TX operating system executes. This includes handling of the major part of the I/O operations.

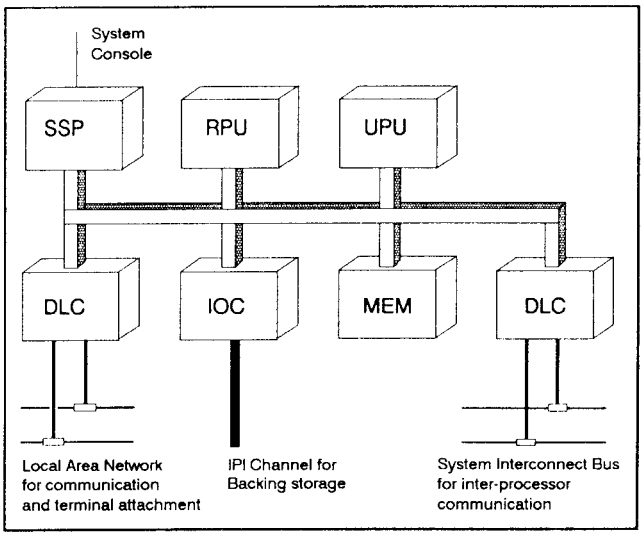


Fig. 3.5: RC9000-40 Processing Unit

The RC9000-30 contains the following modules:
- RC9010 RISC CPU, 2 pcs.
- RC9110 8 MB Main Memory
- RC9140 System Support Processor
- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller

RC9000-40 Processing Unit
The only difference between the RC9000-30 and the RC9000-40 is the presence of the System Interconnect Bus Module in the -40 processing unit. The -40 processing unit is intended for systems with two or more processing units.
The RC9000-40 contains the following modules:
- RC9010 RISC CPU, 2 pcs.
- RC9110 8 MB Main Memory
- RC9140 System Support Processor
- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller
- RC9135 SIB-bus Interface Module

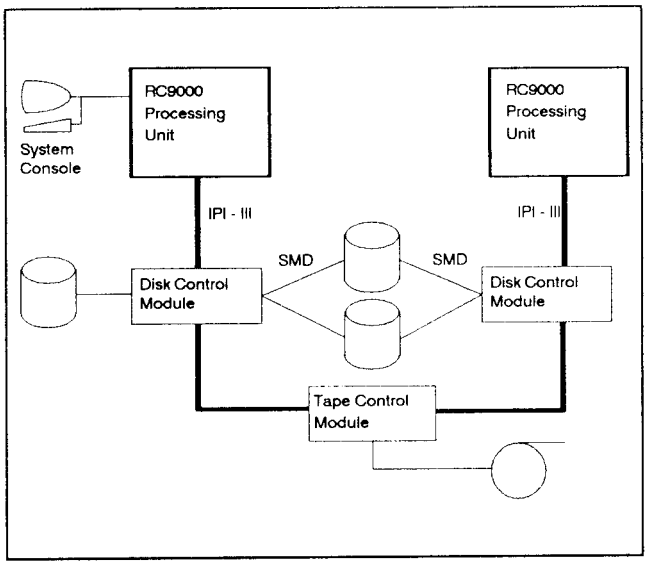


Fig. 3.6: Channel attached Devices

Channel Attached Devices

As mentioned before the term *channel attached devices* covers the devices attached to an RC9000 PU via the Input/Output channel which is controlled by the Input/Output Controller (IOC) located in the PU. In the RC9000 Computer System all backing storage devices are attached via the input/output channel.

Input/Output Channel
The input/output channel offers an IPI-III interface to the device specific controllers, i.e., disk drives and tape stations are connected to the input/output channel via the disk control module or tape control module, repectively. See the figure 3.6.

The IPI-III conforms to the ANSI X3T9 standard for Intelligent Peripheral Interface and has a maximum transfer rate of 10 MBytes/sec. With the ability to perform command interpretation and data transfer simultanously, the Input/Output Controller and the channel have sufficient of capacity for applications with heavy use of backing storage. Each PU can even be equipped with several input/output channels.

RC9220 Disk Control Module
The RC9220 Disk Control Module - in short the DCM - is a separately housed and powered module, mounted in the RC9000 cabinet just above the disk drives attached to the control module.

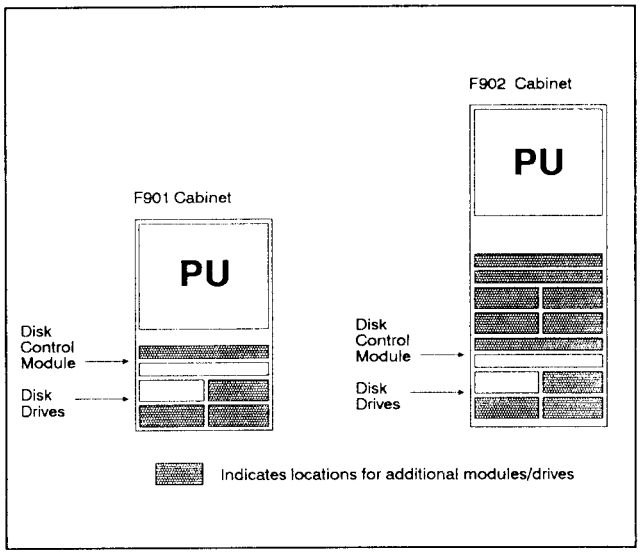


Fig. 3.7: RC9000 Disk Drive Mounting

The DCM has two separate IPI interfaces which gives the oppurtunity to attach the control module to two different input/output channels. This facility may be used for providing a *hot stand-by* function in a system consisting of more than one RC9000-10 PU.
In fault-tolerant configurations, with the RC9000-30/40 PUs, each disk drive is attached to two Disk Control Modules, which again are attached to separate input/output channels and processing units. In this way disk drives may stay in operation even if one of the control modules are failing. The TX Operating System automatically routes requests for disk data through the operating control modules - eventually by means of inter-PU communication.

The other interface of the Disk Control Module, i.e., towards the disk drives is a standard SMD-E interface. Up to 4 disk drives may be attached to each control module with a maximum disk data transfer rate of 24 Mbits/second. The main characteristics of the RC9220 Disk Control Module are:
- Dual IPI-III interface
- SMD-E interface to disk drives

- Up to 4 drives per controller
- 24 Mbits/sec. disk data transfer rate
- Overlapped seek facility
- 64 Kbyte data buffer / track cache
- Microprocessor controlled operation
- DMA-based data transfer

Disk drives
The disk drives are dual-ported, allowing each drive to be attached to two different disk control modules. As mentioned above this is of key importance to the fault-tolerance of TX- based RC9000 systems.
The RC9000 Computer System offers two types of disk drives:

- 8" 850 MByte disk drive
- 8" 1.4 GByte disk drive

Disk drives are placed in the RC9000 cabinet in sections with up to four drives and with the corresponding one or two Disk Control Modules placed above. Each drive is connected to the control module via two standard cables SMD-A and SMD-B.

RC9210 Tape Control Module
Like the Disk Control Module, the RC9210 Tape Control Module - the TCM - is separately powered and housed in a 19" rack cabinet for mounting inside the RC9000 cabinet.

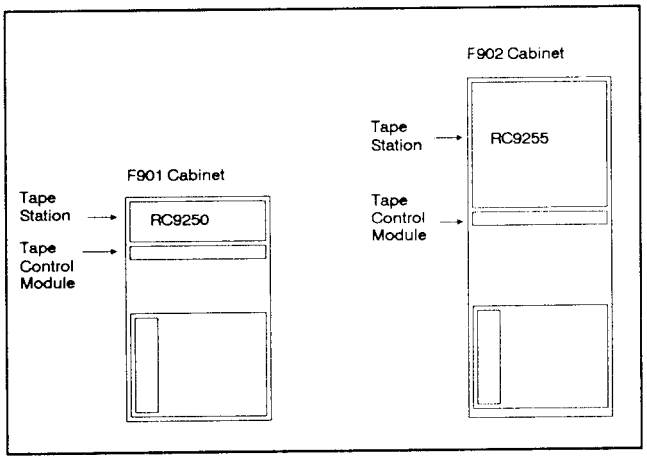


Fig. 3.8: RC9000 Tape Station Mounting

The Tape Control Module has a dual IPI interface, allowing the controller to be attached to two input/output channels, and thereby two processing units.

Each TCM supports one tapestation attached through a standard Pertec interface. A databuffer ensures streaming operation of the tape, even in situations where the input/output channel is heavily loaded.
The main characteristics of the RC9210 Tape Control Module are:

- Dual IPI interface
- Subset of IPI Logical Generic Command Set for magnetic tapes supported.
- Standard Pertec interface to tape drives
- Data buffer ensuring streaming operation of tape
- Drive types supported
  1600 BPI, 25 IPS start-stop and 100 IPS streaming
  1600/3200 BPI PE, 100 IPS
  6250 BPI GCR, 70 IPS

Tape Stations
Two types of tape stations are available for the RC9000 Computer System: One horizontal type for mounting in the low version of the RC9000 cabinet, and one vertical type for mounting in the high cabinets.

The RC9250 Horizontal Tape Station must be placed in the top position of a F901 cabinet with the corresponding RC9210 Tape Control Module placed just below.

The RC9255 Vertical Tape Station must be placed in the top position of a F902 cabinet with the corresponding RC9210 Tape Control Module placed just below.

LAN Attached Devices

Local Area Network hardware and software have been integrated with the RC9000 system architecture from the outset in order to fulfill two main objectives:

1. To establish a flexible and comprehensive connectivity between the terminals and communication systems and the processing units
2. To provide access to other equipment according to industry standard or public protocols.

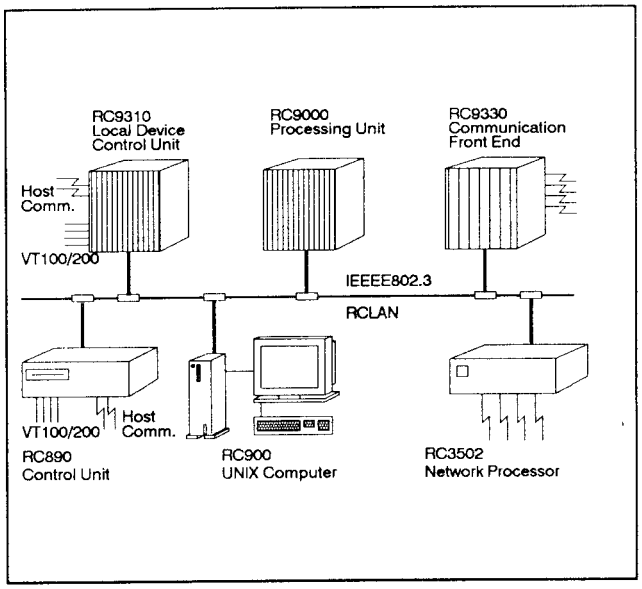


Fig. 3.9: LAN attached Devices

The Local Area Network - with the common designation RcLAN - attaches to the RcLAN Controller located in the processing unit. The interface conforms to the IEEE802.3 standard for a CSMA/CD network and

may either be a RcMikronet (1 Mbps), a Thin Ethernet (10 Mbps) or a Ethernet (10 Mbps). As default all LAN attached devices in the RC9000 Computer System are equipped with Thin Ethernet transceivers.

The LAN attached devices fall in two categories depending on their degree of integration with the RC9000 system:
The first category contains the two communication processors RC9310 and RC9330, which must be mounted inside the RC9000 cabinets. These devices may be equipped with hardware options for fault tolerant capabilities through the use of back-up units.
The second category contains the range of equipment from RC Computer that may be attached to the RcLAN. This equipment can not be covered by the fault tolerance capabilities to the same extend as the first category.
This description concentrates on the two communication processors of the first category that are part of the RC9000 system. The last part of this section gives a brief introduction to other RC Computer products that may be attached to RcLAN.

RC9310 Local Device Control Unit

The RC9310 is a multifunctional device control unit primarily for attaching asynchronous terminals to the RC9000 processing units via RcLAN. The RC9310 has the capability of converting from VT100/200 character oriented communication to 3270 format oriented communication for those applications that use a format oriented handling of the devices. Futhermore, the RC9310 may act as an IBM 3174 Control Unit for communication with a remote host.

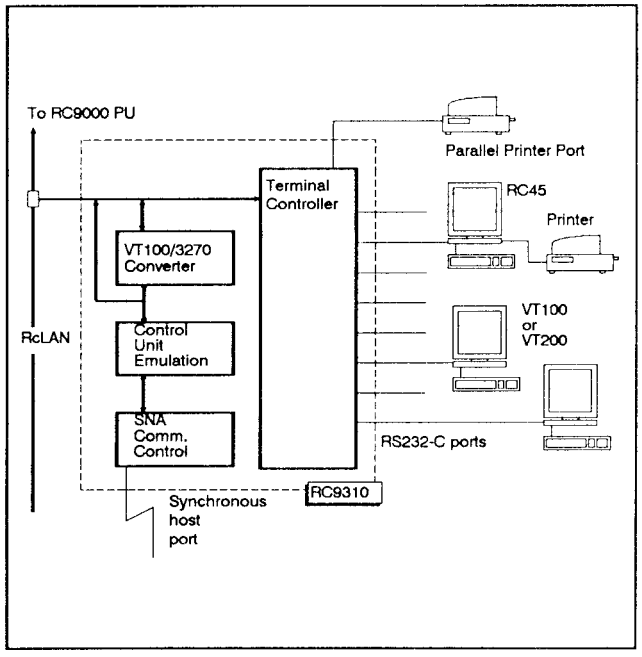


Fig. 3.10: RC9310 - Schematic View

Terminal attachment
Asynchronous terminals may be attached to the RC9000 processing units in two ways: Either via the 8 or 16 RS232-C connectors on the line interface boards of the RC9310 or via the RC911 LAN MUX supporting 8 terminals.

3270 Format Oriented Communication
Each of the attached asynchronous terminals may use the 3270/VT200 conversion facility, which enables the terminal to communicate with applications as a 3270 format oriented device. The conversion facility acts as a format oriented device against the host computer and controls the asynchronous terminal in order to make it appear as a format oriented terminal.

IBM 3174 Control Unit Emulation
The RC9310 is equipped with a synchronous communication port, which, in combination with software for remote host support, enables the RC9310 to be used as a cluster controller for communication with a remote host computer. Communication protocols supperted are: V.24 SDLC, X.21 SDLC and X.25 SNA/QLLC. This feature enables both the asynchronous terminals attached to the RC9310 and other devices attached to RcLAN to use this synchronous communication line. The RC900 Multiuser UNIX computer or any other PC/AT equipped with a LAN board and SW from RC Computer may use the RC9310 IBM 3174 Emulation as a cluster controller.

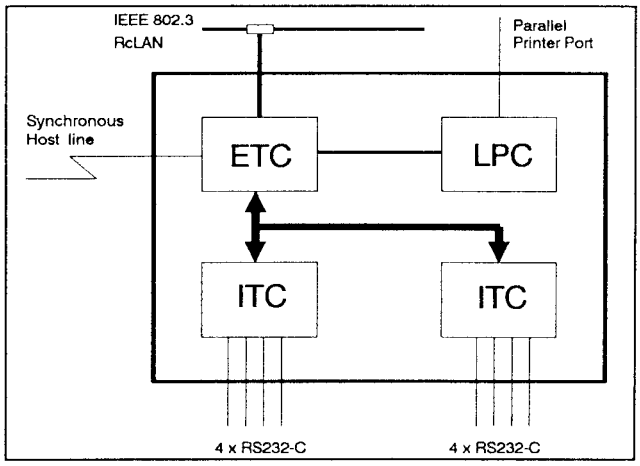


Fig. 3.11: RC9310 Hardware Components

The RC9310 Local Device Control Unit physically consists of a subassembly box with boards and a separate power supply. The box fits into an F908 Mounting Chassis which has room for 5 RC9310 Control Units. The F908 Chassis must be mounted in a RC9000 Cabinet.
All connections to the RC9310 are located on rear of the unit and fit into the corresponding connections in the F908 Mounting Chassis, thus enabling easy mounting.

RC9330 Communications Front End

RC9330 is a front end (FE) processor used for connecting an RC9000 system to networks using synchronous communications lines. One RC9330 FE processor can control up to 12 lines, each of which may connect a large number of terminals to the RC9000 system. RC9330 is used exclusively to connect remote terminals.

Up to three RC9330 FE processors can be mounted in one RC9330 Mounting Chassis. In each RC9330 FE there is room for 8 boards. The RC9330 CPU uses 3 positions, the memory board uses 1, the RcLAN interface another one, thus leaving 3 positions for communication controller boards. These controller boards are equipped with 4 synchronous communication lines each, giving an RC9330 a maximum of 12 communication lines.

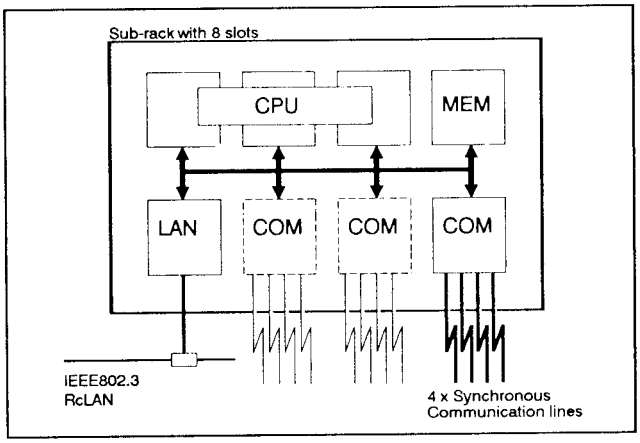


Fig. 3.12: RC9330 Hardware Components

Terminal types

Character-oriented terminals are supported by the RC9330 X.29 host function via a packet switching network providing X.25 service. A sub-host function in RC9330 supports remote format- oriented 3270-type terminals. Terminals of the latter type may be connected in three different ways detailed below. Not all application programs will support both types of terminals. In particular, existing UNIX-based applications only support character-oriented terminals.

Line protocols

The RC9330 Communications Front End initially supports a subset of line protocols from RC3502. The communication lines of an RC9330 FE may be configured to support one of the following protocols or a combination of protocols:

- V.24/V.28/X.25/X.29
  RC9330 is the X.25 DTE and the X.29 host. This can be used to communicate with remote triple-X PADs across a packet switching network providing X.25 service. Remote terminals must be connected to the PADs.
- 3270/SNA - V.24/V.28/SDLC, Leased line.
- 3270/SNA - X.21/SDLC
- 3270/SNA - V.24/V.28/X.25/QLLC
  In all three above-mentioned cases the RC9330 plays the role of SNA subhost, supporting communication with a number of IBM 3174-compatible device control units such as the RC890/30.

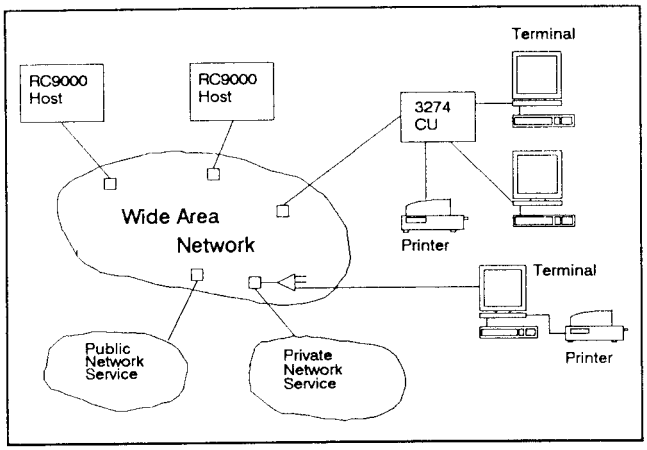


Fig. 3.13: RC9330 Applications

Other RC Products for RcLAN

Besides the above-mentioned communication processors RC Computer has a range of products that support the RcLAN protocols and may form an integral part of an RC9000 system, but are designed as self contained devices. The most important of these are:

- RC890/30 Control Unit
- RC3502 Network Processor
- RC900 Multiuser UNIX Computer

RC890/30 Control Unit

The RC890/30 Control Unit is a close relative of the RC9310 Local Device Control Unit. Essentially, the RC9310 is a re-design of an RC890/30.
The RC890/30 is designed as a cluster controller handling up to 32 terminals, 32 printers, one or two synchronous host ports and four asynchronous ports. The RC890/30 offers a broad selection of communication protocols on each host port link. The communication protocols supported include:

- 3270 BSC and SNA/SDLC for IBM mainframes or equal.
- UTS for Sperry Unisys mainframes
- MSV1 (8151/9750 emulation) for Siemens mainframes
- Triple-X PAD Communication for host computers attached to X.25 networks
- VT100/200 for DEC Computers via asynchromous ports

The SNA/SDLC communication supports V.24,X.21 and X.25 (QLLC) interfaces and the communication links may be either multisession/multi device type for

synchronous communication or single session type for asynchronous communication.
The RC890/30 is equipped with its own 5.25" floppy disk which is used as local load medium.

RC3502 Network Processor

Like the RC9310 and RC890/30, the RC9330 is a close relative of the RC3502 Network Processor, the latter having a more generalized functionality.
The RC3502 is a high-performing network processor for packet switching applications like PAXNET. RC3502 and PAXNET have been developed in co-operation with the Danish PTT authorities and the system is now in operation nation-wide as the public X.25 service with more than 300 network nodes.

PAXNET is based on a vendor-independent and internationally standardized concept, and all protocols conform to CCITT recommendations and ISO's reference model for Open Systems Interconnection.
Through this adherence to CCITT and ISO international standards, PAXNET has achieved the highest degree of independence from both vendors and transmission facilities. Furthermore, the PAXNET data transport mechanism is based on dynamic adaptive routing combined with internal end-to-end control, which provides the network with:

- high transport service reliability
- efficient transmission line utilization
- fast automatic adaption to transmission line failure and configuration changes.

A comprehensive set of gateways, interfaces and an advanced distributed concept of network management make PAXNET equally suited for international co-operation, geographically distributed companies and telecommunication service providers.

RC900 Multiuser UNIX Computer

The RC900 is a multiuser system handling up to 17 users and is based on the iAPX386 microprocessor from Intel and uses the 386/ix UNIX operating system, which allows both UNIX and MS-DOS applications to run concurrently.
The RC900 may be equipped with one or two controllers for RcLAN, multiplexers for attachment of maximum 16 terminals, and one or two communication controllers for synchronous communication.
These facilities make the RC900 an integrated supplement to the RC9000 system either as a communication server with its own file system or a system for personal computing with fast access to the RC9000 processing power.

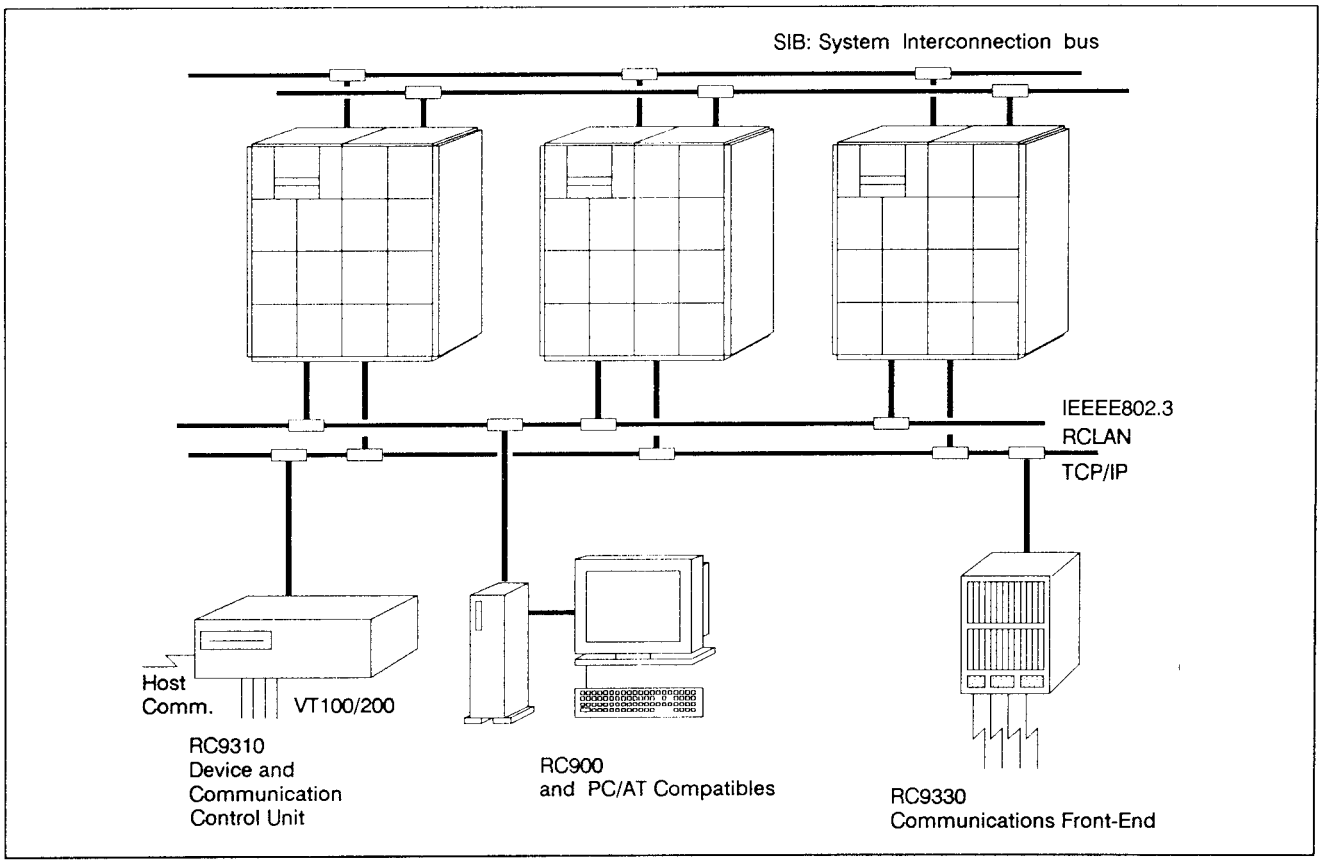


Fig. 3.14: RC9000 Computer System

3.2 TX Operating System

In this chapter the fundamentals of the Transaction Executive™ (TX) operating system will be outlined, focusing on the enhancements in TX compared to traditional UNIX™ systems.

TX must be used on RC9000 systems equipped with the RC9010 RISC based processor. The TX operating system manages the resources of the RC9000 systems from entry-level, single processing unit configurations through high-end, multiple processing unit systems. Through this range, the same TX operating system is used, because of its special design targeted at distributed multiprocessor environments.

UNIX Compatibility

TX is derived from the UNIX operating system developed originally at AT&T Bell Laboratories. TX extends the set of UNIX system calls for features like transaction processing, but does maintain compatibility with both major versions of UNIX in use today: BSD 4.2 and System V.
Most 4.2 BSD calls are retained. A few calls have an extended syntax, and certain new calls have been incorporated.
The entire SVID Base System Definition and Kernel Extension Definition is supported. And almost all other System V features are supported as well.

The compatibility achieved at the user interface level through system calls, libraries, and utilities results in a system environment which supports all of the advanced facilities discribed later, and also opens up the fast growing body of applications and application development tools for UNIX-based systems. It is important to note that TX's online transaction facilities augment rather than replace the standard UNIX facilities, so that no compatibility is compromised for the sake of functionality.

While standard versions of UNIX have many useful attributes, they also have many apparent weaknesses. The design of TX resolves those weeknesses deemed detrimental to the performance of online transaction processing systems, including inefficient disk allocation, low-integrity file systems and inadequate concurrency control.

In addition to fundamental operating system functions such as priority scheduling of processes, physical device management, and virtual memory management, TX's major features include:

- Distributed multiprocessor support
- Improved file system
- Transaction processing
- Transparent application process allocation
- Fault tolerance

The following sections contains a brief description of each of these features.

Multiprocessor support

TX is designed specifically to use and manage systems with a distributed multiprocessor architecture like the RC9000 system. The distribution is made at two distinct levels.

The first level is within the processing unit, where TX functionality is distributed between the *User Processing Unit* (UPU) and the *Real-time Processing Unit* (RPU). In general, the RPU handles those functions that involve hardware - like input/output operations - leaving the UPU free to process application code. The figure below shows how operating system functions are divided between the two units. Both units handle interrupts as appropiate.

User programs and synchronous TX functions requested by application programs run only on the UPU. Major parts of the input/output subsystem run only on the RPU - for example file access across the System Interconnect Bus.

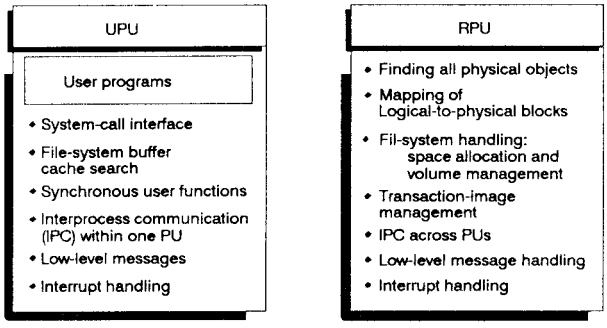


Fig. 3.15: Processor tasks

The second level of distribution is within the loosely coupled, distributed system environment of multiple processing units that are interconnected via the SIB-Bus. TX provides a single-system view of this environment to application developers and end users.
Facilitating this single-system view is a distributed file system supported by the TX "endpoint" mechanism,

which allows tranparent access to all system resources. The target resources can be directly connected to, and accessed from, any processing unit in the system. This endpoint mechanism also permits dynamic reconfigurating of hardware and software resources without affecting the single-system view or transparent access. A later section in this chapter covers more precisely the aspect of transparent access.

Improved File System

The file system is a further development of the standard UNIX file system, however still maintaining the overall characteristics of a UNIX file system.

Like any UNIX file system, the TX file system is tree structured. A TX file system originates in a root directory. All subdirectories, data files and special files exist under the root directory (special files include points of access to devices such as terminals, printers, disks and magnetic tapes). A file system normally consists of several "subsystems". All directories can contain either data or special files, or further directories - or both.

The TX file system is an enhancement of traditional UNIX file systems on the following points:

Distribution of the file system

A file system in a multi-PU system will be distributed among the PUs, together forming the "global name space". This was implemented by adding a top-most level to the traditional UNIX file system, named "the Global root".

This means that files in a multi-PU system are uniformly accessible, irrespective of their actual, physical location.

Improved file extent allocation

While traditional UNIX (such as AT&T's System V, or Berkeley version 4 and 4.1) systems allocate file space in 1 Kbytes blocks, TX has user-selectable file space allocation ranging from 1 Kbytes to 8 Mbytes blocks in the primary and secondary extent, implying that by use of 1 primary and 7 secondary extent, 64 Mbytes of data would be contained in directly accessible blocks. By adding a third level, the data files could contain up to 2 Gbytes of data, with only a single indirect block. Further levels could be added, so the addressable file space is currently much larger (theoretically about 33 Tbytes!) than the limits otherwise imposed on the file system.

For the user, this feature means that large files, having many random accesses, can be allocated large extent, thus resolving the UNIX emphasis on fragmentation of the file system and providing greatly improved performance, expecially with large, static files.

Locking mechanisms

Concurrency control is essential for any multi-user system. In an OLTP environment with a lot of terminal users, this part of the file system philosophy will be very important for the performance of the system.
In TX, 4 file-level locks can be specified:

IS Intent Shared. This is the weakest type of file-level lock. It provides read-only access and prevents any other process from obtaining an exclusive (X) file-level lock. Typical uses include browsing, querying and reporting.

IX Intent eXclusive. This type provides read/write access and prevents any other process from obtaining an exclusive (X) or shared (S) lock. Typical uses include general querying and updating. Typical on-line transactions use this lock.

S Shared. This type provides read-only access and prevents any other process from obtaining an exclusive (X) or intent exclusive (IX) file-level lock. Reproducibility of reads and a consistent view of the entire file is quaranteed (hereby differing from IS). Typical uses include infrequent but critical querying and reporting, where a consistent view is required - for example when making an inventory, or preparing an end-of-the-year report.

X eXclusive. This type provides exclusive read/write access. Typical uses include critical extensive update operations that require a consistent view of the whole file - for example rolling forward end-of-period balances into the next period, or major restructuring of data records.

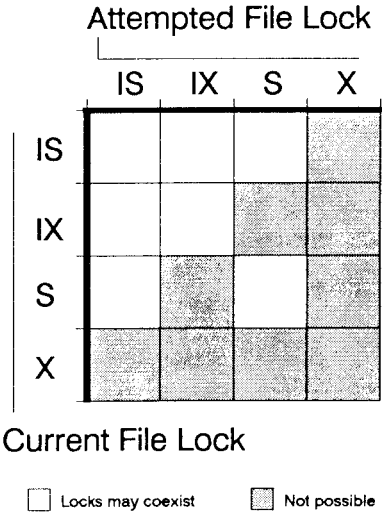


Fig. 3.16: TX Filelocks

TX thus provides possibilities of carefully allocating the file- level lock per process, hereby making way for fine-tuning performance, and for performing critical operations on a file- system, without closing down the global system as such.

Further, TX supports two types of block-level locking: Shared (S), and Exclusive (X). By adding these, the optimization of lock management to further improve system performance has been made possible. This facility is used by TX automatically and only in processes in transaction mode. This scheme, together with the scheme for file-level locks, also provides the maximum desired security (data integrity) and the maximum obtainable performance.
The TX "lock manager" discovers possible dead-locks, even among multiple PUs.

Transaction Processing

The fault tolerance and the improved file system are both part of the TX provisions for transaction processing.

TX entails an easy-to-use transaction programming interface that takes full advantage of the fault-tolerance and of the file system. This means that transaction applications can be developed rapidly and without the often cumbersome and difficult programming required in e.g. most mainframe environments. TX has been developed specifically for use in OLTP environments and for easy OLTP application programming.

The trans system call

The trans system call is the essential part of transaction programming. A user process starts a transaction by issuing this call with the parameters set for transaction-begin. The transaction is committed by issuing the call with the transaction-commit parameters set. Requests for the various lock types described above ensure appropriate locking of the files or the blocks involved in the transaction. If the user process involves a write request, a pre-image of the blocks is automatically logged.

The transaction is not stated as completed until the transaction- commit system call is executed. If instead the transaction-abort system call is issued, or a system error occurs, the transaction is rolled-back, by using the pre-image, hereby reestablishing the file system to the state it was in before the transaction-begin call. This complex of processes - pre-image logging, file or block-level lock - ensures that data remain consistent, even in large systems, involving multiple simultaneous transactions.

Flexible Application Process Allocation

The liniear growth philosophy of adding additional PUs as the need for performance increases (or if a reconfiguration occurs), and still maintaining the single-view appearance of the system is another major facility of TX.

The logical concept of a sub-PU.

It provides a grouping mechanism for application processes and session end-points. The intention is to simplify the task of administering large systems as well as the implementation of fault tolerance. A sub-PU is visible from TX processes as a collection of device nodes and from the terminal control units as a host port. Furthermore the sub-PU identifies the application processes that may be created on behalf of terminal users connected to these end-points. Seen the opposite way, i.e., from the terminal end, a distributed TX system can be completely decomposed into sub-PUs. As the name suggests, a sub-PU and its associated application processes resides at any point in time, in its entirety, on one and only one PU. Consequently, when a PU fails each sub-PU that resided on it migrates as a whole to another PU and re-establishes the terminal sessions.

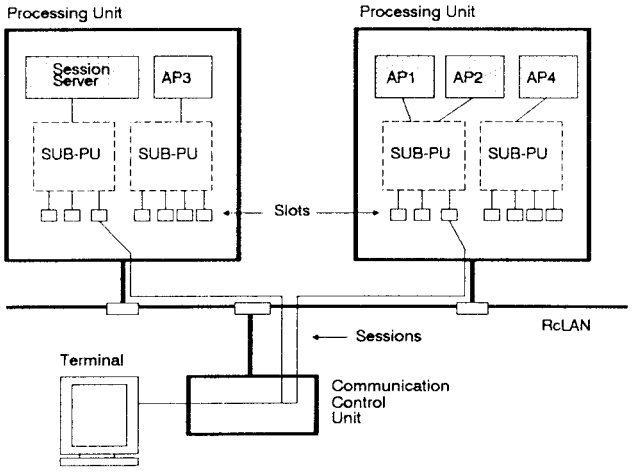


Fig. 3.17: TX Sub-PU Concept

In order to make sub-PUs and their physical location on PUs invisible to the terminal user, the following logon procedure applies.
Before a logon is performed, any terminal will automatically select a special application, the session-server.
This server presents a start-up menu showing all applications selectable from this terminal. Upon menu selection the terminal control unit establishes a new ses-

sion to the sub-PU and application identified by the menu-definition.
This scheme is not only a very user-friendly interface to the whole system but it also enables the system administrator to manage the application process allocation in a very flexible way and to define different menus for each individual terminal.

Fault Tolerance

"Fault Tolerance" in TX covers two distinct concepts:

- **Data Integrity;** the ability of the system to maintain the integrity of data (both user and system), even following a hardware and/or software failure.

- **Continuous Availability;** the ability of the system to continue processing user-designated tasks even following single-point hardware or software failure.

TX can be set up to provide different levels of fault tolerance ranging from none at all - to continuous availability for programs including automatic data integrity control and multi-plexing of data.

It is possible to select the required level of fault tolerance for each application on a system, i.e., applications running at the same time can be defined to incorporate different levels of fault tolerance.
At least four different levels of fault tolerance can be defined:

1. No fault tolerance at all. In case of failure the system gives no protection beyond what is known from any other UNIX system.

2. Automatic data integrity control on a single copy of data. This feature is supported even on a single-PU system. The data integrity is a feature that can be selected in addition to the basic reliability built into the file system. The selection can be made per file. It is implemented by means of pre-image logging before all user I/O requests, and a roll-back mechanism that will ensure the restoration of files after system software or hardware errors.

3. Automatic data integrity control on multiple copies of data - called plexes. TX supports automatic maintenance of multiple copies of files - a maximum of 8 plexes can be maintained. For plexes located on different physical disks, it is possible to acquire protection against serious hardware errors, such as disk head crashes.

4. Continuous processing with automatic data integrity control and multi-plexed data in a multi-PU system. Through use of dual-porting of disk control modules and back-up Communication Processors, it is possible to have terminals and applications migrating to running elements of the system, if the presently used elements fail. This 'fail-over' will to a high degree be transparent to the terminal user.

Continuous processing has been implemented through the use of terminal logging and extensive supervision of the system, from the System Support Processor and from TX.

Additional Features of TX

TX has been improved compared to traditional UNIX systems, at a number of additional points.

One point of certain interest will be that an exception handling mechanism has been added in order to improve error handling. In traditional UNIX systems, errors encountered while executing a system call are reported by returning a value to the calling program. It is then up to the calling program to check this value.

TX provides a centralized mechanism for error reporting that terminates programs in case of severe or fatal errors. This mechanism may be overridden if the calling program itself wishes to handle the UNIX-like error codes.

3.3 Data Base Management Systems

The RC9000 system belongs to the family of UNIX™ systems based on the MIPS RISC chip architecture. This has the benefit that a number of SW-tools and packages are available or can be made available without the need of a cumbersome porting project. These packages include a number of DBMS systems, compilers, OA and business applications.
This chapter concentrates on data base management systems and tools for application development.

C-ISAM File access

RC9000 supports an enhanced version of C-ISAM™, the popular, high- performance file access method that is based on the "C" language. C-ISAM has been designated the standard B-tree file access method for the UNIX operating system by the X/OPEN consortium.

C-ISAM is a library of functions for creating and managing indexed file systems. As an emerging standard access method for UNIX environments, C-ISAM performs index file maintenance and manipulation tasks. It also offers users rapid access and retrieval of data, efficient storage of data on disk, and comprehensive protection of data files.

C-ISAM's flexibility allows users to create a large number of indices. Each index key may consist of from one to eight parts, and each part may represent a different data type. The number of data records per file is unlimited. Record size, number of fields per record, and field size are limited only by addressable memory size.

All C-ISAM files grow dynamically, reusing space vacated by deleted records. Every time a data file is modified, index files are automatically updated and balanced.

For additional flexibility, C-ISAM on the RC9000 has been extended to support partitioned files. Partitioning allows records to reside in multiple files for faster, easier access in high-volume, multiuser environments. However, this partitioning is transparent to the application, which uses the collection of partitioned files as though it were a single file.

C-ISAM's refined indexing structure provides quick data access and retrieval. Response time is consistent for files of all sizes, and for all types of requests.

Access time is further improved by compression of redundant data, whereby fewer accesses are required to locate a particular value.
This is especially useful in applications where duplicate values and characters or trailing blanks represent significant portions of the data base. Data compression also conserves disk storage space for maximum efficiency.

C-ISAM fully utilizes the powerful file system management and transaction control capabilities inherent in the TX operating system. These include file- and block-level locking, deadlock detection, automatic concurrency control, and protection of transaction data integrity. Like other TX files, C-ISAM files can be replicated across multiple disks (N-PLEXed) to ensure their availability despite media failures.

Database Management Systems

RC9000 together with a strong Database Management System (DBMS) is an execellent solution for high-performing environments.
The DBMS of the future is relational and SQL (Structured Query Language) is **the** language, not only for querying, but also for creating and updating the database. SQL can be used interactively or embedded in the programming language used.
The best relational database management systems of today offer effective control of concurrency, consistency and integrity. Further, they support recovery of the database if some failure should occur.
Adding the robustness of RC9000, the dualported disks and the plexed files, the RC9000 system fulfils all the requirements for an effective and secure database system.

Along with each relational database management system becomes a wide range of tools for e.g:

- Forms-based DBMS interaction
- 4th-generation programming (4GL)
- Report generation
- Computer Aided Software Engineering (CASE)
- Screen painting

Several leading relational DBMS product will become available for the RC9000 system. One of these Relational DBMS products is INFORMIX™. This DBMS product is hence available on the entire range of RC computers: RC39, RC900 and RC9000.

INFORMIX

Two of the central INFORMIX products are INFORMIX-SQL and INFORMIX-4GL.

INFORMIX SQL is a relational database management system targeted at developers of custom applications. INFORMIX-SQL offers users a powerful and flexible data management environment. Informix SQL conforms to the proposed ANSI standards for SQL implementations. INFORMIX-SQL tools are specifically designed for application building - to create and maintain databases, design custom screens and menus, and produce custom-formatted reports.

INFORMIX-4GL is built upon INFORMIX SQL, the main features and functions being:

Main features:

- Based on C-ISAM.
- Compatible with all Informix products based on C-ISAM 3.1.
- Non-procedural language.
- Window facilities and pop-up menues.
- Easy development of new applications.

Main functions:

- Create menus
- Collect input from screen forms
- Use SQL to manipulate a database
- Call for help screens
- Create reports
- Collect multi-row data from a single form with scrolling
- Provide query-by-example forms
- Set up conditional screen attributes
- Have access to debugging tools
- Call 4GL or C library functions

- Unlimited number of tables.
- Unlimited number of rows and columns.
- Unlimited number of secondary indices.

Other Tools

A wide range of other tools than the ones mentioned above will be available on the RC9000 system. As mentioned earlier the binary compatibility with the MIPS UNIX-systems is one way of offering this.

3.4 Communication Facilities

The RC9000 Computer System offers a wide range of communication facilities covering both local area and wide area networks. Every processing unit of an RC9000 system must be attached to a local area network, RcLAN, and optionally be attached to multiple networks. Terminals, printers, communication lines and units providing access to public or private wide area networks are always connected to the processing units via RcLAN. The concept of using the RcLAN local area network to all sorts of communication gives a high degree of flexibility, which is essential in a distributed multi-processor environment, especially for fault tolerant systems like the RC9000.

The RC9000 Local Area Network Concept

Local Area Network (LAN) hardware and software has been integrated with the RC9000 system architecture from the outset in order to fulfill two main objectives:
The first objective has been to establish a flexible and comprehensive connectivity between the terminal and communication systems and the processing units. This ideally supports the liniear growth philosophy which is essential for the RC9000 system.
The second objective is to provide access to other equipment according to industry standard or public protocols. This enables integration with existing LAN networks.

As mentioned above all terminals, printers and communication lines are connected to the processing unit via one or more local area networks. Terminals and printers must be connected via appropiate control units for local devices, or via front-end communication processors for remote devices.
Control units for local devices and front-end communication processors are collectively reffered to as communication control units (CCUs).

RcLAN Local Area Network

The common designation RcLAN will be used for this network.
The LAN is based on IEEE802.3 and Thin-wire Ethernet is as standard used for the network cabling. As an option either Ethernet or the proprietary RcMicronet can be applied.
Thin-wire Ethernet an Ethernet uses 10 Mbps transfer rate and RcMicronet uses 1 Mbps transfer rate.
RcLAN offers three basic services which are related to following three protocols:

Character Stream Protocol (CSP) enabling any character-oriented device to access any host computer, either directly connected to RcLAN or via a communication server.
Data Stream Protocol (DSP) enabling 3270 format oriented terminal/workstations to access host com-

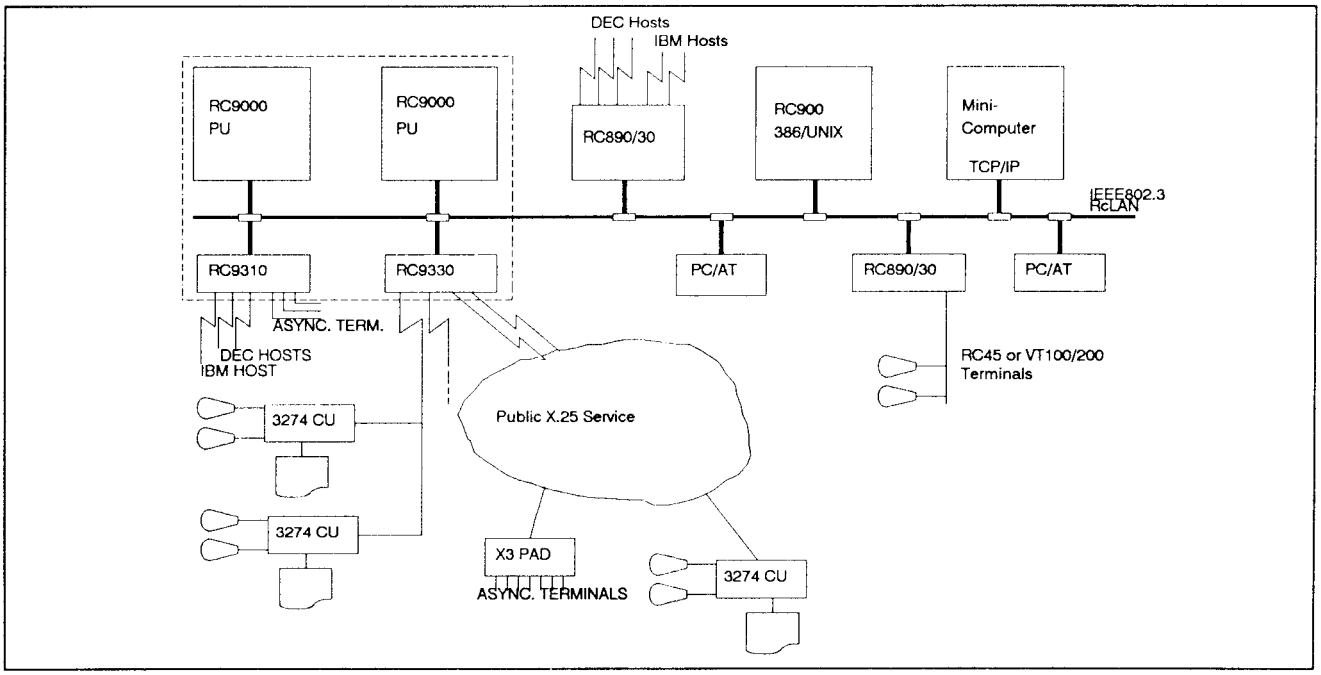


Fig. 3.18: RcLAN Connectivity

puters (supporting 3270 terminals), either directly connected to RcLAN or via a communication server.
File Transfer Service (FTS) offering simple and effective tools for copying of files between heterogeneous file systems.

The above mentioned protocols are standard for RcLAN and RC9000 processing units of all models can, along with a number of other RC products, use these protocols.
In the future, concurrently with the industry acceptance, ISO's OSI protocols will be provided and added to the RcLAN facilities. RC Computer is currently involved in implemtations of the ISO protocols through its participiation in the ESPRIT project CARLOS and the joint venture project with the danish PTT concerning the public packet switched network PAXNET.

Furthermore the industry-standard protocol TCP/IP is supported by the RC9000 processing units. This allows products from other vendors to be attached to the LAN and to interwork with RC9000 systems. The available services are: remote login, file transfer utilities and a socket-based program-to-program communication facility.

RcLAN Attached Devices

RC9000 Processing Units

In general, a CCU may establish connections with any processing unit in a system with multiple processing units. As this type of connection is established per terminal, a CCU will typically communicate with several processing units simultaneously, and vice versa. The CSMA/CD network is well suited for such a pattern of communication.
Each processing unit may be connected to multiple separate networks. The use of multiple networks allow the number of terminals connected to a large RC9000 system to grow beyond the limit which is set by the bandwidth of a single CSMA/CD network. This limit cannot be specified as some fixed number of terminals or CCUs because it depends upon the traffic patterns.

Communication Control Units

As presented in section 2.1, RC Computer offers the following type of equipment connected to RcLAN to be used with RC9000 systems:

- RC9310 Local Device Control Unit mounted in the RC9000 cabinet.
- RC9330 Communication Front-End mounted in the RC9000 cabinet.
- Separately packaged RC890/30 Control Unit, serving a number of terminals and host lines.
- Separately packaged RC3502 Network Processor integrated in already existing networks.
- The RC Computer range of smaller systems, from the RC750 PC to the RC900 iAPX386-based UNIX machine.
- Any PC/AT workstation equipped with LAN board and SW from RC Computer.

All the above-mentioned equipment is fully supported by RcLAN protocols which makes it form an integral part of the RC9000 system architecture.

Terminal and Printer Attachment

The terminals fall into four categories: local and remote, character oriented and format oriented. In the following the attachment of these four types to RC9000 system will be outlined.

Local terminals and printers

Local character oriented terminals and printers are attached via a Communication Control Unit that uses the CSP protocol to communicate with the RC9000 processing units. The CCU will in most cases be the RC9310 Local Device Control Unit with is 8 RS232-C ports and RcCircuit terminal network. The printers may be attached to the RC9310 printer ports. Alternatively the CCU may be either the RC890-30 Control Unit or terminals connected to the RC900 Multiuser UNIX system, if these CCUs is equipped with the appropiate software and hardware for RcLAN attachment.

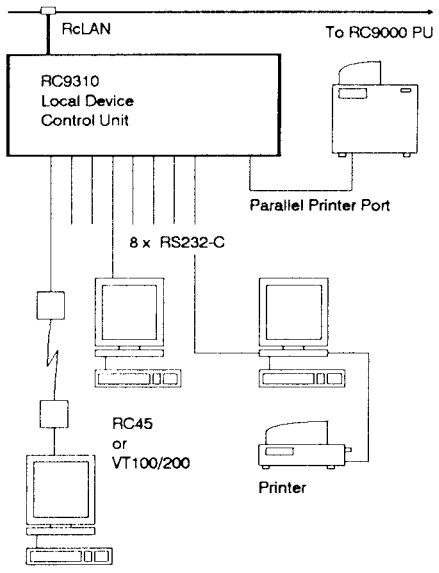


Fig. 3.19:Terminal attachment to RC9310

Local 3270 format oriented terminals must be attached to the RcLAN through a CCU that uses the DSP protocol to communicate with the RC9000 processing unit. As an example the 3180 emulator for RC45 terminals which are connected to the RC890-30 Control

Unit constitutes a cluster of format oriented terminals. 3270 printers may be connected to the RC45 terminals. The iAPX386 based RC900 UNIX system or a PC/AT compatibles may also be used as 3270 format oriented terminal if they are equipped with the appropiate software and LAN controller.

Remote terminals and printers

Both character oriented and 3270 format oriented remote terminals may be attached to the RcLAN via the RC9330 Communication Front- End.

In case of character oriented terminals the RC9330 FE uses the CSP protocol towards the RC9000 processing unit. Towards the remote terminals or printers the RC9330 is the X.25 DTE. The remote terminals or printers must be attached to a Triple-X PAD across an X.25 packet switched network and the RC9330 communicates with the PAD according to X.29.

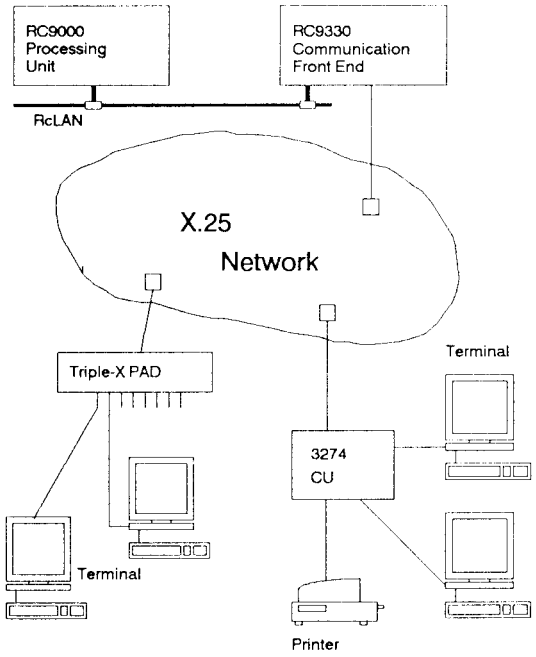


Fig. 3.20: RC9330 attached to X.25 network

Alternatively remote character oriented terminals may be connected via asynchronous modem links to the RC9310 as if the terminals were local. Eventually the use of statistic multiplexers may be an efficient and economical way of attaching a minor number of asynchonous character oriented terminals.

The RC9330 may also play the role of a SNA subhost in order to support remote 3270 format oriented terminals and printers. The remote terminals must be connected to a IBM 3274 compatible control unit as the RC890-30. RC9330 uses the DSP protocol to communicate with the RC9000 processing unit via RcLAN.

The RC9330, which is equipped with synchnous communication lines only, may use the following three protocols when communicating with remote control units:

- 3270/SNA - V.24/V.28/SDLC, Leased line
- 3270/SNA - X.21/SDLC
- 3270/SNA - V.24/V.28/X.25/QLLC

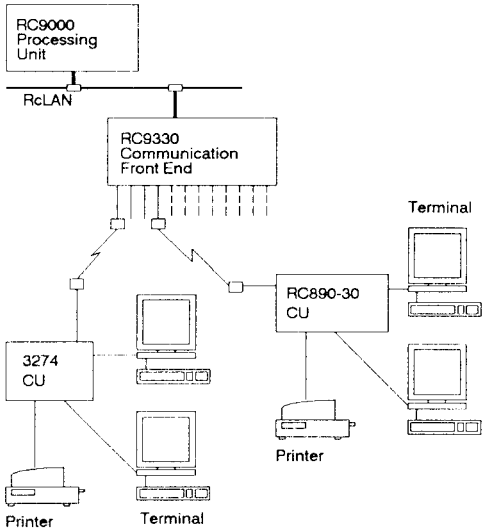


Fig. 3.21: Remote control unit attachment via SDLC

When using the X.25 service across a packet switched network this communication link may be used for character oriented communication to Triple-X PADs simultanously.

Printer handling

In general printers attached as asynchronous devices, i.e. through the CSP protocol (for example printers attached to RC9310 Local Device Control Unit printer ports) are owned by an RC9000 processing unit or another host on the RcLAN. All output to the printer must come from or pass the owner host, which normally holds some sort of spooling facility.

3.5 Compilers for TX

All the compilers for RC9000 are designed for maximum performance. This means that the products are all based on optimizing compiler technology from MIPS Computer Systems Inc. to give most benefit from the RC9000 system. The compilers generate native code and there are no artificial size limitations.

Compiler Technology

In addition to performing the same task as ordinary compilers, the optimizing compiler re-arranges the generated code to minimize its size and - more important - the execution time. The optimizing compilers can produce results often better than those produced by human assembly language programmers. Optimization related to RISC-processor architecture involves the following kinds of operations:

1.
Allocating processor registers so that they contain frequently-used data. This reduces the number of relatively slow memory references, replacing them by faster register references.

2.
Scheduling the execution of instructions. The optimizer attempts to move instructions to a point in the program flow where they better utilize the processor pipeline. For example, a register load may be moved to a point in the instruction sequence where its memory reference can be overlapped by another instruction.

3.
Replacing slow operations by faster ones. Among other things the optimizer can recognize special cases of multiply and divide, and replace them with simpler instructions.

The products are also designed for high productivity offering the following features:

- Common user interface across all languages.
- Common commands for all system options across all languages.
- Common source-level debugger. The debugger is capable of testing the object code, not the intermediate code. In other words, you will debug the final product, not an intermediate product. It is a major advantage of the debug process to work on the final code since the code could change when it is converted from an intermediate language to a native code generator. The interactive source level debugger allows the programmer to test and debug the program using the conventions and symbols of the source language without the need to understand the machine language of the computer.
- Polyglot Capability (Cross-language calling).
- Error messages (easy to read and understand). They specify which conditions have been encountered and where in the source program they were found. Many of the messages indicate what the programmer must do to correct the error.

C Compiler

The C compiler that conforms to the language defined in "The C Programming Language" by Kernighan and Ritchie (Prentice Hall, 1978). This book, referred to as K&R, is considered to be the standard for the C language until the ANSI C commitee completes its work.

The C compiler consist of the compiler and a driver program used to invoke the compiler. The standard C library is provided in the Utilities Package.

The C driver program uses the macro pre-processor provided in the Utilities Package and therefore C has include-file processing and a compile-time macro facility.

The C compiler will support the enumeration type, which is used to provide assignment of symbolic names, and the void type which allows a user to specify no value is to be returned. Both of these extensions are widely used and are expected to be included in ANSI standard C.

The C compiler will also include a partial implementation of the volatile data type which is used when programming I/O devices from C and is proposed in ANSI standard C.

The C compiler will execute the HCR (Human Computing Resources, Toronto, Canada) C Test Suite, version 1.5, passing all tests that are consistent with common usage as defined in K&R.

Pascal Compiler

Pascal is an implementation of IEEE/ANSI Standard Pascal with extensions that make Pascal useful for a wider class of programs.

The extensions were selected to be consistent with the direction of the emerging extended ANSI Pascal standard and be consistent with a UNIX/C programming environment.

Pascal includes the Pascal compiler, a driver program to invoke the compiler and the support library required to provide execution functionality.

The Pascal driver program uses the macro pre-processor provided in the Utilities Package and therefore Pascal has include-file processing and a compile-time macro facility.

Pascal is a standard conforming Pascal (ANSI/IEEE770 X3.97-1983) compiler. It will execute the Pascal Validation Suite, version 4.1, and will pass all of the conformance and quality tests. It will produce reasonable results for the implementation defined and implementation dependent tests; further it will pass all error tests that can be implemented with reasonable performance and space requirements.

Fortran Compiler

FORTRAN is a standard conforming FORTRAN 77 (ANSI X3.9-1978) compiler. FORTRAN extends FORTRAN 77 in order make it easier to communicate with C procedures and to permit compilation of older FORTRAN 66 programs.

FORTRAN includes the FORTRAN compiler, a driver program to invoke the compiler and the support library required to provide execution functionality.

The FORTRAN driver program uses the macro preprocessor provided in the Utilities Package and therefore FORTRAN has include-file processing and a compile-time macro facility.

FORTRAN 77 will be a standard conforming FORTRAN 77 (ANSI X3.9- 1978) compiler. It will pass the FORTRAN Compiler Validation System Version 2.0 (1978).

Cobol Compiler

The LPI-COBOL™ Compiler from Language Processors Inc. is a GSA certified implementation of the American National Standard Institute (ANSI) COBOL X3.23-1985 at the high level. Extensions have been added to provide compatibility with RM/COBOL. This allows the large number of applications written using RM/COBOL to be transported to COBOL without any source changes and to obtain the benefits of the LPI language environment. These include very high performance and the extensive productivity gains provided by Component Architecture™. Other extensions have been added to obtain compatibility with the IBM/370 COBOL, Micro Focus Level II COBOL and the previous ANSI COBOL-68,75.

The compiler has a full set of listing options that includes an annotated listing of the source program, user symbols and their attributes, a cross reference and a summary of compilation statistics. The compiler also allows the user to request that any COBOL construct or feature exceeding a particular level in the Federal Information Processing Standard be reported in the listing ("FIPS flagging").

An extensive run-time library provides an array of user callable subprograms. It also contains a multikey, indexed sequential file handler and a highly efficient SORT/MERGE routine.

PL/I Compiler

Like the COBOL Compiler the PL/I Compiler is developed by Language Processors Inc. LPI-PL/I™ is a full implementation of the American National Standard Institute (ANSI) PL/I X3.74-1981. General Purpose Subset Extensions have been added to provide the most useful and most commonly requested additional language features of IBM PL/I and DEC VAX PL/I.
These extensions facilitate the transporting of applications written for mainframes onto systems using PL/I. PL/I General Purpose Subset is the PL/I that is used on all supermini class computers and a large number of programs can thus be made readily available using PL/I.

The compiler has a full set of listing options that include an annotated listing of the source program, user symbols and their attributes, a cross reference and a summary of compilation statistics. Optionally, PL/I also provides a summary of the nesting level of logical control in the source listing.

An extensive run-time library provides an array of user callable subprograms. It also provides for the run-time checking of out- of-bounds array subscripts and out-of-bounds character substring indexes.

3.6 RC9000-10 Software

The RC9000-10 Processing Unit is compatible with the RC8000 series of minicomputers from RC Computer which gives existing RC8000 customers the oppurtunity to carry their applications to an RC9000 System.
Most of the software known from RC8000 is available for the RC9000C systems but is structured different. The following software packages are available for the RC9000C system:

- RC9000-10 Basic System Software
- RC9000-10 BOSS
- RC9000-10 Compiler Collection
- RC9000-10 Graphics Support

In the following sections the contents of these basic software packages for the RC9000C system vill be described briefly.

RC9000-10 Basic System Software

This package includes the basic operating systems called **Monitor** and "s". The monitor may be regarded as a software extension of the hardware structure and "s" is a rather raw operating system, that in most cases is used only for controlling an operating system at a higher level.
The operating system **SOS**, the file router module **PRIMO**, is part of the Terminal Access System (**TAS**) which is also included in this Basic System Software Package. For readers acquainted with RC8000 software, it should be mentioned that TAS replaces the formerly known terminal access module (TEM). TAS enhances the facilities for terminal access and access control, provides a menu system for end-user application-selection and logs the user on to the relevant application automatically. Further more TAS allows multi-terminal jobs.
The category of programs called **System Utilities**, which is also part of the Basic System Software, includes two larger subgrups: The Utility part and the Maintenace part.
The Utility part consists of the central control program, the **File Processor** (FP) and a number of programs used for catalog handling, data handling and job control, and also the standard file names corresponding to commonly used files on peripheral devices.
The maintenance part contains various programs used for system maintenance and trouble shooting.
At last the Basic System Software package includes the **Screen Editor** and the **TTY-Emulator**. The Screen Editor is a editor that is well-suited for writing and editing source programs and is operated much like a word processer, but without advanced facilities for printer handling and formatting. The TTY-Emulator is a program that enables applications intended for teletype devices to use 3270 format oriented devices.

RC9000-10 BOSS

BOSS is primarily an efficient batch operating system, enhanced with facilities for program development. Resources are allocated dynamically, and jobs are scheduled according to resource consumption and duration.
Text files and thereby jobs can be manipulated by means of the BOSS editor commands, which work on the current edit file, i.e. the file currently connected to the terminal.
BOSS can be set up to suit individual requirements be edition of an option file. It is possible to configure BOSS to meet the specific demands of your installation regarding performance and so forth.

RC9000-10 Compiler Collection

The Compiler Collection Software package consist of three different compilers and an assembler for the RC9000-10. The compilers are ALGOL, FORTRAN and Pascal.

The **ALGOL** compiler is based upon the definition of ALGOL 60, but has been extended with facilities for programming of such basic software as operating systems.
Two software packages contain useful liberies for the ALGOL programmer: The ALGOL Text Procedures, for text handling, and the ALGOL Coroutine System, for scheduling of coroutines and message communication.
The runtime system of ALGOL and FORTRAN is the same, and will be linked into the translated program, almost as an external procedure. When conforming to certain rules, it is also possible to link external FORTRAN procedures to ALGOL programs.

The RC FORTRAN Compiler presents a FORTRAN version close to ISO FORTRAN. There are a number of limitations, as compared to the ISO standard, but there are extensions as well.
The limitations concern mainly the use of local variables, and some less used areas, which have not been implemented. The extensions concern the character set, the possibility of having 48-bit integers, masking and shifting operations, zone and record handling procedures, and more.
The RC9000-10 Compiler Collection also includes a XFORTRAN pre-processor that transforms programs written in a subset of FORTRAN IV (ANSI FORTRAN) into RC FORTRAN.
The **Pascal** Compiler for RC9000-10 has been implemented according to the ISO Pascal standard.

The Pascal Compiler comprises the compiler itself, as well as some utility programs for formatting pascal source programs and for generating cross reference listnings.
The Pascal Compiler further entails a facility for performance measurements, i.e. for making a listning of routines called in a program, the number of times called, and some time measurements.

The RC9000-10 Compiler Collection holds **SLANG** the symbolic assembler for RC9000-10 and some utility programs for this assembler.

The RC9000-10 Compiler Collection contains the following elements:

- ALGOL Compiler
- ALGOL Text Procedures
- ALGOL Coroutines
- Backing Storage Libery
- Database Libery
- Math./Statistics Libery
- FORTRAN
- XFORTRAN Preprocressor
- PASCAL
- SLANG Assembler

RC9000-10 Graphics Support

The Graphics Support software package is a ported software package called UNIGKS. UNIGKS is an implementation of the International Standard Graphics Kernel System (GKS version 7.2 of level 2b.)
UNIGKS is a FORTRAN (ISO FORTRAN) subroutine libery that provides handling of several graphical devices simultanously. UNIGKS is based upon the European Software Contractors implementation of GKS. The subroutines can be used both in FORTRAN and ALGOL programs. The documentation for software package contains a description of some minor syntactical differences between the RC- implemetation and GKS as known on e.g. a VAX.

RC9000 Product List

Systems

Sales no.	Available week	Product description
RC9000C-L	05.89	RC9000C Low model, Including: - RC9000-10 Processing Unit - RC9210 Disk Control Module - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive - RC9250 Tape Unit, horizontal - RC9310 Local Device Control Unit - F901-1 Low cabinet with side doors - F901-2 Low cabinet extension - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console
RC9000C-H	05.89	RC9000C High model, Including: - RC9000-10 Processing Unit - RC9210 Disk Control Module - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive - RC9255 Tape Unit, vertical - RC9310 Local Device Control Unit - F902-1 High cabinet with side doors - F902-2 High cabinet extension - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console
RC9000MR-L	22.89	RC9000MR Low model, Including: - RC9000-30 Dual RISC Processing Unit - RC9210 Disk Control Module - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive - RC9250 Tape Unit, horizontal - RC9310 Local Device Control Unit - F901-1 Low cabinet with side doors - F901-2 Low cabinet extension - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console
RC9000MR-H	22.89	RC9000MR High model, Including: - RC9000-30 Dual RISC Processing Unit - RC9210 Disk Control Module - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive - RC9255 Tape Unit, vertical - RC9310 Local Device Control Unit - F902-1 High cabinet with side doors - F902-2 High cabinet extension - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console

RC9000FT-L	31.89	RC9000FT Low model, Including: - RC9000-40 Dual RISC Processing Unit ×2 - RC9210 Disk Control Module ×2 - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive ×2 - RC9250 Tape Unit, horizontal - RC9310 Local Device Control Unit - F901-1 Low cabinet with side doors - F901-2 Low cabinet extension ×2 - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console ×2
RC9000FT-H	31.89	RC9000FT High model, Including: - RC9000-40 Dual RISC Processing Unit ×2 - RC9210 Disk Control Module ×2 - RC9220 Tape Control Module - RC9230 8" 850 MB Disk Drive ×2 - RC9255 Tape Unit, vertical - RC9310 Local Device Control Unit - F902-1 High cabinet with side doors - F902-2 High cabinet extension - F908 Mounting Chassis for RC9310 - M45-011-08 RC45 System Console ×2

Processing Units

Sales no.	Available week	Product description
RC9000-10	05.89	RC9000-10 Processing Unit, Incl: - RC8500 RC8000 Compatible CPU/FPU - RC9110 6 (8) Mb Main Memory - RC9140 System Support Processor - RC9142 Floppy Disk Module for RC9140 - RC9120 I/O Channel Controller - RC9130 RcLAN Controller - Processing unit chassis with power supply
RC9000-30	22.89	RC9000-30 Dual RISC Processing Unit, Incl: - RC9010 RISC CPU ×2 - RC9110 8 Mb Main Memory - RC9140 System Support Processor - RC9142 Floppy Disk Module for RC9140 - RC9120 I/O Channel Controller - RC9130 RcLAN Controller - SW9001 TX Operating System - Processing unit chassis with power supply
RC9000-40	31.89	RC9000-40 Dual RISC Processing Unit, Incl: - RC9010 RISC CPU ×2 - RC9110 8 Mb Main Memory - RC9140 System Support Processor - RC9142 Floppy Disk Module for RC9140 - RC9120 I/O Channel Controller - RC9130 RcLAN Controller - RC9135 SIB Interface Module - SW9001 TX Operating System - Processing unit chassis with power supply

Processing Unit Modules

Sales no.	Available week	Product description
RC8500	05.89	RC8000 Compatible CPU/FPU
RC9010	22.89	MIPS R2000 based RISC CPU
RC9110	05.89	Main memory module, 8 Mb
RC9112	05.89	Main memory module, 16 Mb
RC9120	05.89	I/O Channel Controller (IPI-III)
RC9130	05.89	RcLAN Controller
RC9135	31.89	SIB-bus Interface Module
RC9140	05.89	System Support Processor
RC9142	05.89	Floppy Disk Module for RC9140
F911	05.89	Power Supply Module (+ 5V/40A)
F920	22.89	RC9000-10 to RC9000-30 upgrade
F921	31.89	RC9000-30 to RC9000-40 upgrade
F930	05.89	Ethernet option *For RC9130 RcLAN Controller*
F931	05.89	RC Micronet option *For RC9130 RcLAN Controller*

Storage Devices

Sales no.	Available week	Product description
RC9210	05.89	Disk Control Module *Incl. CF941-3 IPI cable*
RC9220	05.89	Tape Control Module *Incl. CF941-3 IPI cable*
RC9230	05.89	8" 850 MB Disk Drive *Incl. SMD A and B cables*
RC9235	05.89	9" 1.4 GB Disk Drive *Incl. SMD A and B cables*

RC9250	05.89	Tape Unit, horizontal *Incl. Pertec interface cables* *For mounting in F901, low cabinets only*
RC9255	05.89	Tape Unit, vertical *Incl. Pertec interface cables* *For mounting in F902, high cabinets only*
F905	05.89	Mounting Chassis for 2×RC9230
F906	05.89	Mounting Chassis for 2×RC9235

Communication modules

Sales no.	Available week	Product description
RC9310	05.89	Local Device Control Unit *RcLAN Attached control unit for max. 8 asynchronous devices and one parallel printer* *Incl. SW9310 Async Terminal Control Program*
RC9320	05.89	Direct Line Interface for RC9310 *Non switching interface module for RC9310*
RC9325	05.89	Direct Line Interface for RC9330 *Non switching interface module for one F935/F936 slot position in each of the RC9330 FrontEnds in a F909 Mounting Chassis.*
RC9330	14.89	Communication FrontEnd *FrontEnd with room for 3 line controllers* *Incl. SW9330 Basis SW and basic X.25 protocol*
F908	05.89	Mounting Chassis for RC9310 *The mounting chassis has slots for max. 5 RC9310s.* *Incl. power cables*
F909	14.89	Mounting Chassis for RC9330 *The mounting chassis has slots for max. 3 RC9330s.* *Incl. power cables*
F932	05.89	Ethernet interface for RC9310
F935	14.89	4 Channel V.24 Line Controller for RC9330
F936	14.89	4 Channel X.21 Line Controller for RC9330

Printers

Sales no.	Available week	Product description
RC632U	Now	Laser printer, HP LaserJet series II *Printing speed: 8 pages/minute.* *Incl. original HP documentation.* *Excl. cable.*
RC640U	Now	Laser printer, HP LaserJet 2000 *Printing speed: 20 pages/minute.* *Incl. Duplex print, large paper storage, 3.5 Mb memory and original HP documentation.* *Excl. Interface and cable.*
RC650P	Now	Heavy Duty Matrix Printer *Printing speed: 800/600 lines/minute.* *Incl.: Documentation, parallel interface and a cable (5m).*

Accessories for Printers

Sales no.	Available week	Product description
TF268	Now	Serial Interface for RC650P *Incl. cable.*
TF269	Now	Intelligent Graphics Processor for RC650P
TF270	Now	1 Mb Memory expansion for RC632U
TF271	Now	2 Mb Memory expansion for RC632U
TF272	Now	4 Mb Memory expansion for RC632U
TF273	Now	Parallel interface for RC640U *Incl. cable: TF676-S*
TF274	Now	Serial interface for RC640U *Incl. cable: TF686-S*

Cabinets

Sales no.	Available week	Product description
F901-1	05.89	Low cabinet with 2 side covers *Incl. main supply connectors and one 3 channel status display*
F901-2	05.89	Low cabinet extension (w/o side covers) *Incl. main supply connectors and one 3 channel status display*

F902-1	05.89	High cabinet with 2 side covers *Incl. main supply connectors and one 4 channel status display*
F902-2	05.89	High cabinet extension (w/o side covers) *Incl. main supply connectors and one 4 channel status display*

Cables

Sales no.	Available week	Product description
TF676S	Now	Printer Cable, 5 meters *Cable for parallel connection of RC632U, RC640U and RC650P printers*
TF676M	Now	Printer Cable, 12 meters *Cable for parallel connection of RC632U, RC640U and RC650P printers*
TF676L	Now	Printer Cable, 25 meters *Cable for parallel connection of RC632U, RC640U and RC650P printers*
TF663S	Now	Sync. V.24 DCE Cable, 5 meters *Cable for V.24 communication on RC9310 host port*
TF663M	Now	Sync. V.24 DCE Cable, 12 meters *Cable for V.24 communication on RC9310 host port*
TF663L	Now	Sync. V.24 DCE Cable, 25 meters *Cable for V.24 communication on RC9310 host port*
TF666XS	Now	Sync. X.21 DCE Cable, 5 meters *Cable for X.21 communication on RC9310 host port*
TF666XM	Now	Sync. X.21 DCE Cable, 12 meters *Cable for X.21 communication on RC9310 host port*
TF666XL	Now	Sync. X.21 DCE Cable, 40 meters *Cable for X.21 communication on RC9310 host port*
TF686S	Now	Async. Serial Device Cable, 5 meters *Cable for serial connection of RC632U and RC640U printers and RC45 terminals.*
TF686M	Now	Async. Serial Device Cable, 12 meters *Cable for serial connection of RC632U and RC640U printers and RC45 terminals.*
TF686L	Now	Async. Serial Device Cable, 25 meters *Cable for serial connection of RC632U and RC640U printers and RC45 terminals.*

TF687S	Now	Async. Serial Modem Cable, 5 meters *Cable for serial connection of modem to RC9310.*
TF687M	Now	Async. Serial Modem Cable, 12 meters *Cable for serial connection of modem to RC9310.*
TF687L	Now	Async. Serial Modem Cable, 25 meters *Cable for serial connection of modem to RC9310.*
TF690S	Now	VT200 Async. Serial Device Cable, 5 meters *Cable for serial connection of VT200 compatible terminals.*
TF690M	Now	VT200 Async. Serial Device Cable, 12 meters *Cable for serial connection of VT200 compatible terminals.*
TF690L	Now	VT200 Async. Serial Device Cable, 25 meters *Cable for serial connection of VT200 compatible terminals.*

Cables for Storage Devices

Sales no.	Available week	Product description
CF940-1	05.89	Dual Access Disk Cables, 0.6 m *Additional SMD A and B cables for attaching disk drive to a second disk control module*
CF940-2	05.89	Dual Access Disk Cables, 1.2 m *Additional SMD A and B cables for attaching disk drive to a second disk control module*
CF941-1	05.89	I/O Channel Cable (IPI-III), 0.25 m
CF941-2	05.89	I/O Channel Cable (IPI-III), 0.6 m
CF941-3	05.89	I/O Channel Cable (IPI-III), 1.2 m
CF941-4	05.89	I/O Channel Cable (IPI-III), 1.6 m
CF941-5	05.89	I/O Channel Cable (IPI-III), 2.0 m
CF941-6	05.89	I/O Channel Cable (IPI-III), 5.0 m

Accessories and Cables for LAN

Sales no.	Available week	Product description
MF107	Now	RcMicronet Transceiver
MF117	Now	Thin Ethernet Transceiver

MF124	Now	RcMicronet Transceiver Cable, 5 m
MF125	Now	RcMicronet Transceiver Cable, 12 m
MF126-1	Now	2 m COAX-cable with BNC connector
MF126-2	Now	4 m COAX-cable with BNC connector
MF126-3	Now	8 m COAX-cable with BNC connector
MF126-4	Now	16 m COAX-cable with BNC connector
MF126-5	Now	32 m COAX-cable with BNC connector
MF128C	Now	BNC Male Connector
MF128M	Now	BNC Interconnector
MF128T	Now	BNC T-Connector
MF129	Now	200 meters COAX-Cable
MF134	Now	Ethernet/Thin Ethernet Transceiver Cable, 5 m *One connector with snap-lock and one with screws*
MF135	Now	Ethernet/Thin Ethernet Transceiver Cable, 12 m *One connector with snap-lock and one with screws*
MF137	Now	Thin Ethernet Terminator ×2
MF138	Now	Multiport Ethernet/Thin Ethernet Transceiver
MF139	Now	Multiport Thin Ethernet Repeater
MF154	Now	Ethernet/Thin Ethernet Transceiver Cable, 5 m *For snap-lock mounting at both ends*
MF155	Now	Ethernet/Thin Ethernet Transceiver Cable, 12 m *For snap-lock mounting at both ends*

RC9000 Software

Transaction Executive Operating System

Sales no.	Available week	Product description
SW9001I	22.89	TX Operating System, Incl: *TX System Administrator's Manual Set* *TX User's Manual Set* *TX Programmer's Manual Set* *Delivered with RC9000-30/40 PU*

Utilities

Sales no.	Available week	Product description
SW9101I	22.89	RcDialog *Incl. documentation.*

Database Management Systems

Sales no.	Available week	Product description
SW9201I	22.89	C-ISAM File Access Method *Incl. documetation*
SW9210I	26.89	INFORMIX-4GL *Application Development Language* *Incl. documentation*
SW9211I	26.89	INFORMIX-4GL *Run Time System*
SW9212I	26.89	INFORMIX-SQL *Data Base Management System* *Incl. documentation*
SW9213I	26.89	INFORMIX-SQL *Run Time System*
SW9214I	26.89	INFORMIX-ESQL C *Embedded SQL & tools for C*
SW9215I	26.89	INFORMIX-ESQL C *Run Time System*

Communication

Sales no.	Available week	Product description
SW9310I	05.89	Async Terminal Control Program, Rel.1.0 *Delivered with RC9310*
SW9311I	22.89	3270 Terminal Support for RC9310, Rel.1.0 *Incl. 3270/VT200 conversion facility*
SW9315I	05.89	SNA/SDLC/QLLC Remote Host Support *Enables use of hostline from RC9310*
SW9316I	05.89	X.25 DTE Support *Enables X.25 communication from RC9310*
SW9330I	05.89	Basic RC9330 Communication Front-End SW *Incl. X.25 protocol* *Delivered with RC9330*
SW9335I	05.89	X.29 Host facility *X.29 host support for RC9330*
SW9336I	05.89	3270 SNA Subhost for RC9330 *Incl: SDLC/V.24/X.21 protocol and X.25/QLLC*

Compilers for TX

Sales no.	Available week	Product description
SW9401I	22.89	COBOL-85 *Run Time & Development* *Incl. documentation*
SW9402I	22.89	COBOL-85 *Run Time System only*
SW9410I	22.89	FORTRAN-77 *Run Time & Development* *Incl. documentation*
SW9420I	22.89	PASCAL *Run Time & Development* *Incl. documentation*
SW9430I	22.89	PL/I *Run Time & Development* *Incl. documentation*
SW9431I	22.89	PL/I *Run Time System only*

SW9490I	22.89	DBX Symbolic Debugger

RC9000-10 Software

Sales no.	Available week	Product description
SW9800	05.89	RC9000-10 Basic System Software *Monitor* *System Utility* *Screen Editor* *TAS* *TTY-Emulator* *Incl. documentation*
SW9802I	05.89	RC9000-10 BOSS
SW9805	05.89	RC9000-10 Compiler Collection *ALGOL* *Database libery* *Backing storage libery* *Math./statistics libery* *ALGOL text procedures* *ALGOL coroutines* *FORTRAN* *XFORTRAN* *PASCAL* *Assembler* *Incl. documentation*
SW9822I	26.89	RC9000-10 Graphics Support *UNIGKS* *Incl. documentation*

Separate Documentation

System Documentation

Sales no.	Available week	Product description
SW9901I-D	22.89	RC9000 TX System Overview, Incl: *General Introduction To The RC9000 System* *The TX Operating System*
SW9910I-D	05.89	RC9000-10 System Overview, Incl: *General Introduction To The RC9000 System* *RC9000-10 System Software*
SW9911I-D	05.89	RC9000-10 System Administrator's Guide

TX Documentation

Sales no.	Available week	Product description
SW9001I-D	22.89	TX Operating System Documentation, Incl: *TX System Administrator's Manual Set* *TX User's Manual Set* *TX Programmer's Manual Set*
SW9902I-D	22.89	TX System Administrator's Manual Set, Incl: *Site Management Guide* *System Manager's Reference* *System Messages Manual* *Software Troubleshooting Guide* *Hardware Troubleshooting Guide* *Software Installation Guide*
SW9903I-D	22.89	TX User's Manual Set *TX User's Reference Manual*
SW9904I-D	22.89	TX Programmer's Manual Set *TX Programmer's Reference Manual* *TX Programmer's Guide* *TX System V Reference Manual*

Utility Documentation

Sales no.	Available week	Product description
SW9101I-D	22.89	RcDialog Documentation

Database Management Systems Documentation

Sales no.	Available week	Product description
SW9201I-D	22.89	C-ISAM File Access Documentation
SW9210I-D	26.89	INFORMIX-4GL Documentation
SW9212I-D	26.89	INFORMIX-SQL Documentation
SW9214I-D	26.89	INFORMIX-ESQL C Documentation *Embedded SQL & tools for C*

Communication Documentation

Sales no.	Available week	Product description
SW9311I-D	22.89	3270/VT200 Conversion facility *User's Guide*

Compilers for TX Systems, Documentation

Sales no.	Available week	Product description
SW9401I-D	22.89	COBOL-85 Manual Set *Run Time & Development*
SW9410I-D	22.89	FORTRAN-77 Manual Set *Run Time & Development*
SW9420I-D	22.89	PASCAL Manual Set *Run Time & Development*
SW9430I-D	22.89	PL/I Manual Set *Run Time & Development*
SW9490I-D	22.89	DBX Symbolic Debugger Manual Set

RC9000-10 Software Documentation

Sales no.	Available week	Product description
SW9890I-D	05.89	Monitor Manual set *5 titles in English*
SW8010I-D	05.89	System Utility Manual set *3 titles in English*

SW8020-D	05.89	Screen Editor Reference Manual *1 title in Danish*
SW8110-D	05.89	TAS Manual set *5 titles in Danish*
SW8232-D	05.89	TTY-Emulator Manual set *2 titles in Danish*
SW8101I-D	05.89	RC9000-10 BOSS Manual Set *BOSS User's Guide* *BOOS Operating Guide* *BOOS Installation And Maintenance*
SW8585-D	05.89	Compiler Collection Manual set Including: ALGOL Manual Set *3 titles in English* Database Library Manual set *3 titles in English* Backing Storage Library Manual set *4 titles in English* Math./statistics Reference Manual *1 title in English* ALGOL Text Procedures User's Guide *1 title in English* ALGOL Coroutines Manual set *2 titles, 1 in English and 1 in Danish* FORTRAN User's Manual *1 title in English* XFORTRAN Manual *1 title in English* PASCAL User's Guide *1 title in English* Assembler Manual set *4 titles in English*
SW8222I-D	26.89	UNIGKS Manual Set *6 titles in English*

RC9000 Processing Unit

RC9000-10

The RC9000-10 is a high performance processing unit equipped with a processor that is compatible with the existing series of RC8000 minicomputers. Through the use of the most modern technology in the design of the central processor and the use of the same high performance controllers as the RISC based RC9000 processing units, the RC9000-10 Processing Unit is fully competitive with todays minicomputers.

Characteristics

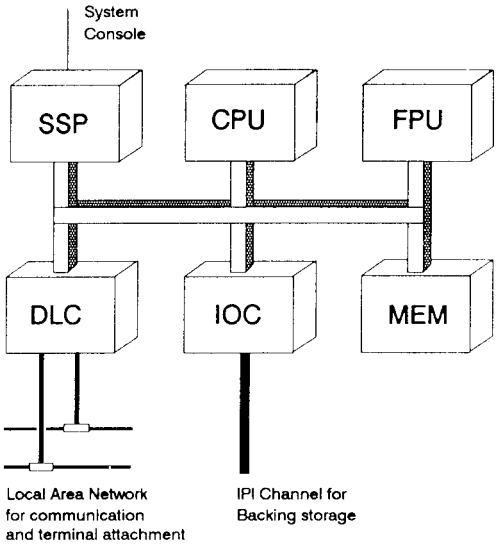
- 24 bit CPU with cache floating point unit
- 8 Megabyte memory with error correction
- Independent System Support Processor
- Dual port Local Area Network controller
- High performance I/O channel for backing storage
- Modular design covering both interface boards and main processor boards
- Compact mounting chassis with power supply modules

Product Description

The RC9000-10 Processing Unit is build around a mounting chassis, which is designed for mounting in the RC9000 Cabinets. The mounting chassis has on the front side 16 slots for the main modules. Through a backplane, which holds the system bus, the main modules has connections to the interface boards located on the rear side of the chassis along with the power supply modules. The mounting chassis is equipped with fans to ensure the nessesary airflow that will maintain a correct operating temperature inside the chassis.

The RC9000-10 Processing Unit is equipped with the following main modules:

- RC8500 CPU/FPU
- RC9110 6 (8) Megabyte Memory
- RC9140 System Support Processor
- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller



RC9000-10 Processing Unit

The RC8500 is the central processor and is the only module that differs RC9000-10 from the greater RISC-based RC9000-30 processing unit. Through the backplane in the mounting chassis the I/O Channel controller has connections to a interface board with a IPI-III channel for backing storage devices. The RcLAN controller has connection to an interface board with a build-in tranceiver for Thin Ethernet. This interface board may as an option be replaced by an interface board for a separate tranceiver for either RC Micronet or Ethernet.

The 16 slots for main modules makes it posible to add 3 extra RC8500 CPU/FPUs to the RC9000-10 Processing Unit in order to increase the processing capacity. Free slots may also be used for additional controllers if the need is not processing capacity but for example high bandwidth for terminal traffic.

Product application

The RC9000-10 Processing Unit is the central component of RC9000 systems that has compatibility with the RC8000 minicomputer. The high reliabilty known from the RC8000 series is maintained in the RC9000-10 due to the use of special designed chips and the processing capacity is compared to the RC8000-55 model increased about 4 times. If the RC9000-10 is fully equipped with four RC8500 CPU/FPUs the processing capaity will be about 10 times the capacity of an RC8000-55.

Mounted in a RC9000 Cabinet along with disk drives, disk control modules, communication control units and eventually a tape unit with is control unit, the RC9000-10 has the nessesary processing capacity to take advantage from these high performance devices. The possibility to add RC8500 CPU/FPUs and memory modules gives the RC9000-10 a growth potential that satisfies even the most demanding requirement for processing capacity. If processing capacity is not the key factor, the RC9000-10 may be extended with additional I/O controllers or RcLAN controller in order to tune the system for maximum performance.
Overall the RC9000-10 is an excellent starting point for a minicomputer system with very flexible oppurtunities for upgrading.

Documentation

Introductionary documentation about RC9000-10 is part of "RC9000C System Overview" (SW9910I-D).
Configuration and operation is described in "RC9000-10 System Administrator's Guide" (SW9911-D).

RC9000-10

Main Modules
RC8500 CPU/FPU
RC9110 6 (8) Megabyte Memory
RC9140 System Support Processor
RC9142 SSP Floppy Disk Module
RC9120 Input/Output Channel Controller
RC9130 RcLAN Controller

Interface Modules
Thin-wire Ethernet RcLAN Interface Module, including tranceiver.
IPI-III Interface Module
System Support Processor interface module

Power Supplies
SSP Power Supply Module
2 × +5V/40A Power Supply Module
1 × ±12V/4A Power Supply Module

Main Power supply
3 × 1 phase, neutral and ground.
Cables for attaching RC9000-10 to main power distribution connectors in RC9000 Cabinet are included.

Mechanics
Processing Unit mounting chassis for 19" rack mounting, including all mounting fittings.

RC9000 Processing Unit

RC9000-30

The RC9000-30 is a ultra high performance processing unit equipped with two RC9010 RISC Processor Modules and delivered with the advanced UNIX-based TX operating system. The UNIX™ compatibility opens up the fastest growing area of applications and application development tools and the RC9000-30 RISC processors burst the performance from these applications far beyond the limits of most minicomputers.

Characteristics

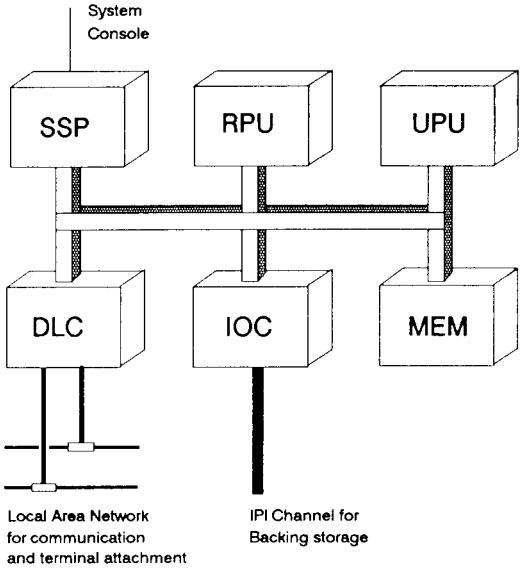
- Two RISC Processor Modules yelding 22 Mips
- Enhanced UNIX-based TX Operating System
- 8 Megabyte memory with error correction
- Independent System Support Processor
- Dual port Local Area Network controller
- 10 Mbytes/sec High performance I/O channel for backing storage
- Modular design covering both interface boards and main processor boards
- Compact mounting chassis with power supply modules

Product Description

The RC9000-30 Processing Unit is build around a mounting chassis, which is designed for mounting in the RC9000 Cabinets. The mounting chassis has on the front side 16 slots for the main modules. Through a backplane, which holds the system bus, the main modules has connections to the interface boards located on the rear side of the chassis along with the power supply modules. The mounting chassis is equipped with fans to ensure the nessesary airflow that will maintain a correct operating temperature inside the chassis.

The RC9000-30 Processing Unit is equipped with the following main modules:

- RC9010 RISC Processor Module ×2
- RC9110 8 Megabyte Memory
- RC9140 System Support Processor



RC9000-30 Processing Unit

- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller

Through the backplane in the mounting chassis the I/O Channel controller has connections to a interface board with a IPI-III channel for backing storage devices. The RcLAN controller has connection to an interface board with a build-in tranceiver for Thin Ethernet. This interface board may as an option be replaced by an interface board for a separate tranceiver for either RC Micronet or Ethernet.

The 16 slots for main modules makes it posible to add extra memory up to 128 Mbyte and extra controllers. The oppurtunity to add extra modules makes it possible to increase the system performance only in those parts that limits the performance.

Product application

The RC9000-30 Processing Unit is the central component of the single processing unit RISC-based RC9000 systems.
In combination with the rest of the RC9000 product program, the RC9000-30 gives very flexible oppurtunities to compose a processing unit that corresponds to the actual application task.

The RC9000-30 Processing Unit must be mounted in a RC9000 Cabinet and attached to minimum one disk

drive through a RC9210 Disk Control Module. The RcLAN Controller must be attached to a RcLAN local area network that provides terminals with access to the processing unit via communication control units like the RC9310 Local Device Control Unit.

Documentation

Introductionary documentation about RC9000-30 is part of "RC9000 TX System Overview" (SW9901I-D). Configuration and operation is described in the TX documentation, which consist of:

- "TX System Administrator's Manual Set"
- "TX User's Manual Set"
- "TX Programmer's Manual Set"

RC9000-30

Software
SW9001 TX Operating System

Main Modules
RC9010 RISC Processing Module
RC9110 8 Megabyte Memory
RC9140 System Support Processor
RC9142 SSP Floppy Disk Module
RC9120 Input/Output Channel Controller
RC9130 RcLAN Controller

Interface Modules
Thin-wire Ethernet RcLAN Interface Module, including tranceiver.
IPI-III Interface Module
System Support Processor interface module

Power Supplies
SSP Power Supply Module
2 × +5V/40A Power Supply Module
1 × ±12V/4A Power Supply Module

Main Power supply
3 × 1 phase, neutral and ground.
Cables for attaching RC9000-30 to main power distribution connectors in RC9000 Cabinet are included.

Mechanics
Processing Unit mounting chassis for 19" rack mounting, including all mounting fittings.

RC9000 Processing Unit

RC9000-40

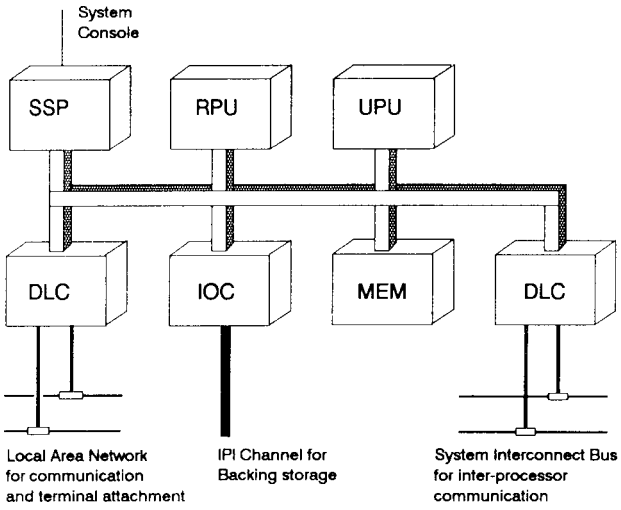
The RC9000-40 Processing Unit is as the RC9000-30 a high performance processing unit equipped with two RC9010 RISC Processor Modules, but is further more equipped with a SIB-bus Interface Module for interconnection of multiple processing units. The RC9000-40 is delivered with the advanced UNIX-based TX operating system, which is specially designed to handle a distributed system environment with loosely coupled processing units.

Characteristics

- Two RISC Processor Modules yelding 22 Mips
- Enhanced UNIX-based TX Operating System
- SIB-bus Interface Module for interconnecting processing units
- 8 Megabyte memory with error correction
- Independent System Support Processor
- Dual port Local Area Network controller
- 10 Mbytes/sec high performance I/O channel for backing storage
- Modular design covering both interface boards and main processor boards
- Compact mounting chassis with power supply modules

Product Description

The RC9000-40 Processing Unit is build around a mounting chassis, which is designed for mounting in the RC9000 Cabinets. The mounting chassis has on the front side 16 slots for the main modules. Through a backplane, which holds the system bus, the main modules has connections to the interface boards located on the rear side of the mounting chassis along with the power supply modules. The mounting chassis is equipped with fans to ensure the nessesary airflow that will maintain a correct operating temperature inside the chassis.



RC9000-40 Processing Unit

The RC9000-40 Processing Unit is equipped with the following main modules:

- RC9010 RISC Processor Module ×2
- RC9110 8 Megabyte Memory
- RC9140 System Support Processor
- RC9142 SSP Floppy Disk Module
- RC9120 Input/Output Channel Controller
- RC9130 RcLAN Controller
- RC9135 SIB-bus Interface Module

Through the backplane in the mounting chassis the I/O Channel controller has connections to a interface board with a IPI-III channel for backing storage devices. The RcLAN controller has connection to an interface board with a build-in tranceiver for Thin Ethernet. This interface board may as an option be replaced by an interface board for a separate tranceiver for either RC Micronet or Ethernet.

The 16 slots for main modules makes it posible to add extra memory up to 128 Megabyte and extra controllers. The oppurtunity to add extra modules makes it possible to increase the system performance only in those parts that limits the performance.

Product application

The RC9000-40 Processing Unit is the central component of the RISC-based RC9000 systems with multiple processing units.

In combination with the rest of the RC9000 product program, the RC9000-40 gives very flexible oppurtunities to compose a processing unit that corresponds to the actual application task.
The RC9000-40 Processing Unit must be mounted in a RC9000 Cabinet and attached to minimum one disk drive through a RC9210 Disk Control Module. The RcLAN Controller must be attached to a RcLAN local area network that provides terminals with access to the processing unit via communication control units like the RC9310 Local Device Control Unit.
The RC9135 SIB-bus Interface Module must be connected to a dual Thin-wire Ethernet which has connection to the other RC9000-40 Processing Units that constitutes the actual RC9000 installation.

Documentation

Introductionary documentation about RC9000-40 is part of "RC9000 TX System Overview" (SW9901I-D).
Configuration and operation is described in the TX documentation, which consist of:

- "TX System Administrator's Manual Set"
- "TX User's Manual Set"
- "TX Programmer's Manual Set"

RC9000-40

Software
SW9001 TX Operating System

Main Modules
RC9010 RISC Processing Module
RC9110 8 Megabyte Memory
RC9140 System Support Processor
RC9142 SSP Floppy Disk Module
RC9120 Input/Output Channel Controller
RC9130 RcLAN Controller
RC9135 SIB-bus Interface Module

Interface Modules
Thin-wire Ethernet RcLAN Interface Module, including tranceiver.
Thin-wire Ethernet SIB-bus Interface Module, including tranceiver
IPI-III Interface Module
System Support Processor interface module

Power Supplies
SSP Power Supply Module
2 × +5V/40A Power Supply Module
1 × ±12V/4A Power Supply Module

Main Power supply
3 × 1 phase, neutral and ground.
Cables for attaching RC9000-40 to main power distribution connectors in RC9000 Cabinet are included.

Mechanics
Processing Unit mounting chassis for 19" rack mounting, including all mounting fittings.

RC8000 Compatible Processor Module

RC8500

The RC8500 is a high performance processor module which is instruction set compatible with the existing line of RC8000 CPUs. Implemented by means of a CMOS gate array and LSI TTL-logic, the RC8500 yields about 4 million instructions per second which is four times the performance of the RC8000/55 CPU.

Characteristics

- 24-bit pipelined CPU with floating point unit (FPU)
- 100 nsec cycle time
- 4 Kwords instruction cache
- 4 Kwords data cache
- Store through updating and snooping for cache consistency
- High performance system bus interface
- Estimated performance: 4 Mips

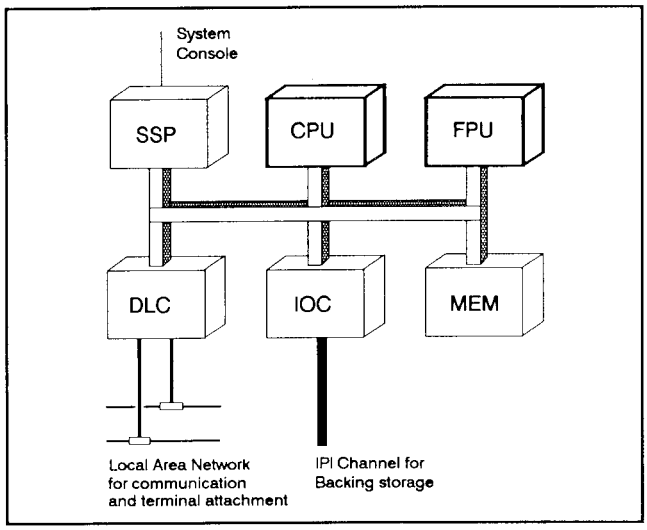
Product Description

The RC8500 processor module is instruction set compatible with the existing line of RC8000 CPUs. The central part of the CPU, i.e. register set, ALU, address calculation unit and the memory protection system, is implemeted by means of a CMOS gate array with approximately 8000 gates. The control functions are implemented with LSI and MSI TTL-logic.

Instructions are executed in a three stage pipeline: instuction fetch, address caculation and instuction execution. The separate intruction and data caches ensures that both instuction and data can be fetched within the same clock cycle.
The caches are direct mapped, and cache consistency is ensured by store-through and bus snooping.

The floating point unit (FPU) is located on a separate board which is connected directly to the CPU board through a special high speed bus.

A 24-bit word occupies a 32-bit memory location in RC9000 memory. Eight bits of each 32-bit memory word are unused in the Processing Unit.



The peak performance is 8 Mips, while the sustained performance consisting of a typical instuction mix, is 4 Mips.

Product application

The RC9000-10 Processing Units in the RC9000 Computer System contains one RC8500 processor module. In order to increase the performance the RC9000-10 Processing Unit may be equipped with up to four RC8500 Processor Modules in a tightly coupled configuration. Each added RC8500 Processor Module will increase the performance with approximately half of its own capacity, i.e. 2 mips.

The RC8500 Processor Module is accessible from the front of the processing unit subrack in order to allow easy replacement.

Documentation

Configuration and operation is described in "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000-10 Processing Unit.

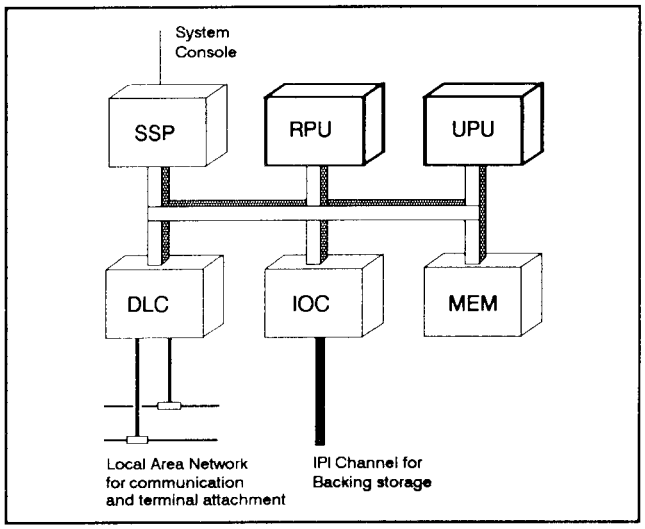
RC8500 Specifications

Architecture	Custom designed gate array
Chip technology	CMOS, TTL
Word length	24 bits
Registers	4 working registers
Address space	8 Mega words
Base address blocks	4 Kbytes
Instruction cache	4 Kwords, direct mapped
Data cache	4 Kwords, direct mapped
Data cache consistency	store-through, snooping
Cycle time	100 ns
Peak performance	10 Mips
Sustained performance	4 Mips
Floating point	
add	3.5 µsec
Subtract	3.5 µsec
Multiply	2.0 µsec
Divide	3.5 µsec
Power	+5V
Power consumption	
+5V	typ. 20 A
Mechanical outline	Triple Eurocard Size ×2
Dimensions	367 × 340 × 20 mm ×2

RISC Processor Module

RC9010

The RC9010 is a ultra high performance processor module based on a state of the art RISC chip set from MIPS Computer Systems Inc. Two RC9010 modules constitutes the main processor in the RC9000-30/40 Processing Units.



Characteristics

- 32-bit RISC architecture
- MIPS R2000 16.67 MHz RISC Processor
- MIPS R2010 Floating Point Coprocessor
- Demand paging virtual memory
- 64 Kbytes instruction cache
- 64 Kbytes data cache
- High performance system bus interface
- Data cache consistency by hardware
- Estimated performance: 11 Mips (native)

Product Description

The RC9010 RISC processor module is based upon the MIPS R2000 RISC processor and the R2010 floating point coprocessor, which together define the instruction set. The R2010 floating point coprocessor conforms to the ANSI/IEEE 754-1985 standard for floating point formats and precision. Both processors use a pipeline technique, and the execution of multi-cycle floating point instructions in the R2010 may overlap execution of ordinary instructions performed by the R2000 RISC processor. The Memory Management Unit inside the processor support demand paging virtual memory with a page size of 4 Kbytes.

The split instruction and data caches supply the RISC processor with the required instructions and data for load instructions at **full** speed. The negative effect of cache misses is minimized by employing large caches and by filling several words into a cache if a miss occurs. The MIPS R2020 write buffer captures data/address pairs from the store instructions so the processor can proceed without waiting for the actual writing to take place. The data in the write buffer is written into memory as an independant activity. Data cache consistency, which make the data cache tranparent in a multiprocessor and DMA based system like the RC9000, where several units operate on the same data, is ensured by store- through and bus snooping.
The peak performance is 16.67 Mips, while the sustained performance is 11 Mips, which translates into approximately 10 VAX 11/780™ equivalent Mips.

Product application

The RC9000-30/40 Processing Units in the RC9000 Computer System contains two RC9010 RISC processors modules. The use of two RC9010 Processor Modules is closely related to design of the kernel in the TX transaction Executive operating system where the real-time tasks are separated from the other application tasks.

The RC9010 Processor Module is accessible from the front of the processing unit subrack and may be replaced by the customer.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000-30/40 Processing Unit.

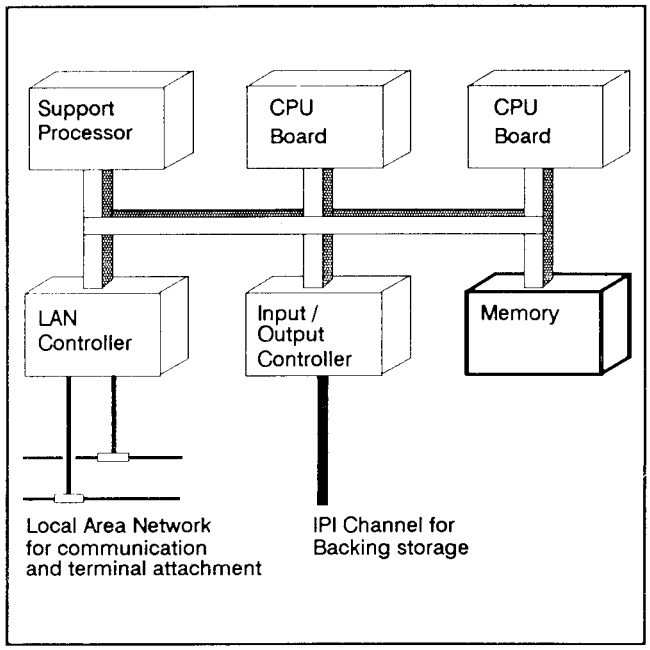
RC9010 Specifications

Architecture	MIPS RISC
Chip technology	CMOS
Word length	32 bits
Registers	32
Virtual address space	
Supervisor	4 Gbytes
User	2 Gbytes
Page size	4 Kbytes
Translation look-aside buffer	64 entries, fully associative
Instruction cache	64 Kbytes, direct mapped
Data cache	64 Kbytes, direct mapped
Data cache consistency	store-through, snooping
Cycle time	60 ns
Peak performance	16.67 Mips
Sustained performance	11 Mips
Floating point	
add, single precision	120 ns
add, double precision	120 ns
Subtract, single precision	120 ns
Subtract, double precision	120 ns
Multiply, single precision	240 ns
Multiply, double precision	300 ns
Divide, single precision	720 ns
Divide, double precision	1140 ns
Power	+5V, ±12V
Power consumption	
+5V	max. 21 A, typ. 14 A
+12V	max. 22 mA, typ. 10 mA
−12V	max. 20 mA, typ. 9 mA
Mechanical outline	Triple Eurocard Size
Dimensions	367 × 340 mm

8 Mbyte / 16 Mbyte Memory Module

RC9110 8 Mbyte Memory Module
RC9112 16 Mbyte Memory Module

The RC9110 and RC9112 Memory Modules are 8 Mbyte and 16 Mbyte memory modules respectively. These modules are designed to meet the requirements of fast access memory in order to support the RC9010 MIPS RISC processor.



Characteristics

- Data transfer rate up to 53 Mbyte/s
- Single bit error detection and correction
- Double bit error detection
- Read/write formats:
  - Byte
  - Word
  - Double word
  - Quad word
  - Octal word
- 64 bits of data in one access
- On board fast read-modify-write feature to handle byte writes.

Product Description

The RC9110 and RC9112 memory modules are designed with the fastest dynamic RAM chips commercial available at the market today. The RC9112 16 Mb module is a "double" version of the RC9110 8 Mb memory module.
In RC9110 the memory is organized in two banks of 32 bit $\times 1$ Mbit plus 7 Mbyte of check words.
In RC9112 the memory is organized in two banks of 2×32 bit $\times 1$ Mbit plus 2×7 Mbyte of check words.

Byte writes are performed as on-board fast read-modify-write operations.
The RC9110/2 memory modules are specially designed to handle RC9000-10 (RC8000 compatible) half-words as fast as half-word and bytes writes in systems equipped with the RC9010 MIPS RISC processor.

Product application

All RC9000 processing units must be equipped with at least one RC9110 8 Mbyte memory module, but may be upgraded with several more memory modules.

Both the RC9110 8 Mbytes and the RC9112 16 Mbyte Memory Module are mounted in the processing unit subrack from the front to allow easy replacement.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000 Processing Unit.

Specifications

RC9110 8 Mbyte Memory

Interfaces

System bus	Pipelined, 10 MHz
Address lines	32 bit
Data lines	64 bit

Memory

Size	8 Mbyte DRAM
Organization	2 × 32 × 1 Mbit banks
Error detection	
Check words	7 bit × 1 M
Single bit error	detection, correction
Correction time	100 ns
Double bit	detection
Detection time	0 ns

Performance

Byte write	16 Mbyte/sec
1 word or less, read	20 Mbyte/sec
1 word write	26 Mbyte/sec
2 word read or write	26 Mbyte/sec
4 word read or write	40 Mbyte/sec
8 word read or write	53 Mbyte/sec

Power

	+5V
Power consumption	max. 19 A / 95W

Mechanical outline

	Triple Eurocard Size
Dimensions	367x340x20 mm

RC9112 16 Mbyte Memory

Interfaces

System bus	Pipelined, 10 MHz
Address lines	32 bit
Data lines	64 bit

Memory

Size	16 Mbyte DRAM
Organization	2 × 2 × 32 × 1 Mbit banks
Error detection	
Check words	2 × 7 bit × 1M
Single bit error	detection, correction
correction time	100 ns
Double bit	detection
Detection time	0 ns

Performance

Byte write	16 Mbyte/sec
1 word or less, read	20 Mbyte/sec
1 word write	26 Mbyte/sec
2 word read or write	26 Mbyte/sec
4 word read or write	40 Mbyte/sec
8 word read or write	53 Mbyte/sec

Power

	+5V
Power consumption	max. 20 A / 100W

Mechanical outline

	Triple Eurocard Size
Dimensions	367x340x20 mm

Input/output Channel Controller

RC9120

The RC9120 is a high performance controller utilizing the the ANSI X3 Intelligent Peripheral Interface (IPI) standard for high performance data transfer between the RC9000 processing Unit and the disk and tape storage system.

Characteristics

- IPI level 0 and 1 voltage mode physical interface
- IPI level 3 Device Generic logical interface
- 10 Mbytes/s continous DMA transfer rate between processing unit main memory and IPI channel.
- 10 MHz Intel™ 80286 microprocessor architecture with independent access to main memory.

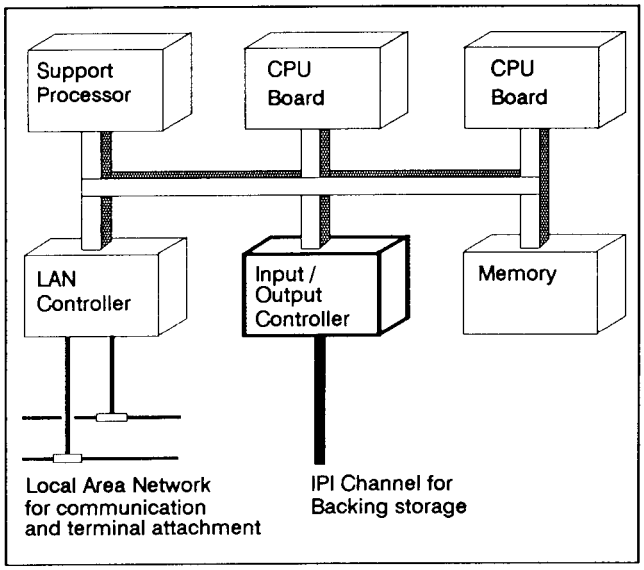
Product description

The RC9120 Input/output Controller establishes very fast standardized access to disk and tape storage via the ANSI Intelligent Peripheral Interface on a message packet structured basis.
The controller consists of a DMA block which allows continuous data transfer at the maximum rate for the IPI channel and a microcontroller block which interprets commands and controls communication.

The microcontroller block is based on a 10 MHz Intel™80286 microprocessor and 1 Mbyte banked memory utilizing zero wait states at consecutive addressing.
Independent system bus data interfaces allows the microcontroller to access the main memory in the processing unit simultaneously to DMA data transfer between the IPI channel and the main memory.
The RC9120 Input/output controller program is loaded into the RC9120 upon power up from the RC9140 System Support Processor which is allowed access to the entire memory located on the RC9120. Through this access to the RC9120 memory the RC9140 System Support Processor can also perform diagnostics and test of the RC9120 controller.

Product application

The RC9120 Input/output controller provides the RC9000 processing units with access to the backing storage devices.



Utilizing the IPI interface allows up to 8 disk or tape control modules to be attached to the I/O channel, each of these control modules interfacing to a number of disk drives or a tape unit.
Dual ported access to data storage is supported by the IPI standard and the software for RC9120.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000 Processing Unit.

Related products

Cables
CF941 IPI Cable.

RC9120 Specifications

Interfaces	
System bus	Pipelined, 10 MHz
IPI channel physical	level 0 and 1 (EIA485)
IPI channel logical	level 3
Magnetic/optical disks	X3.132
Magnetic tape	X3.147
Test and service	V.24 async
performance	
Continuous transfer rate, Data streaming	
Double octet mode	10 Mbytes/sec.
Hardware	
CPU	Intel® 80286
Clock frequency	10 MHz
Memory	
Size	1 Mbyte DRAM
Error detect	Parity
Organization	2 × 16 bit banks
Access	Interleaved
Power	+5V, ±12V
Power consumption	
+5V:	17 A / 85W
+12V:	0.1 A / 1.2W
-12V:	0.1 A / 1.2W
Total:	87.5W
Mechanical outline	Triple Eurocard Size
Dimensions	367x340x20 mm

RcLAN Controller

RC9130

The RC9130 is a high performance controller module designed to connect an RC9000 Processing Unit to one or two local area networks.

Characteristics

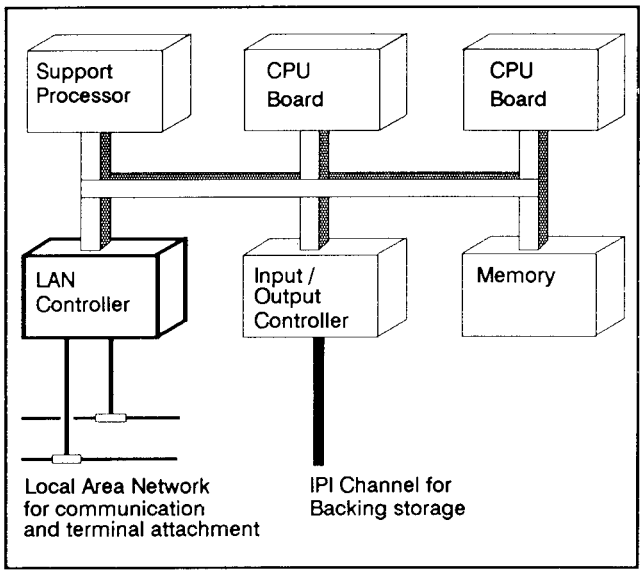
- Intel® 80286 Microprocessor
- 1 Mbyte local memory
- Dual 82586 LAN coprocessor
- Dual 64 Kbyte triple port buffer memory
- Local Area Networks supported:
  - Thin Ethernet (standard)
  - RC Micronet (option)
  - Ethernet (option)

Product Description

The RC9130 RcLAN Controller is based upon the 82586 Local Area Network coprocessor which performs full IEEE802.3 access control and channel interface functions. The RC9130 controller is equipped with two 82586 coprocessors each being able to access their own 64 Kbyte buffer memory without wait states. A DMA controller transfers data between the 64 Kbyte buffer and the processing unit system bus. Protocol handling is performed by the 80286 microprocessor which operates at a 10 MHz clock frequency and accesses the 1 Mbyte RAM memory without wait states.
The system bus interface is implemented by means of specially designed chips which buffer data to be transfered. Both the DMA and the 80286 microprocessor has interface to the system bus to allow simultaneously transfer of data.

Product application

The RC9130 RcLAN controller provides the RC9000 processing unit with interface to the RcLAN network on which all communication devices, control units and workstations are attached either directly or via communication links.
The RC9130 is as standard equipped with interface for the 10 Mbit/s Thin Ethernet without the use of separate transceivers, but may as an option operate either the 1 Mbit/s RC Micronet or the 10 Mbit/s Ethernet.



Dual LAN interface

The two LAN interfaces on the RC9130 must be equipped for the same type of LAN network, but may be connected either to two separate cables or to the same cable. When connecting the two LAN interfaces of a RC9130 to the end points of the same cable the sequrity against bad cable connections is raised considerably.

The concept with two interfaces connected to the same LAN network is possible because the two interfacess and their connected network is handled as one logical network.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000 Processing Unit.

Related products
F930 Ethernet interface module
F931 RC Micronet interface module

Cables
MF134/135 Ethernet/Thin Ethernet transceiver cable
MF154/155 Ethernet/Thin Ethernet transceiver cable

RC9130 Specifications

Interfaces	
System bus	Pipelined, 10 MHz
Local Area Network	
Thin Ethernet	
Type	CSMA/CD IEEE 802.3 MAU 10BASE2
Speed	Max. 10 Mbits/s
Connector	2 × BNC
Ethernet (option)	
Type	CSMA/CD IEEE 802.3 AUI
Speed	Max. 10 Mbits/s
Connector	2 x 15 pin D*
* Separate tranciever required	
RC Micronet (option)	
Type	CSMA/CD
Speed	Max. 1 Mbits/s
Connector	2 × BNC
Hardware	
CPU	Intel® 80286
Speed	10 MHz
Memory	
Size	1 Mbyte DRAM
Error detect	Parity
Organization	2 x 16 bit banks
Access	Interleaved
Buffer Memory	
Size	2 × 64Kbyte
Error detect	Parity
Coprocessor	
LAN processor	2 × 82586
Clock frequency	10 MHz
Power	+ 5V, ± 12V
Power consumption	
+ 5V:	max. 14.5 A / 73W
+ 12V:	max. 1.04 A / 13W
-12V:	max. 0.04 A / 0.5W
Total:	86.5W
Mechanical outline	Triple Eurocard Size
Dimensions	367x340x20 mm

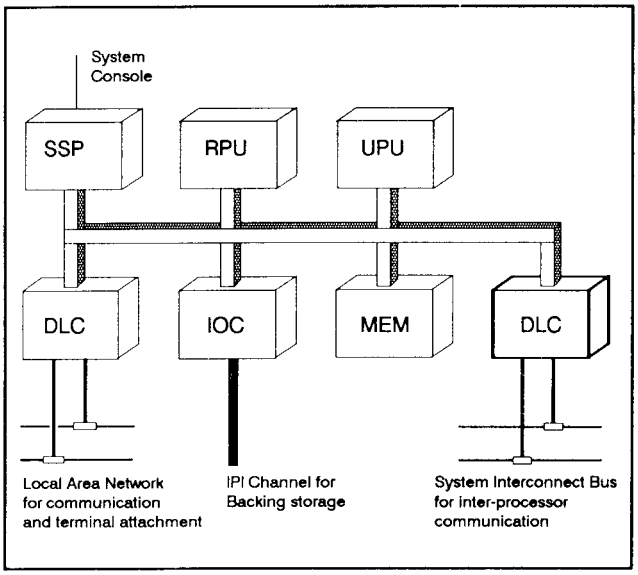
SIB-bus Interface Module

RC9135

The RC9135 is a high performance controller module desigend to interconnect RC9000 Processing Units. The media is Thin-Ethernet which is duplicated to obtain fault tolerance and increase bandwidth.

Characteristics

- Intel® 80286 Microprocessor
- 1 Mbyte local memory
- Dual 82586 LAN coprocessor
- Dual 64 Kbyte triple port buffer memory
- Direct Thin Ethernet connection



Product Description

The RC9135 System Interconnect Bus Module is a controller based upon the 82586 Loacal Area Network coprocessor which performs full IEEE802.3 access control and channel interface functions. The RC9135 controller is equipped with two 82586 coprocessors each being able to access their own 64 Kbyte buffer memory without wait states. A DMA controller transfers data between the 64 Kbyte buffer and the processing unit system bus. Protocol handling is performed by the Intel® 80286 microprocessor which operate at a 10 MHz clock frequency and accesses the 1 Mbyte RAM memory without wait states.
The system bus interface is implemented by means of specially designed chips which buffer data to be transfered. Both the DMA and the 80286 microprocessor has interface to the system bus to allow simultaneously transfer of data.

Product application

The RC9135 SIB-bus Interface Module provides the RC9000 processing unit with interface to the dual LAN network by which the processing units in a multi-PU environment are interconnected.
The RC9135 is equipped with interface for the 10 Mbit/s Thin Ethernet without the use of separate transceivers.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D).

Prerequisites

RC9000-30/40 Processing Unit ×2.

Related products

Cables
MF134/135 Ethernet/Thin Ethernet Transceiver Cable

RC9135 Specifications

Interfaces	
System bus	Pipelined, 10 MHz
Local Area Network	Thin Ethernet
Type	CSMA/CD
	IEEE 802.3
	MAU 10BASE2
Speed	Max. 10 Mbits/s
Connector	2 × BNC
Performance	
LAN transfer rate	1.25 Mbyte/s/channel
DMA transfer rate	max. 4.25 Mbyte/s
Hardware	
CPU	Intel® 80286
Speed	10 MHz
Memory	
Size	1 Mbyte DRAM
Error detect	Parity
Organization	2 x 16 bit banks
Access	Interleaved
Buffer Memory	
Size	2 × 64Kbyte
Error detect	Parity
Coprocessor	
LAN processor	2 × 82586
Clock frequency	10 MHz
Power	+5V, ±12V
Power consumption	
+5V:	max. 14.5 A / 73W
+12V:	max. 1.04 A / 13W
-12V:	max. 0.04 A / 0.5W
Total:	86.5W
Mechanical outline	Triple Eurocard Size
Dimensions	367x340x20 mm

System Support Processor

RC9140 System Support Processor
RC9142 SSP Floppy Disk Module

The RC9140 is an independent support processor within the RC9000 Processing Unit. RC9140 is responsible for test, load and healthiness monitoring of the other modules in the RC9000 system.

Characteristics

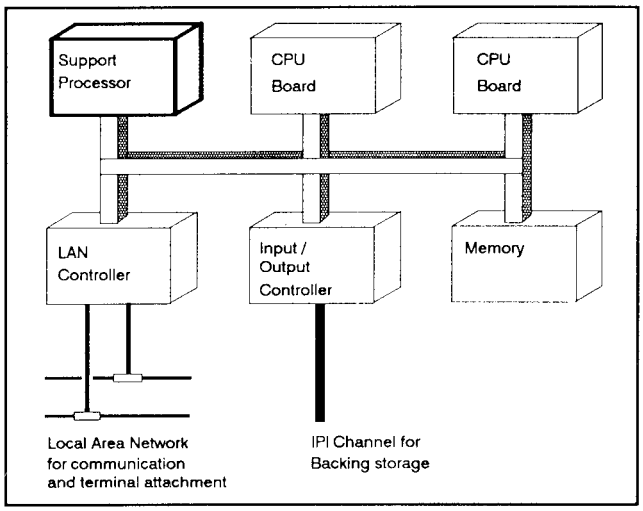
- Intel® 80286 Microprocessor
- 1 Mbyte local memory
- Temperature monitoring
- Power supply monitoring
- System bus monitoring
- System console interface
- High density floppy disk drive
- 10 Mbits/s IEEE 802.3 LAN interface

Product Description

Together with the RC9142 SSP Floppy Disk Module and its separate power supply, the RC9140 System Support Procesor constitutes a selfcontained processing system within the RC9000 processing unit. This independency allows the RC9140 to turn on or off the power supply for the processing unit, or control the operating state of the other modules.

The central part of the RC9140 is based on a 10 MHz Intel® 80286 microprocessor with 1 Mbyte zero wait state local memory with parity check.
By use of special monitor electronics, the microprocessor may survey the processing unit at operation in order to detect excess temperatures on different location inside the processing unit cabinet, power supply failures or system bus protocol violations. An onboard DMA controller may transfer files between the local memory on the RC9140 and the PC/AT compatible floppy disk within the RC9142. The drive supports high density disks, providing 1.2 Mbyte of formatted data storage.

Communication between the RC9140 and the rest of the processing unit is done via the system bus through a system bus interface with a maximum transfer rate of 4.0 Mbyte/s utilizing four word blocks.



In order to communicate with a local area network the RC9140 is equipped with a 82586 LAN coprocessor allowing transfer rates up 10 Mbits/s.

Product application

In a RC9000 computer system each processing unit contains one and only one RC9140 System Support Processor. The System Support processor play a central role during the boot procedure of the processing unit, where it is responsible for testing, loading and initializing the other modules in the processing unit. During normal operation the RC9140 monitors the processing unit and provides the system console interface.
Both the R9140 System Support Processor and the RC9142 SSP Floppy Disk Module are mounted in the processing unit subrack from the front to allow easy replacement.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9000 Processing Unit.

Related products

M45-011-08 RC45 System Console
TF686 Terminal cable, serial
MF134 Thin Ethernet transceiver cable, 5m

RC9140 Specifications

Interfaces	
System bus	Pipelined, 10 MHz
System Console	
Connector	V.24
Protocol	Async. VT100
Speed	9600 bps
Local Area Network	
Type	Thin Ethernet
	IEEE 802.3
	MAU 10BASE2
Speed	Max. 10 Mbits/s
Hardware	
CPU	Intel® 80286
Clock frequency	10 MHz
Memory	
Size	1 Mbyte DRAM
Error detect	Parity
Organization	2 × 16 bit banks
Access	Interleaved
Coprocessor	
LAN processor	82586
Clock frequency	10.0 MHz
Power	+5V, ±12V
Power consumption	
+5V:	max. 13 A / 65W
+12V:	max. 2.0 A / 24W
-12V:	max. 0.03 A / 0.3W
Mechanical outline	Triple Eurocard Size
Dimensions	367x340x20 mm

RC9142 Specifications

Floppy disk drive	1/2-height, 5.25"
Data transfer rate	500 Kbyte/sec
Floppy disk	high density, 96 TPI
Capacity	1.2 Mbyte
File format	DOS
Power	+5V, +12V
Power consumption	
+5V	max. 0.5 A / 2.5 W
+12V	max. 0.5 A / 6.0 W

Disk Control Module

RC9210

The RC9210 is a high performance disk control module based on an Intel® 80286 microprocessor. The module is equipped with 2 IPI-III host interfaces, and 4 SMD interfaces for connection of disk drives.
The RC9220 is designed for mounting in the RC9000 System Cabinets and powered separately.

Characteristics

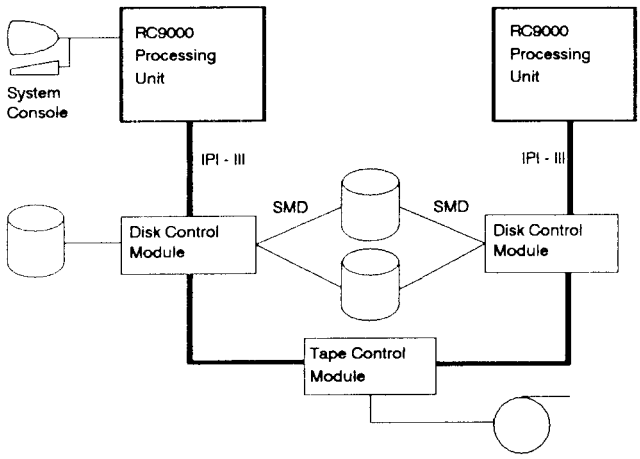
- 10 MHz Intel®80286 microprocessor
- 128 Kbytes databuffer
- Two IPI-III ports:
  - 1 Kbyte command buffer
  - 1 Kbyte response buffer
  - Transfer rate up to 10 Mbyte/s
- Four SMD disk interfaces:
  - Transfer rate up to 25 Mbit/s

Product description

The RC9210 is equipped with two IPI-III host interfaces. In order to reduce overhead to a minimum large amounts of the IPI standard has been hardware implemented. An extensive diagnostic of the interface is performed at power up. During this phase all possible transactions between the disk control module and the input/output controller in the processing unit are simulated.
Up to eigth control modules may be attached to each input/output channel. The RC9210 Disk Control Module is designed to allow installation and removal while transfer is taking place to other modules attached to the input/output channel.
Up to four disks can be attached to each disk control module. RC9210 interfaces to the disks via 4 separate SMD ports which allows power up/down of one disk with the others still in operation.

IPI-III Highlights

- 18 IPI-III commands, including:
  - Read
  - Write
  - Port control
  - Format
  - Read raw data
  - Abort
- Pipelined and quad buffered command execution
- Queing of max. 10 commands per IPI port
- Simultaneously transfer of data to/from disk and IPI channel via 128 Kb data buffer
- Overlapped seeks on the 4 disk drives
- Mixed disk types and disk formats
- Support of physical and logical data addressing
- Extended data recovery commands
- Full reallocating of bad sectors and tracks
- Defect list management and updating
- Power-up test of SMD interface including read, write and seek tests
- Controller command overhead om 32 Kbyte read or write less than 2mS



Product application

The RC9210 Disk Control Module is used for attaching the disk drives to the input/output channel.
The two IPI-III ports makes it posible to connect the module to two RC9000 processing units, thus if a fault arises in one of the two processing units, disk access is still posible from the other processing unit. This *hot stand-by* function may be used in systems with more than one RC9000-10 Processing Units.
In RC9000 systems with more than one RC9000-30/40 processing units the second IPI-III interface is not used for fault tolerant purposes. In these systems each disk drive is instead attached to two disk control modules which are attached to separate input/output channels.

The RC9210 is housed in a 19" cabinet designed for mounting inside the RC9000 cabinet just above a sec-

tion with room for two or four disk drives depending on the type of drive.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9230 or RC9235 disk drives.

Related products

Cables

CF940 SMD A/B Cables for attachment of disk drive to two separate RC9210 Disk Control Modules.

CF941 IPI Cable for dual PU attachment.

RC9210 Specifications

Input/output Channel Interface	
Response buffer	1 Kbyte
Command buffer	1 Kbyte
Transfer rate	max. 10 Mbyte/s
Cable length	max. 50m
Disk Drive Interface	
Type	SMD
Transfer rate	max. 24 Mbit/s
Cable length	max. 15m
Capacity	4 Drives
Error correction	
	48 bit ECC
	9 bit guaranteed correction
Hardware	
CPU	Intel® 80286
Clock frequency	10 MHz
Data Buffer	128 Kb
Power	93-132V,60Hz
	187-264V,50Hz
Power consumption	160 W
Dimensions	Heigth 86 mm
	Width 440 mm
	Depth 600 mm
Weigth	10 kg

Tape Control Module

RC9220

The RC9220 is a high performance tape control module based on an Intel™ 80286 microprocessor. The module is equipped with 2 IPI-III host interfaces, and a PERTEC tape interface for connection of up to two tape drives. The RC9220 is designed for mounting in the RC9000 System Cabinet and has a build-in power supply.

Characteristics

- 10 MHz Intel 80286 microprocessor
- 128 Kbytes databuffer
- Two IPI-III ports:
  - 1 Kbyte command buffer
  - 1 Kbyte response buffer
  - Transfer rate up to 10 Mbyte/s
- PERTEC tape interface:
  - Transfer rate up to 625 Kbyte/s
  - Two tape drive interfaces

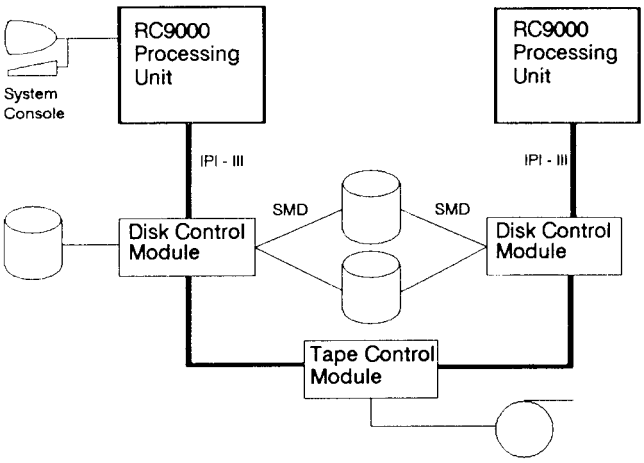
Product description

The RC9220 is equipped with two IPI-III host interfaces. In order to reduce overhead to a minimum large amounts of the IPI standard has been hardware implemented. An extensive diagnostic of the interface is performed at power up. During this phase all possible transactions between the tape control module and the input/output controller in the processing unit are simulated.
Up to eight control modules may be attached to each input/output channel. The RC9220 Tape Control Module is designed to allow installation and removal while transfer is taking place to other modules attached to the input/output channel.
In order to increase the data transfer rate the RC9220 Tape Control Module is capable of performing transfer of data on both the IPI channel and the PERTEC interface simultanously.
15 different IPI commands are supported including: Read, write, space block/filemark, position tape, operating mode, abort etc.

Command Execution
The RC9220 uses a pipeline technique in order to minimize the execution time for each command and may have up to 10 commands at execution simultaneously. Chaining of commands are supported in order to faciliate fast recovery from failing command sequences and automatic retry is performed on failed read and write commands.

Product application

The RC9220 Tape Control Module is used for attaching either the RC9250 Horizontal Tape Unit or the RC9255 Vertical Tape Unit to the input/output channel.
The two IPI-III ports makes it possible to connect the module to two RC9000 processing units, thus if a fault arises in one of the two processing units, tape access is still possible from the other processing unit.



The RC9220 is housed in a 19" cabinet designed for mounting inside the RC9000 cabinet just below the attached tape unit.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9250 Horizontal Tape Unit or RC9255 Vertical Tape Unit.

Related products

Cables
CF941 IPI Cable for dual PU attachment.

RC9220 Specifications

Input/output Channel Interface	
Response buffer	1 Kbyte
Command buffer	1 Kbyte
Transfer rate	max. 10 Mb/s
Cable length	max. 50m
Tape Unit Interface	
Transfer rate	max. 625 Kb/s
Cable length	max. 6m (20 ft.)
Tape Operation	
Densities	PE 1600 BPI
	DDPE 3200 BPI
	GCR 6250 BPI
Speed control	Automatic
Operation	start/stop, streaming
R/W error handling	Automatic retry
CPU	Intel® 80286
Clock frequency	10 MHz
Data Buffer	128 Kbyte
Power	93-132V,60Hz
	187-264V,50Hz
Power consumption	115 W
Dimensions	Heigth 86 mm
	Width 440 mm
	Depth 600 mm
Weigth	10 kg

8" 850 Megabyte Disk Drive

RC9230

The RC9230 is a disk drive that stores 850 Megabyte of unformatted data on 8-inch disk platters. The disk drive employs thin film coated platters and winchester-type technology, which provides the most modern method of recording large amounts of data for high speed, reliable computer accessability.

Characteristics

- Sealed 8-inch disk platters
- 850 Megabyte of unformatted data
- 2.46 Megabytes/sec transfer rate
- 16 Milliseconds average seek time
- 8.3 Milliseconds average latency
- MTBF more than 30,000 hours
- Separate housed power supply

Product description

The RC9230 is a high performance 8" disk drive equipped with two standard SMD-E interfaces in order to support fault tolerance by attaching the drive to two separate disk control modules.

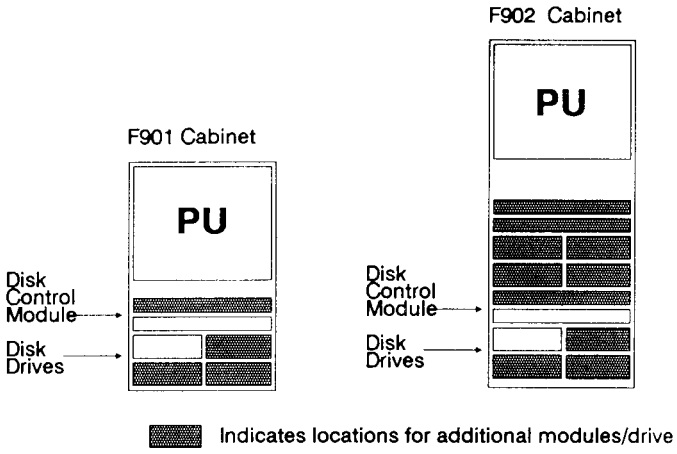
The drive may be powered up/down without affecting the operation of other drives attached to the disk control modules.

Product application

The RC9230 disk drive is intended for mounting inside the RC9000 Cabinet in sections with room for four drives and with the corresponding two disk control modules placed just above.

Documentation

RC9230 disk drives must be installed by personel autorized by RC Computer.
Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).



Disk Drive Mounting

Prerequisites

RC9210 Disk Control Module.

Related products

F905 Disk Mounting Kit.

Cables

CF940 SMD A/B Cables for attachment of disk drive to two separate RC9210 Disk Control Modules.

RC9230 Specifications

Disk Drive Interface	
Type	SMD-E
Data transfer rate	2.46 MB/s
Cable types	SMD-A/B
Cable length	max. 15m
Disk Drive	
Capacity, unformatted	851 MBytes
Data heads per cylinder	15
Cylinders per drive	1381
Average latency	8.3 msec
Seek time	
One cylinder seek	5 msec
Average seek	16 msec
Max cylinder seek	30 msec
Start time	< 90 sec
Stop time	< 60 sec
Power	85-132V,60Hz
	177-264V,50Hz
Frequency	48 - 62Hz
Power consumption	145 W
Temperature,operating	10-45 °C
Dimensions	Heigth 121 mm
	Width 216 mm
	Depth 567 mm

9" 1.4 Gigabyte Disk Drive

RC9235

The RC9235 is a compact disk drive that stores 1.4 Gigabyte of unformatted data on 9-inch disk platters. The disk drive employs thin film coated platters and winchester-type technology, which provides the most modern method of recording large amounts of data for high speed, reliable computer accessability.

Characteristics

- Sealed 9-inch disk platters, drive motor and rotary actuator
- 1.4 Gigabyte of unformatted data
- 3.07 Megabytes/sec transfer rate
- 15 Milliseconds average seek time
- 8.3 Milliseconds average latency
- MTBF more than 50,000 hours
- Incl. separate power supply unit

Product description

The RC9235 is a high performance 9" disk drive equipped with two standard SMD-E interfaces in order to support fault tolerance by attaching the drive to two separate disk control modules.

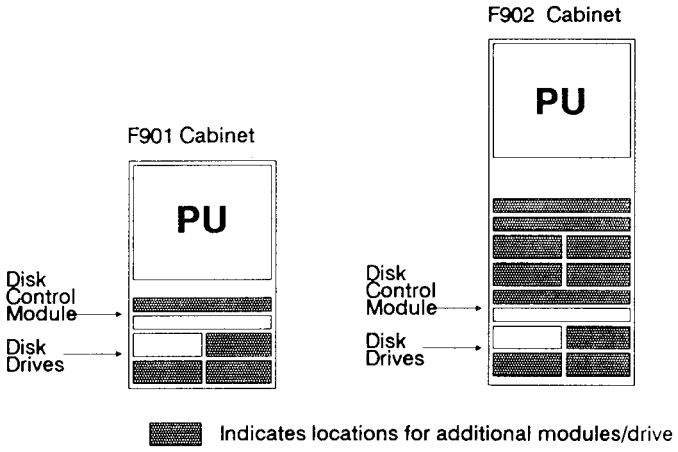
The drive may be powered up/down without affecting the operation of other drives attached to the disk control modules.

Product application

The RC9235 disk drive is intended for mounting inside the RC9000 Cabinet in sections with room for two drives and with the corresponding one or two disk control modules placed just above.

Documentation

RC9235 disk drives must be installed by personel autorized by RC Computer.



Disk Drive Mounting

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9210 Disk Control Module.

Related products

F906 Mounting Chassis for 2 × RC9235.

Cables

CF940-1/2 SMD A/B Cables for attachment of disk drive to two separate RC9210 Disk Control Modules.

RC9235 Specifications

Disk Drive Interface	
Type	SMD-E
Data transfer rate	max. 3.07 MB/s
Cable types	SMD-A/B
Cable length	max. 15m
Disk Drive	
Capacity, unformatted	1,415 MBytes
Head per cylinder	27
Cylinders drive	1024
Average latency	8.3 msec
Seek time	
One cylinder seek	5 msec
Average seek	15 msec
Max cylinder seek	27 msec
Start time	< 30 sec
Stop time	< 20 sec
Power	100-120V,60Hz
	200-240V,50Hz
Frequency	50/60 Hz ±2%
Power consumption	150 W
Temperature,operating	10 C-40 C
Dimensions	Heigth 259 mm
	Width 216 mm

Horizontal Tape Unit

RC9250

The RC9250 is a high performance front loading 1/2" tape unit for horizontal mounting in a F901, low RC9000 System Cabinet. The compact design of the RC9250 makes it possible to equip the RC9000 Computer System with a professional device for backup and data interchange, while maintaining the modern industrial design characterizing the RC9000 system.

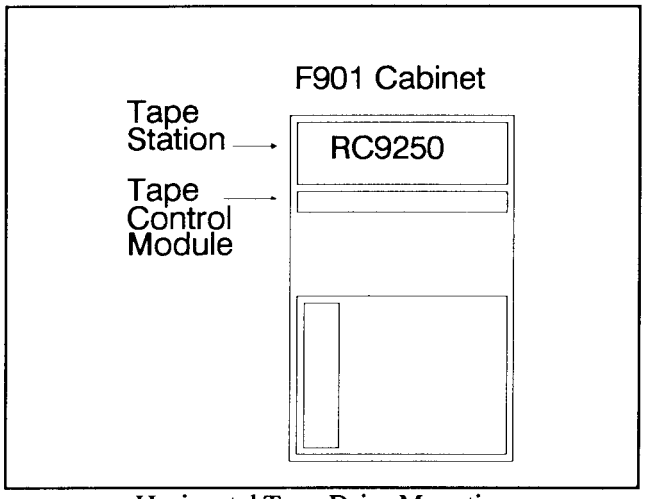
Characteristics

- Pertec Enhanced Formatter Interface
- Fully automatic hub locking and tape threading using any standard tape
- Tape speeds of 50 and 100 ips
- 1600, 3200, and 6250 cpi operation
- Speed and densities selectable via interface or front panel
- Tape in motion indicator
- Self-adjusting read, write, and tape handling circuitry
- Extended status capability

Product description

The RC9250 is a multi-format, front loading, self-threading, 9-track, 1/2-inch tape drive using the Pertec® Enhanced Formatter interface. Densisties of 1600, 6250 cpi at 50 and 100 inch per second (ips), and 3200 cpi at 50 ips, are selectable from the front panel or via the interface. The maximum burst transfer rate at the formatter interface is 904.2 Kilobytes per second. The drive can be used in either a streaming mode or in a start/stop mode with selectable gap sizes.

The drive records and reads data consistent with the ANSI X3 standards using a read-after-write 9- track head.
All operator controls and indicators are located on the front panel for easy access. Tape loading is accomplished by inserting the tape reel through a door in the front bezel. The front door and top cover are



Horizontal Tape Drive Mounting

equipped with interlock switches which can be defeated if necessary to service the tape drive. Cooling air is brought in through the front of the unit and exhausted at the front and rear. Connections for the RC9220 Tape Control Module are provided at the rear of the drive.
Build-in diagnostics automatically performs a self test during each power-up cycle. Front panel service diagnostics allow automatic adjustment of the read and write circuitry without the need for external test equipment.

Product application

The RC9250 Tape Unit and the corresponding RC9220 Tape Control Module constitutes a highly reliable backing storage device which is attached to the RC9000 System through either one or two IPI-III input/output channels.
Every RC9000 Computer System must be equipped with a tape unit either vertical or horizontal as the RC9250 Tape Unit. The two IPI-III interfaces at the RC9220 Tape Control Module makes it possible to access the RC9250 Tape Unit from two different RC9000 processing units.
The tape unit is the first-time load medium and a very efficient way of producing reliable backup. The high degree of standardization of 1/2-inch tape formats and recording techniques, promoted by ANSI, and the RC9250 Tape Unit's compatibility with these standards allows for data interchange with a wide range of data equipment.

The RC9250 is housed in a cabinet desinged for mounting inside a low RC9000 cabinet.

Documentation

RC9250 Operating Guide is included in RC 9250.
Configuration and operation is described in "TX System Administrator's Manual Set" (SW99021-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9220 Tape Control Module.

RC9250 Specifications

Reels	
Size	7, 8.5, 10.5 inches
Tape	
Conforming to ANSI X3.40-1976	
Tension	9 ounces (± 1 ounce)
Speed	50 or 100 ips
Recording	
Methodes	
Phase Encoded (1600 cpi)	ANSI X3.39-1973
Double PE (3200 cpi)	
Group Coded Rec. (6250 cpi)	ANSI X3.54-1976
Error correction	
Group Code Recording (GCR)	2 channel (read)
Phase Encoded	1 channel (read)
Interface	
Type	Perlec
Cable length	max. 20 feet (6m)
Transfer rates	
Burst 50 ips	452 Kbytes/sec
Burst 100 ips	904 Kbytes/sec
Max. effective (50 ips)	312 Kbytes/sec
Max. effective (100 ips)	625 Kbytes/sec
Temparature	
Operating	5 to 40 C (40 to 104 F)
Non-operating	-28 to 71 C (-20 to 160 F)
Humidity	
Operating	15% to 95% (no condensation)
Power	
Input voltage	100, 120, 220, 240 V AC
Frequency	48-62 Hz
Power consumption	Max. 350 W
Dimensions	Heigth 220 mm
	Width 478 mm
	Depth 568 mm
Weigth	App. 57 kg (125 pounds)

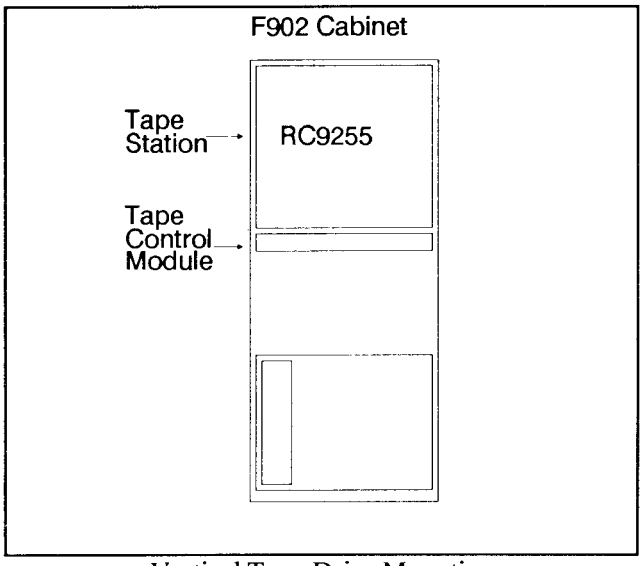
Vertical Tape Unit

RC9255

The RC9255 is a high performance, microprocessor based 1/2-inch magnetic tape unit for vertical mounting in the high RC9000 Cabinet.

Characteristics

- Pertec Enhanced Formatter Interface
- Uses 1/2-inch standard tapes
- Selectable 25 and 75 Inch per second tape speed
- 1600 and 6250 Characters per inch density
- Start/stop and streaming mode
- Vertical mounted for easy operation



Vertical Tape Drive Mounting

Product description

The RC9250 Tape Unit is a microprocessor based half-inch wide magnetic tape drive. The tape unit consists of a tape deck, read/write electronics formatting electronics, microprocessor based control control logic, and interface for the RC9220 Tape Control Module.
Three operating modes are available: 25 inches per second (ips) start/stop mode, 25 ips streaming mode, and 75 ips streaming mode. Data is recorded in the ANSI compatible 1600 CPI phase Encoded (PE) or 6250 CPI Group Coded Recording (GCR) methode.
The compatibility with the ANSI standard makes the tapes interchangeable with other tape units conforming to this standard.

The RC9250 Tape Unit incorporates solid-state logic to replace many components that are traditionally mechanical. Tape is transported directly under electronic control with no tape buffers required and the tape tension is controlles by build-in sensors.

Multiple data transfer rate capability is achieved by allowing selection of the 25 ips modes and 75 ips streaming mode and density selection through the tape control module interface.

The two-character digital display illuminates when the tape unit is in off-line diagnostic/test mode. The display is used to display test sequence numbers, results from microdiagnostic or failure codes.

The RC9250 is designed for mounting inside the high RC9000 cabinet with the corresponding tape control module placed just below.

Product application

The RC9255 Tape Unit and the corresponding RC9220 Tape Control Module consitutes a highly reliable backing storage device which is attached to the RC9000 System through either one or two IPI-III input/output channels.
Every RC9000 Computer System must be equipped with a tape unit either horizontal or vertical as the RC9255 Tape Unit. The two IPI-III interfaces at the RC9220 Tape Control Module makes it possible to access the RC9255 Tape Unit from two different RC9000 processing units.

The tape unit is the first-time load medium and a very efficient way of producing reliable backup. The high degree of standardization of 1/2-inch tape formats and recording techniques, promoted by ANSI, and the RC9255 Tape Unit's compatibility with these standards allows for data interchange with a wide range of data equipment.

Documentation

RC9255 Operating Guide is included in RC9255.
Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and

"RC9000-10 System Administrator's Guide"
(SW9911I-D).

Prerequisites

RC9220 Tape Control Module.

RC9255 Specifications

Reels	
Size	7, 8.5, 10.5 inches
Tape	Conforming to ANSI X3.40-1976
Tension	8 ounces
Speed	25 or 75 ips
Recording	
Densities	
Phase Encoded (1600 cpi)	ANSI X3.39-1973
Group Coded Rec. (6250 cpi)	ANSI X3.54-1976
Error correction	
Group Code Recording (GCR)	2 channel (read)
Phase Encoded (PE)	1 channel (read)
Interface	
Type	Pertec
Cable	2 × 50 wire flat signal cable
Cable length	max. 20 feet (6m)
Transfer rates	
1600 cpi, 25 ips	40 Kbytes/sec
6250 cpi, 25 ips	156 Kbytes/sec
1600 cpi, 75 ips	120 Kbytes/sec
6250 cpi, 75 ips	469 Kbytes/sec
Temperature	
Operating	15 to 33 C (60 to 90 F)
Non-operating	-10 to 50 C (14 to 122 F)
Humidity	
Operating	20% to 80% relative (no cond.)
Power	
Input voltage	187 to 256 V AC
Frequency	50 Hz
Power consumption	Max. 400 W
Dimensions	Heigth 603 mm (24 inch)
	Width 478 mm (19 inch)
	Depth 440 mm (17.5 inch)
Weigth	App. 50 kg (110 pounds)

Local Device Control Unit

RC9310

The RC9310 is a control unit for attaching local devices to the RC9000 processing units. This control unit incorporates connections for 8 asynchronous terminals. These terminals may communicate with the processing units either as character oriented terminal or as a 3270 format oriented terminal via a cluster control unit emulation.

Characteristics

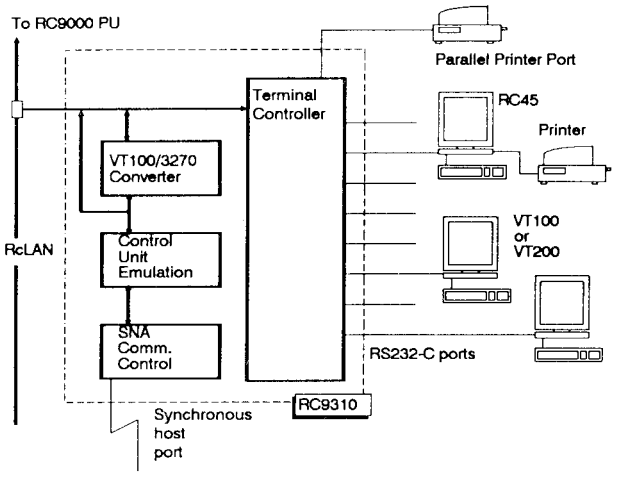
- 8 asynchronous terminals attachable via RS232-C interface
- Centronics printer interface
- Connection for 10 Mbps RcLAN local area network according to IEEE802.3
- Conversion program from VT220 character oriented to 3270 format oriented communication
- Emulation of IBM 3174 control unit with one communication line to a remote host.
- For mounting in F908 Mounting Chassis with max. 5 RC9310 Local Device Control Units

Product description

The RC9310 is a multifunctional device control unit primarily for attaching asynchronous terminals to the RC9000 processing units via RcLAN. The RC9310 has the capability of converting from VT200 character oriented communication to 3270 format oriented communication. Furthermore the RC9310 may act as an IBM 3174 Control Unit for communication with remote hosts.

Asynchronous terminal attachment
The RC9310 is equipped with 8 RS232-C interfaces for attachment of asynchronous terminals either direct or via asynchronous modems. In order to use the 3270/VT200 conversion module described below the attaached terminals must be VT200 compatible.

3270 Format oriented communication
Each of the asynchronous terminals attached to a RC9310 may either communicate directly to the RC9000 processing units on a character oriented basis or use a conversion module located in the RC9310 in order to communicate with applications on the RC9000 processing unit like a 3270 format oriented device.
This conversion module acts as a format oriented device against the host computer and controls the asynchronous terminal so it appears as a format oriented terminal.



RC9310 Schematic view

IBM 3174 Control Unit Emulation
The RC9310 is equipped with a synchronous communication port which in combination with a software module, emulating an IBM 3174 Control Unit, enables the RC9310 to be used as a cluster controller for communication with a remote host computer.
This feature enables both the asynchronous terminals attached to RC9310 and other devices attached to the RcLAN like the RC900 UNIX machine to use the synchronous communication line.
Asynchronous terminals must use the above mentioned conversion module in order to communicate with remote host via the synchronous communication line.
The RC900 UNIX machine and PCs equipped with LAN board and SW from RC Computer use the RC9310 3174 Emulation as cluster for communication with a remote host.

Product application

The RC9310 Local Device Control Unit is mounted from the front side in a F908 Mounting Chassis which may contain up to 5 RC9310 Units. All connections to the RC9310 are located on the rear side of the unit and fits into corresponding connections in the F908 Chassis

enabling easy mounting.
At the rear side of the F908 Mounting Chassis one line interface module holds the connectors for each mounted RC9310.
The RC9310 Local Device Control Unit has it own build-in 150W power supply and 5 status lamps located on the front panel.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

F908 Mounting Chassis for RC9310

Related products

Hardware
RC9320 Direct Line interface *(not included in RC9310))*

Software
SW9310 Asynchronous Control Program
(included in RC9310)
SW9311 3270 Format Oriented Communication
SW9315 SNA/SDLC/QLLC Remote Host Support
SW9316 X.25 DTE Support

RC9310 Specifications

Asynchronous communication

No. of ports	8
Type	RS232-C
Connector	9-pin D
Speed	Max.19.200 bps
Databit	7 or 8
Stopbit	1,1.5 or 2
Parity	None, odd or even
Handshaking	none or XON/XOFF
Cable length	Max. 25m

Synchronous Communication

Emulation	IBM 3174
PU type	2
LU session types	1, 2 and 3

(SCS printer, terminal and 3270 printer)
Comm. line configurations:

- V.24 SNA/SDLC with a modem controlled maximum speed of 19.200 bps
- X.21 SNA/SDLC with the maximum Datex network speed of 9600 bps
- X.25 SNA/QLLC for packet switched network access

Devices	128
Character set	configurable
Conversion table	configurable
Connector	25-pin D

Local Area Network

Type	CSMA/CD,Thin Ethernet *
Connector	15-pin D
Speed	10 Mbps
Cable type	RG223/U, Coax
Segment length	Max.200m
Total length	Max.2500m
Specification	ECMA 80-82

* Ethernet available as option

Printer connection

Type	Centronics
Connector	25-pin D
Cable length	Max.12m

Communication Front End

RC9330 Communication Front End
F935/F936 Line Controllers

The RC9330 is a Communication Front End for attaching remote terminals to the RC9000 processing units via RcLAN. The remote terminals may either be character oriented terminals or 3270 format oriented devices belonging to an IBM 3274- compatible cluster. The RC9330 must be equipped with 1 to 3 F935/F936 Line Controllers each having 4 synchronous communication lines.

Characteristics

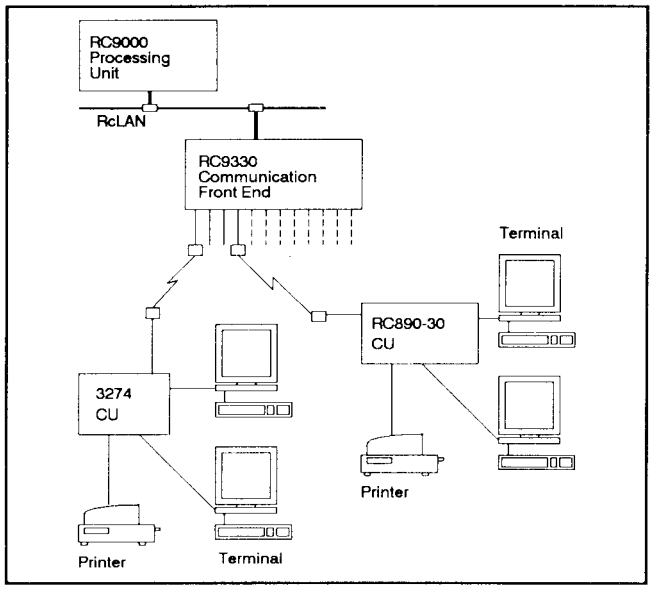
- Up to 12 synchronous communication lines
- V.24 or X.21 interface
- X.25 DTE facility supporting 255 virtual circuits per channel.
- X.29 host facility for Triple-X PAD communication
- SNA subhost facility for communication with remote IBM 3274-compatible clusters
- Connection for 10 Mbps RcLAN local area network according to IEEE802.3
- Integrated in RC9000 cabinets by use of mounting chassis with room for 3 RC9330.

Product description

The RC9330 is a multiline communication front end primarily for attaching remote terminals to the RC9000 processing units via RcLAN.

As standard each RC9330 is equipped with 5 boards leaving 3 of the 8 slots free for additional boards. The 5 boards supplied as standard holds the CPU, 3 megabyte of memory, and a RcLAN controller. The three free slots are for the line controllers, of which at least one must be present. A fully equipped RC9330 with 3 line controllers will have 12 communication lines each supporting a large number of remote devices.

Line Controllers
There are two types of line controllers for the RC9330 one with V.24 interfaces and one with X.21 interfaces. The first type, F935, which is equipped with four V.24 interfaces may be configured to use either a SDLC or HDLC protocol. The second type, F936, which is equipped with four X.21 interfaces uses SDLC protocols only.



RC9330 Attachment

The RC9330 Communication Front End is mounted from the front side in a F909 Subrack which may contain up to 3 RC9330 Units. All connectors on the RC9330 are located on the rear of the unit and fit into corresponding connectors in the F909 subrack enabling easy mounting.
Main power supply is placed in the F909 Mounting Chassis, which holds a separate power supply for each RC9330 in the mounting chassis.
Connectors for RcLAN tranceivers and communication lines are located on the rear side of the F909 Mounting Chassis.

Product application

RC9330 allows remote terminals to access hosts in the RcLAN environment, primarily RC9000 hosts. Communication between RcLAN hosts and remote 3270 printers is also supported. Terminals can either be character oriented, such as TTY terminals, communicating via a remote PAD terminal access service to a public X.25 data network, or they can belong to IBM 3274-compatible clusters.

Communication via X.25 service
A channel which is set up as X.25 DTE supports up to

255 virtual circuits to remote devices via a public data network. Each virtual circuit may connect RC9330 either to a character oriented terminal attached to a PAD access service or to a remote IBM 3274-compatible cluster controller, which controls a number of terminals and printers. Virtual circuits may be permanent or switched.

Remote character oriented terminals
Remote character oriented terminals must be connected to a Triple-X PAD with an X.28 interface, e.g. RC3502 or RC890, whichs allows for communication with the X.29 host facility in RC9330.

3270 format oriented devices
RC9330 supports the following three SNA protocols for communication with IBM 3274-compatible clusters:

- V.24/SDLC on a leased line or multidropped network with up to 32 cluster controllers.
- X.21/SDLC. By means of af short hold mode and port sharing a number of cluster controllers may share a smaller number of RC9330 channels.
- X.25/QLLC. The virtual circuits must be permanent or set up by calls made by cluster controllers.

RC9330 plays the role of a SNA subhost. This means that in the communication with cluster controllers RC9330 behaves like an IBM 37xx Front End, with its SNA functionality corresponding to a PU type 2.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

F909 Mounting Chassis for 3 × RC9330

Related products

Hardware
RC9325 Direct Line interface

Software
SW9330 Basic RC9330 Communication FrontEnd SW *(included in RC9330)*
SW9335 X.29 Host Facility
SW9336 3270 SNA subhost for RC9330

RC9330 Specifications

F935 V.24 Line Controller

No. of ports	4
Interface	V.24
Connector	25 pin D
Speed	Max.9.600 bps
Protocols	SDLC and HDLC
On-board hardware	
Processor	Intel™80186
Clock frequency	8 MHz
Memory	512 Kbyte ram

F936 X.21 Line Controller

No. of ports	4
Interface	X.21
Connector	25 pin D
Speed	Max.9.600 bps
Protocols	SDLC
On-board hardware	
Processor	Intel™80186
Clock frequency	8 MHz
Memory	
512 Kbyte ram	

Local Area Network

Type	CSMA/CD,Thin Ethernet *
Connector	15 pin D
Speed	10 Mbps
Cable type	RG223/U, Coax
Segment length	Max.200m
Total length	Max.2500m
Specification	ECMA 80-82

* Ethernet available as option

Central processor

Type	Proprietary, 16 bit
	with stack oriented instruction set
Microprogram step cycle time	216ns
Register sets	128
Hardware stacks	128
Interrupt levels	128
Memory	3 Mbyte
Memory error detect	Parity

System Cabinets

F901-1/2 System Cabinets, Low version
F902-1/2 System Cabinets, High Version

The RC9000 System Cabinets are designed to meet both the requirements for accommodating compact computer equipment and the wish for a functional and modern industrial design. The cabinets conform to the 19" rack standard.

Characteristics

- Low and high versions avaialable
- Easy removeable front and rear covers.
- Build-in power distribution
- Builds-in suppression of mains conducted transients
- Guarding against conducted emission of EMI
- Build-in 4 channel status display
- Castor wheels and screw stand-offs
- Conforms to 19" rack standard

Product description

The four cabinets differ in two aspects: Height and side covers. F901 is 24 units high and F902 is 36 units high. They both are available either with (-1) or without (-2) the side covers. Front and rear covers are always included.
The cabinets without side covers (-2) are ment as expansion cabinets. The expansion of an installation requires the removal of one side cover. Then the expansion cabinet is bolted to the open side and the side cover is mounted on the expansion cabinet.
The cabinets are mounted on castor wheels and with screw stand-offs for permanent installation.

The air for cooling is let through the front cover and filtered just behind the cover. Then the air is passed through the system unit and let out through the rear cover.

Each cabinet may dissipate 2.2 KW (F901) or 3.3 KW (F902) if front and rear covers are full height.
Main power supply is routed to each cabinet as 3 phases, neutral and ground: $3 \times 380/220$ V + ground. Required wire gauge is 5×1.5 mm^2. Internally the power is distributed via 9 outlets in the low cabinet (F901) and 15 outlets in the high cabinet (F902).
Mains supply connector is of CEE 17/16A type.

Product application

The RC9000 System cabinets are used to accomodate the various units of the RC9000 Computer System: Processing units, communication processors, disk and tape control modules, disk drives and tape units.
The processing units and the communication processors are assembled in subracks that are specially desiged for mounting the RC9000 System Cabinets.
Disk and tape control modules are designed so the can be mounted in the RC9000 System Cabinets directly. The disk drives and the tape unit needs mounting kits.

Prerequisites

F901-1 required for adding F901-2
F902-1 required for adding F902-2.

F901 & F902 Dimensions and weights

Type	Height	Width	Depth	Weight	
F901-1	1246	595	894	80	With side covers
	(49.05)	(23.42)	(35.19)	(36.3)	
F901-2	-	565	-	60	Without side covers
	-	(22.24)	-	(27.2)	
F902-1	1779	595	-	103	With side covers
	(70.04)	(23.42)	-	(46.7)	
F902-2	-	565	-	78	Without side covers
	-	(22.24)	-	(35.4)	

Dimensions are in mm's and ( ) in inches
Weights are in Kg's and ( ) in lbs.

Ethernet Interface Module

F930

The F930 Ethernet Interface Module is an option for the RC9130 RcLAN Controller which enables the RC9130 to use a standard Ethernet instead of the default Thin Ethernet.

Characteristics

- Interface to RC9130 RcLAN Controller
- 2 × Interface for Ethernet transceiver
- 10 Mbit/s data transfer rate

Product Description

The F930 Ethernet Interface Module is a printed circuit board that replaces the standard Thin Ethernet interface module on the back side of the RC9000 Processing Unit.
Instead of the default direct interface to the Thin Ethernet, the F930 has two 15 pin D-connectors where the Ethernet transceiver cables are attached. When using Ethernet, separate transceivers for Ethernet are required.

F930 must be installed by personel authorized by RC Computer.

Product application

The F930 Ethernet Interface Module is intended for use in enviroments where an existing Ethernet is to be used as RcLAN media.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9130 RcLAN Controller
Ethernet transceiver

Related products

Cables
MF134/135 Ethernet / Thin Ethernet transceiver cable
MF154/155 Ethernet / Thin Ethernet transceiver cable

F930 Specifications

Interfaces	
RC9130 Interface	2 × 15 pin
Local Area Network	Ethernet
Type	CSMA/CD
	IEEE 802.3
	AUI
Speed	Max. 10 Mbits/s
Connector	2 × 15 pin female D
Performance	
LAN transfer rate	1.25 Mbyte/s/channel
Power	+5V
Power consumption	max. 0.1 A / 0.5W
Dimensions	104.15 × 201.5 mm

Micronet Interface Module

F931

The F931 Micronet Interface Module is an option for the RC9130 RcLAN Controller which enables the RC9130 to use a Rc-Micronet instead of the default Thin Ethernet.

Characteristics

- Interface to RC9130 RcLAN Controller
- 2 × Interface for Micronet
- 1 Mbit/s data transfer rate

Product Description

The F931 Micronet Interface Module is a printed circuit board that replaces the standard Thin Ethernet interface module on the back side of the RC9000 Processing Unit.
Instead of the default direct interface to the Thin Ethernet, the F930 has two connectors for the Micronet.

F931 must be installed by personel authorized by RC Computer.

Product application

The F931 Micronet Interface Module is intended for use in enviroments where an existing Micronet is to be used as RcLAN media.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisites

RC9130 RcLAN Controller

F931 Specifications

Interfaces	
RC9130 Interface	2 × 15 pin
Local Area Network	RC Micronet
Type	CSMA/CD
Speed	Max. 1 Mbits/s
Connector	2 × BNC
Performance	
LAN transfer rate	0.125 Mbyte/s/channel
Power	+5V
Power consumption	max. 0.5 A / 2.5W
Dimensions	104.15 × 201.5 mm

TX Operating System

SW9001I
Release 1

The TX Operating System is a high performance, commercial UNIX operating system. TX offers data integrity, system expandability and fault tolerance in a transparent environment.

Characteristics

- UNIX Compatibility
- Support for On-Line Transaction Processing (OLTP)
- Reliable, distributed, extent based file system
- Transparent distributed evironment
- Fault Tolerance covering both data integrity and continuous availability

Product Description

Transaction Executive (TX) is based on the 4.2 BSD version of UNIX, but has been expanded and enhanced in order to support online, transaction oriented applications in a fault tolerant way and to comply with the envolving UNIX standards (System V and POSIX).

Distribution
TX makes the loosely coupled multiprocessor architecture of RC9000 completely transparent to the user, e.g. by creating a global name space in which all system objects (files, directories, devices, processes) live independently of their physical location. The system configuration may expand or contrct, and objects will enter or leave the name space.

UNIX Compatibility
The TX kernel supports all the well known UNIX system calls (BSD version) and in addition several to support transaction processing, the multi processing unit environment and interprocess communication. The TX kernel also support major parts of the following UNIX System V components: Base system (complete), Kernel Extensions, Basic Utilities Extension (complete), Advanced Utilities Extension and Terminal Interface Extension.

Utilities
TX includes all the well known UNIX commands and utilities. Several system administration utilities has been added to manage the TX specific features. These include utilities to handle the TX file system and utilities to gather and interpret statistical data from the distributed environment.

File System
Disk space allocation is managed on a file basis in user definable extents. The extents can have a size between 1 Kbyte and 8 Megabytes. Individual file systems may span several physical disks. In order to support data integrity up to eight copies (plexes) of a file system may be maintained by TX.

The transaction mechanism is a built-in feature of TX accessible at the system call level. It has deadlock detection and locking at both the file and block level.

C Compiler
TX includes an optimizing C compiler aimed at generating code for the RC9010 RISC Processor Module. Also supplied is an enhanced version of the symbolic debugger, DBX, that allows debugging of multible processes, of processes started independently of DBX, and of processes on another processing unit.

Interprocess Communication
Traditional UNIX interprocess communication models (pipes, sockets, shared memory, semphores, messages) has been supplemented with *easy to use* TX specific models, TXIPC and MXIPC, which are integrated in the file system. TXIPC provides a channel between two processes, while MXIPC provides multiplexed message handling between several processes. Both models support the transaction mechanism.

Continuous Availability
TX is equipped with a "Continous Mode" execution that allows processes to migrate from one processing unit to another, if the first becomes unavailable. This continuous processing feature has been implemented through the use of terminal logging and extensive supervision of the system, from the System Support Processor (SSP) and from TX.
Software for the System Support Processor is part of this TX Operating System software package.

Documentation

Introductionary information about TX is part of SW9901I-D RC9000 TX System Overview.

SW9001I includes one copy of the complete TX documentation: SW9001I-D TX Operating System

Documentation, which consist of:

- TX System Administrator's Manual Set
- TX User's Manual Set
- TX Programmer's Manual Set

Prerequisites

RC9000-30/40 Processing Unit, which includes SW9001I TX Operating System

Licensing conditions

SW9001I is licensed for use with the processing unit of which it is a part.

Asynchronous Terminal Control Program

SW9310I
Release 1

The Asynchronous Terminal Control Program is the basic software package for the RC9310 Local Device Control Unit. The Control Program allows the attached terminals to communicate as character oriented terminals with a RC9000 Processing Unit via the RcLAN network.

Characteristics

- Real-time monitor for RC9310
- Level 2-3 protocol handling according to IEEE802.3 on LAN
- High level Character Stream Protocol (CSP) handling for RcLAN
- Support for VT200 protocol at terminal handling
- Software controlled individual configuration of terminal ports
- Parallel printer port handling
- Loading from processing unit via RcLAN
- Handling of status lamps on RC9310 front panel
- Updating of error-log file.

Product Description

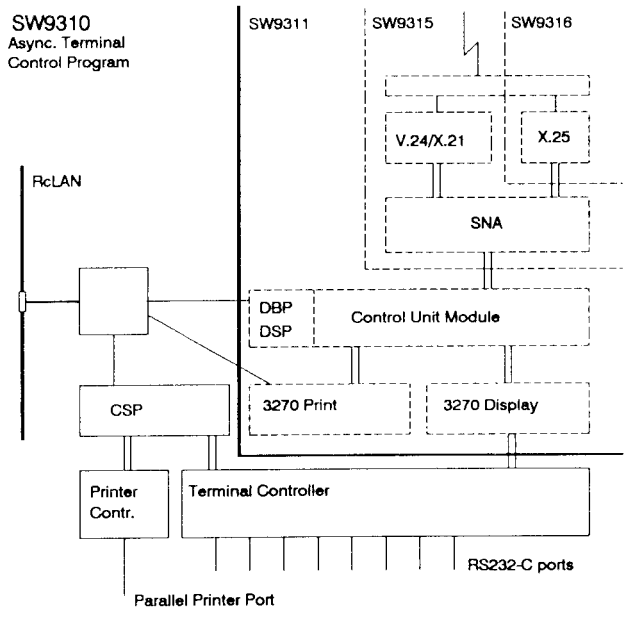
The Asynchronous Terminal Control Program is the basic software package for the RC9310 Local Device Control Unit and consist four major components:

- Real-time monitor controling the RC9310
- Software for handling the low level protocols at the local area network.
- Software for handling the character oriented high level protocol on RcLAN, called Character Stream Protocol (CSP).
- Drivers for handling the device ports on RC9310

Since the RC9310 is not equipped with is own file storage device the Asynchronous Terminal Control program is loaded from files on the backing storage managed by the RC9000 host operating system. This is done via a server function across the RcLAN.
The RC9310 has access to the binary program files constituting the Control Program and a number of parameter files containing a customized specification of the way the terminal ports shall operate. This customization must be done by the system administrator. Along with these customization files the system administrator has access to a log file created on the backing storage of the RC9000 system by the real-time monitor on RC9310. Errors experienced by the RC9310 during load as well as during normal operation will cause information to be written in the log file.

Product application

Besides the software for the fundamental real-time monitoring tasks the Asynchronous Terminal Control Program contains software for handling the 9 channels for local devices. 8 asynchronous V.24 ports and a parallel printer port. The channels are used to attach character oriented devices and the Asynchronous Terminal Control Program handles the communication between the channels and the RC9000 processing units via RcLAN.
The Character Stream Protocol (CSP) is the protocol used for character oriented communication with the RC9000 Processing Units via RcLAN.



RC9310 SW Structure

The 8 channels with V.24 ports, may be customized as terminals, printers, no-login, asynchronous communication lines, or as asynchronous CSP gateway ports.

Terminal Channels
Ports customized as terminals are used to attach character oriented terminals which are to have access to a number of applications runing on the RC9000 Processing Units and possibly other RcLAN hosts as well.

Printer Channel
A printer channel is owned by a RC9000 Processing Unit. All output to the printer must come from or pass through the owner, normally through a spooler.

No-login Channel
A no-login channel is, like the printer channel, owned by a RC9000 Processing Unit on the RcLAN. Such a channel may be used to connect a terminal with console status.

CSP Gateway Channel
A CSP Gateway channel gives the oppurtunity to use a V.24 port on the RC9310 as asynchronous gateway to equipment that is not able to attach the RcLAN network. Any terminal attached to RcLAN using the CSP protocol may - if properly configured - select a CSP Gateway channel.

Documentation

Configuration and operation is described in "TX System Administrator's Manual Set" (SW9902I-D) and "RC9000-10 System Administrator's Guide" (SW9911I-D).

3270 Terminal Support for RC9310

SW9311I
Release 1

The 3270 Terminal Support for the RC9310 Local Device Control Unit makes the RC9310 function as control unit for 3270 format oriented communication between RC9000 hosts, terminals and printers. The terminals and printers may either be attached via the RcLAN network or be character oriented VT200 compatible terminals using a conversion facility and attached directly to the RC9310.

Characteristics

- IBM 3174 Control Unit Emulation
- 3270 to VT200 conversion facility
- 3270 print device emulation
- High level Data Stream Protocol (DSP) handling for communication with host attached to RcLAN
- High level Device Buffer Protocol (DBP) handling for communication with display and print devices attached to RcLAN.
- Software controlled configuration of control unit emulation
- Loading from processing unit via RcLAN

Product Description

The 3270 Terminal Support is the basic software package for 3270 format oriented communication via RC9310 and consist of four major componenets:

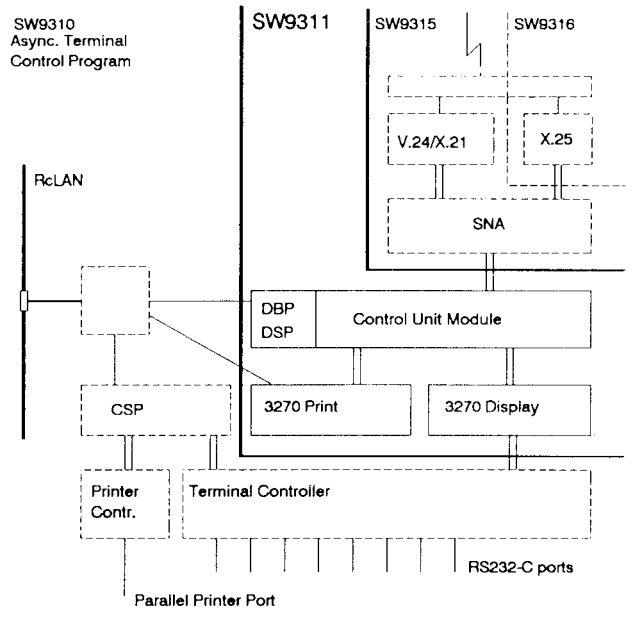
- IBM 3174 Control Unit Emulation
- 3270 Display Device module
- 3270 Print Device module

Since the RC9310 is not equipped with is own file storage device the 3270 Terminal Support program is loaded from files on the backing storage managed by the RC9000 host operating system. This is done via a server function across the RcLAN.
The RC9310 has access to the binary program files constituting the 3270 Terminal Support Program and a number of parameter files containing a customized specification of the way the IBM 3174 Control Unit Emulation shall operate. This customization must be done by the system administrator by editing the appropiate files residing on the RC9000 disks.

Product application

The control unit emulation handles the communication between a number of 3270 display devices and 3270 print devices and one or more hosts attached to the RcLAN network - for example RC9000 processing units running an application using 3270 format oriented communication to terminals and printers.
The communication between the control unit and the host is done according to the Data Stream Protocol (DSP) via the Control Unit LAN Interface module.

Display Device Attachment
3270 Display devices using the IBM 3174 control unit emulation may be of two types.
The first type is the character oriented VT200 compatible terminals attached to the RS232-C ports on the RC9310 - these terminals use a 3270/VT200 conversion facility that makes them act as 3270 format oriented terminals when communicating with the control unit emulator. The 3270/VT200 conversion facility controls the character oriented terminal so it appears to the operator as a 3270 terminal. The conversion facility



RC9310 Software Structure

makes intensive use of the VT200 protocol (ANSI X3.64) when controlling the character oriented terminal.
The second type of display device is attached via the RcLAN network. The 3270 Terminal Support program

uses the high level Device Buffer Protocol (DBP) to communicate with devices attached via RcLAN. These devices may be PCs or the RC900 UNIX machine equipped with 3270 Terminal programs and appropiate hardware for RcLAN attachment. The display devices may also be character oriented terminals attached to another RC9310 equipped with the SW9311 Terminal Support Program.

Print Device Attachment
The SW9311 Terminal Support Program includes a 3270 Print Device module that handles the printing functions of the control unit emulator. This module acts as a print device seen from the host and formats the data for printing. The formatted print data is send via RcLAN to a printer server, normaly with a spooling facility, which sends the data to the printer. The printer may physically be attached to the RC9310 or some other equipment attached to RcLAN.

Documentation

Configuration and operation is described in a separate manual intended for insertion in "TX System Administrator's Manual Set" (SW9902I-D) or "RC9000-10 System Administrator's Guide" (SW9911I-D).
3270/VT200 Conversion Facility User's Guide is included in SW9311. This guide describes how to operate a VT200 compatible terminal as a 3270 format oriented display device.

Prerequisites

RC9310 Local Device Control Unit with SW9310 Asynchronous Terminal Control Program.

For use of 3270/VT200 conversion facility the character oriented terminals must be VT200 compatible.

Related Products

SW9315 SNA/SDLC/QLLC Remote Host Suppport
SW9316 X.25 DTE Support

SW9311 Specifications

Control Unit	
Devices	max. 128
Character set	Configurable
Conversion table	Configurable
Display devices	
Screen format	24 × 80 characters
Statusline	80 characters
Commands	Erase all unprotected
	Erase/Write
	Erase/Write alternate
	Read Buffer
	Read Modified
	Read Modified all
	Write
Printer Devices	
Format	selectable up to 132 chars/line

SNA/SDLC/QLLC Remote Host Support

SW9315I
Release 1

The SNA/SDLC/QLLC Remote Host Support for the RC9310 enables the terminals and printers using the SW9311 3270 Terminal Support to communicate with a remote host. The Remote host support uses the synchronous port on RC9310.

Characteristics

- V.24/SNA/SDLC communication supported
- X.21/SNA/SDLC communication supported
- X.25/SNA/QLLC communication supported (requires SW9316)
- IBM Alert function supported
- IBM Maintenance Statistics supported
- Software controlled configuration of communications port
- Loading from processing unit via RcLAN

Product Description

The SNA/SDLC/QLLC Remote Host Support enables the IBM 3174 Control Unit emulator included in SW9311 to communicate with a remote SNA-host via the synchronous port on the RC9310 Local Device Control Unit. The Remote Host Support includes the software which controls the SNA protocol, the character set encoding/decoding, and the low level protocols.
The SW9315 Remote Host Support enables the RC9310 to use one of the following type of communication protocols:

- V.24 / SDLC / SNA with a transmission rate of max. 19.200 bps, half/full duplex
- X.21 / SDLC / SNA with a transmission rate of max. 9.600 bps. according to DATEX specifications.

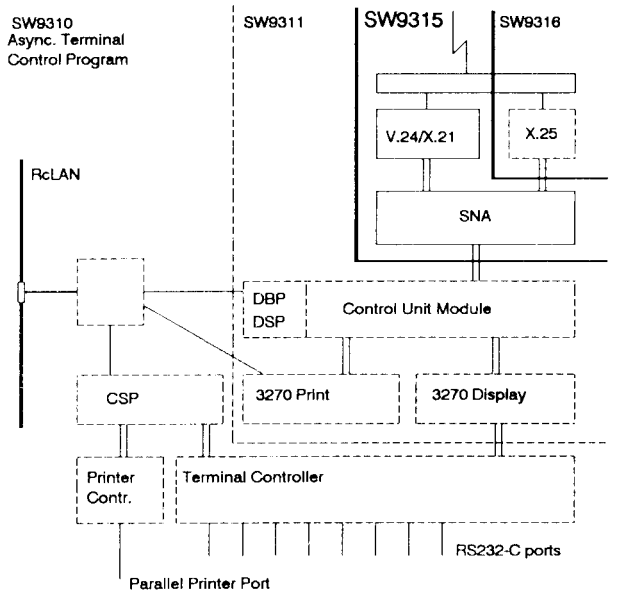
SW9310 Remote Host Support is prepared for support of X.25 communication, which requires the installation of the SW9316 X.25 DTE Support.

Since the RC9310 is not equipped with is own file storage device the SNA/SDLC/QLLC Remote Host support program is loaded from files on the backing storage managed by the RC9000 host operating system. This is done via a server function across the RcLAN.

The RC9310 has access to the binary program files constituting the SW9315 remote host support and a number of parameter files containing a customized specification of the way the communication to the remote host port shall operate. This customization must be done by the system administrator.

Product application

In combination with SW9311 3270 Terminal Support the SW9315 Remote Host Support turns the RC9310 into an IBM 3174-compatible control unit with a high speed communication line to a remote host computer using the SNA protocol.



RC9310 Software Structure

Terminals supported
Character oriented terminals attached to an RC9310 may use the 3270/VT200 conversion facility, the IBM 3174 Control Unit emulation and the SW9315 Remote host support to communicate as a 3270 format oriented display device with a remote SNA host.
Terminals connected to the RC900 UNIX machine equipped with the 3270 Terminal software package may use the RC9310 as control unit for remote host communication. The SW9315 Remote Host Support enables 128 devices attached either via the RcLAN network or directly to the RC9310 to use the communication link to a remote SNA-host.

SNA host print
SW9315 Supports both SCS printing and 3270 printing. The remote SNA-host may send print data to the RC9310 via the communication line, and the 3270 print module supplied with the SW9311 3270 Terminal Support package will format the data and send it to the printer.

The SW9315 supports the IBM Alert function. Information about errors and operator generated messages are send to the application, IBM Netview, in the host computer as *Network Management Vector Transport (NMVT)* type = Alert.
Information exchange about the RC9310 configuration is also supported. The host computer may ask for information by use of a *REQest Maintenance Statistics (REQMS)* command and the RC9310 will answer by sending a *RECord Formatted Maintenance Statistics (RECFMS)* type 5.

SW9310 Remote Host also supports *Error Recovery Procedure (ERP)* initiated by the host computer. The error recovery is used in a multi domaine SNA network, when part of the network has been out of operation. The error recovery on RC9310 will take place without interrupting active sessions.

SW9315 Specifications

Control Unit

Link level protocols	V.24 SDLC
	X.21 SDLC
Transmission speed V.24	19.200 bps
Transmission speed X.21	9.600 bps
Encoding	NRZ
Devices	128
Data Streams	3270 Data stream
	SNA Character Stream
PU type	2.0
LU types	1 (SCS printer)
	2 (3270 Display)
	3 (3270 Printer)

SNA Commands

ACTLU (COLD/ERP)
ACTPU (COLD/ERP)
BIND / UNBIND
CLEAR
DACTLU / DACTPU
SDT
CANCEL
CHASE
LUSTAT
NOTIFY
RTR
SHUTC / SHUTD
SIGNAL
NMVT type ALERT and Response Time Monitor

Documentation

Configuration of the remote host communication is described in a separate manual intended for insertion in either "TX System Administrator's Manual Set" (SW9902I-D) or "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisistes

RC9310 Local Device Control Unit equipped with SW9310 Asynchrouns Terminal Control Program and SW9311 3270 Terminal Support.

TF663S/M/L Synchronous V.24 DCE Cable or TF666XS/M/L Synchronous X.21 DCE Cable depending on the type of communication link.

Related Products

SW9316 X.25 DTE Support which enables the SW9315 Remote Host Support to use an X.25 Packet switched network.

X.25 DTE Support

SW9316I
Release 1

The X.25 DTE Support package makes it possible to attach the RC9310 to a packet switched network by using the synchronous communication port on RC9310. The X.25 DTE Support can be used by the SW9315 SNA Remote Host Support in order to use X.25 communication with a remote SNA host.

Characteristics

- Protocol according to CCITT X.25 level 2 and 3, 1984
- Software controlled configuration of customization parameters
- Loading from processing unit via RcLAN

Product Description

The X.25 DTE Support software contains the programs required to communicate with a network according to the CCITT recommendation X.25 (level 2 and 3) from 1984; in most cases, networks based on the recommendation from 1980 can be handled as well.
In brief the programs contained are:

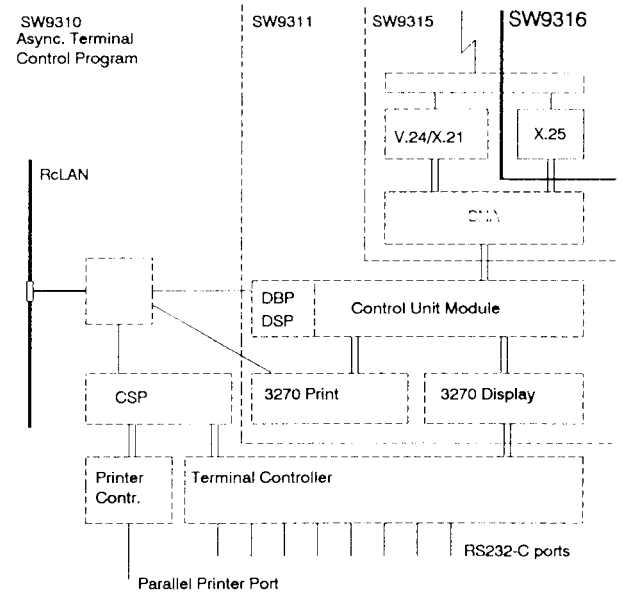
- X.25 - which controls the basic start-up of the X.25 software
- HDLC - which communicates via the physical network link node of the network according to level 2 of the recommendation.
- DTE - which communicates via the network with the remote subscribers accroding to level 3 of the recommendation.

The communication at level 3 (DTE) uses so-called *permanent virtual circuits* and *virtual calls*. A permanent virtual circuit is permanently established between two subscribers, and a virtual call can be initiated by a call request from this subscriber, or it can be initiated by an incomming call to this subscriber.

Since the RC9310 is not equipped with is own file storage device the X.25 DTE programs are loaded from files on the backing storage managed by the RC9000 host operating system. This is done via a server function across the RcLAN.
The RC9310 has access to the binary program files constituting the X.25 DTE Program and a number of parameter files containing a customized specification of the way the X.25 communication shall operate. This customization must be done by the system administrator.
The RC9310 Control Unit reads the customization file at start-up; in case of failure - possibly due to errors in the customization file - the control units writes an error message in the error-log file at the RC9000 backing storage.

Product application

The X.25 DTE Support requires that one or more additional software packages are installed to take care of the various kinds of high level communication. For instance, the X.25 DTE Support working together with the SW9315 SNA Remote Host Support package enables the RC9310 Local Device Control Unit to communicate with a remote SNA host via a X.25 network. In this case the protocol is SNA/QLLC.



RC9310 Software Structure

Documentation

Configuration of the X.25 communication is described in a separate manual intended for insertion in "TX System Administrator's Manual Set" (SW9902I-D) or "RC9000-10 System Administrator's Guide" (SW9911I-D).

Prerequisistes

RC9310 Local device control Unit equipped with SW9310 Asynchronous Terminal Control Program
TF663S/M/L Synchronous V.24 DCE Cable

SW9316 Specifications

Connector	25-pin D on RC9310
Transmission rate	19.200 bps
Protocols	X.25 level 2, 3 1984 (X.25 level 2, 3 1980)
Virtual circuits	Permanent or switched

Customization parameters

Network address
No. of permanent virtual circuit
Lowest channel number, incomming calls
Highest channel number, incomming calls
Lowest channel number, two-way operation
Highest channel number, two-way operation
Lowest channel number, outgoing calls
Highest channel number, outgoing calls
Packet size
Maximum packet size in virtual calls

RC9000-10 Basic System Software

SW9800
Release 1

The package contains the basic software for the RC9000 systems based on the RC9000-10 Processing Unit. This includes downloadable software for the various controllers, the System Support Processor software, the basic multiprogramming environment, the Monitor, as well as the basic operating system, called "s", and a number of useful system software packages.

Characteristics

- RC9000-10 Monitor
- System Support Processor software
- Terminal Access System (TAS)
- SOS operating system
- PRIMO printer module
- System Utilities
- Screen Editor
- TTY-Emulator

Product Description

The package is distributed as a diskette and a number of magnetic tapes.
The diskette contains the controller software, the SSP software and the Monitor. During installation a number of basic system parameters are stored on the diskette, among these the necessary parameters for the Monitor. This provides a flexible way of configuring and reconfiguring a system.
The following are short descriptions of each sub- package:

Monitor
The Monitor is the basic multiprogramming environment for the RC9000-10. The Monitor is not in itself an operating system, but a kernel that provides a number of facilities to be used by operating systems. In this context an operating system is simply a program that schedules resources for other programs.

S
The basic operating system is called s. It will always be the first process, and as such the owner of all resources. s hands out resources to more specialized operating systems, but application programs may run directly under s if so desired. s does not perform swapping.

Terminal Access System (TAS)
The Terminal Access System provides a number of features, oriented towards user administration. Menus for application selection may be customized for individual users, and the application selection can be fully controlled, i.e. TAS provides a security system for RC9000-10.

SOS
The Swapping Online System is an operating system, mainly targeted towards on-line applications, although batch jobs may also be executed.

PRIMO
PRIMO is a printer spooler module, to be used with any application and operating system.

System Utilities
The System Utilities covers a wide area. The central program is the File Processor, a command interpreter shell, that controls job execution. A set of programs for catalog handling, data handling and job control is provided, as well as a number of programs labelled Maintenance Utilities, which are used for troubleshooting and system services. The package also contains programs for tape back-up procedures.

Screen Editor
The Screen Editor is a screen editor especially aimed at program development. It contains a number of facilities for easy and fast editing of source programs. The Screen Editor may be customized to handle a wide range of terminal types by editing a parameter file .

TTY-Emulator
The TTY-Emulator allows 3270-format oriented devices to access applications intended for TTY devices.

Documentation

The following documentation is included in SW9800:

- SW9890I-D: Monitor Manual Set
- SW8010-D: System Utility Manual Set
- SW8020-D: Screen Editor Reference Manual
- SW8110-D: TAS Manual Set
- SW8232-D: TTY-Emulator Manual Set

RC9000-10 BOSS

SW9802I
Release 1

The BOSS operating system provides fast batch processing of jobs while at the same time serving a number of terminal users - as many as 50 terminals, from which independent users can perform editing and job entry. BOSS offers the possibility of editing a file, e.g. a source file, a configuartion parameter file or a the job file currently connected to the terminal.

Characteristics

- No. of concurrent jobs optimized dynamicly
- Resource allocation may be specified both at project and user level.
- Resource account file facility
- Dynamic job scheduling relative to job size.

Product Description

BOSS is primarily an efficient batch operating system, enhanced with facilities for program development.
BOSS is structured in a way where all those permitted to run under BOSS are registered in the BOSS user catalog, ordered in groups called projects. The BOSS user/project catalog contains descriptions on the resources available to the members of each project. The user/project scheme also implements data access control and an account file.
If a BOSS system is loaded into a child process of the basic operating system "s", s can allocate some or all of its resources to the BOSS system. The BOSS system can then ceate child processes of its own, but it is only possible to have one BOSS system running at a time.
BOSS handles up to 8 Mega halfwords of memory.

The basic task for a multiuser time-sharing system like BOSS is the ability to swap programs in and out of memory, thereby making it possible for several processes to share the same memory area, and in consequence to make room for a larger munber of terminal users simultaneously.
BOSS swaps programs between the job execution areas in memory and the backing storage, where jobs await execution. The number of jobs running at any moment is constantly optimizes by reorganizing the use of the memory area. The job execution sequence is determined by a priority scheduling algorithm, such that the ratio between estimated running time and waiting time is the same for all jobs in the job queue. This dynamic scheduling strategy means that small jobs, requiring little computing time are executed quickly, while large batch jobs and similer jobs are guaranteed execution, but must expect longer turn-around times.

Documentation
BOSS installation and operation is described in RC9000-10 BOSS Manual Set which contains the following titles:
- BOSS User's Guide
- BOSS Operating Giude
- BOSS Installation and Maintenance

RC9000-10 BOSS Manual Set is included in SW9802 but additional copies may be ordered under the sales no. SW8101-D.

RC9000-10 Compiler Collection

SW9805
Release 1

The RC9000-10 Compiler Collection is an assembly of the compilers available for the RC9000-10 systems. The compilers are functionaly identical to the corresponding compilers known from the RC8000 Series in order to make applications easily portable from RC8000 to RC9000. Almost all of the documentation for the compilers is redesigned.

Characteristics

- ALGOL compiler
- FORTRAN compiler
- Run Time System
- XFORTRAN preprocessor
- PASCAL compiler
- Symbolic Assembler for RC9000-10
- Libraries for ALGOL and FORTRAN

Product Description

The Compiler Collection Software package consists of three different compilers and an assembler for the RC9000-10 Processing Unit with an extensive collection of procedures in libraries. The compilers are ALGOL, FORTRAN and Pascal.

ALGOL Compiler
The ALGOL compiler is based upon the definition of ALGOL 60, but has been extended with numerous facilities for e.g. programming of such basic software as operating systems.
The runtime system of ALGOL and FORTRAN is the same, and will be linked into the translated program, just as an external procedure. When conforming to certain natural rules, it is also possible to link external FORTRAN procedures to ALGOL programs, and vice versa.

FORTRAN Compiler
The RC FORTRAN Compiler presents a FORTRAN version close to ISO FORTRAN. There are a number of limitations, as compared to the ISO standard, but there are extensions as well.
The extensions concern the character set, the possibility of having 48-bit integers, masking and shifting operations, zone and record handling procedures, and more.
The RC9000-10 Compiler Collection also includes an XFORTRAN pre-processor that transforms programs written in a subset of FORTRAN IV (ANSI FORTRAN) into RC FORTRAN and provides the user with the cross reference listing option.

Pascal Compiler
The Pascal Compiler for RC9000-10 has been implemented according to the ISO Pascal standard.
The Pascal Compiler comprises the compiler itself, as well as some utility programs for formatting Pascal source programs and for generating cross reference listings.
The Pascal Compiler further includes a facility for performance measurements, i.e. for making a listning of routines called in a program, the number of times called, and some time measurements.

SLANG Assembler
The RC9000-10 Compiler Collection holds SLANG, the symbolic assembler for RC9000-10 and the utility programs for this assembler.

Procedure Libraries
Two software modules contains procedure libraries for Indexed Sequential File Access (ISQ) and database programming according to the Connected Files concept, both accessible from ALGOL as well as FORTRAN.
One software module contains the procedure libraries for mathematical-statistical programming, supplying the ALGOL/FORTRAN programmer with high standard tools in numerical and statistical analysis.
Two software modules contain useful libraries for the ALGOL/FORTRAN programmer in the fields of text handling and coroutine programming, scheduling and message communication.

Package Contents

The RC9000-10 Compiler Collection contains the following elements:

- ALGOL Compiler
- FORTRAN Compiler
- XFORTRAN Preprocressor
- PASCAL Compiler
- SLANG Assembler
- Backing Storage Library
- Database Library

- Math./Statistics Library
- ALGOL Text Procedures
- ALGOL Coroutines

Documentation

The documentation for the compiler collection may be ordered separately, sales no. SW8585-D, and consist of the following items:

- ALGOL Manual Set
- FORTRAN User's Manual
- XFORTRAN Manual
- Pascal User's
- Assembler Manual Set
- Backing Storage Library Manual Set
- Database Library Manual Set
- Math./Stat. Reference Manual
- ALGOL Text Procedures User's Guide
- ALGOL Coroutines Manual Set

RC9000-10 Graphics Support

SW9822I
Release 1

The Graphics Support software package is a ported software package called UNIGKS. UNIGKS is an implementation of the International Standard Graphics Kernel System.

Characteristics

- Implementation of Graphics Kernel System (GKS)
- Makes graphic applications independent of graphic devices
- New graphic devices supported simply by providing one driver for that device

Product Description

The Graphics Support software package contains UNIGKS. UNIGKS is an implementation of the International Standard Graphics Kernel System (GKS version 7.2 of level 2b.)
UNIGKS is a FORTRAN (ISO FORTRAN) subroutine library that provides handling of several graphical devices simultanously and is based upon the European Software Contractors implementation of GKS. The subroutines can be used both in FORTRAN and ALGOL programs. The documentation for software package contains a description of some minor syntactical differences between the RC- implemetation and GKS as known on e.g. a VAX.

The main design concept of UNIGKS performs a close mapping of the original GKS concepts into ANSI FORTRAN (66 or 77) language dependent layers.

UNIGKS provides a set of basic functions for computer graphics programming. An application system calls GKS subroutines to generate graphic images on one or more graphic display devices.
The benefits obtained by using a standard for basic computer graphics are:

- Portablity - an application program should be easily portable among different installations.
- Device independence - an application program should produce similar, perhaps identical, images on quite different devices without modifications of the program.
- Device longevity - the entire array of graphical devices becomes controllable in a uniform manner.

UNIGKS provides handling of several graphical devices simultaneously and managing of user defined picture elements, which leads to the following tasks:

- Handling a set of internal tables that describes the state of GKS and the application program at any instant of time.
- Transmitting all graphical output from the application program to any active workstation or storage location for pictures.
- Transmitting graphical input data from workstations to application program.

UNIGKS is device independent at such a level of abstraction that hardware peculiarities are shielded from the application program. Different levels of device intelligence are hidden from the application program by simulating missing firmware facilities in software.
All graphical devices are accessed in a uniform way by UNIGKS. A new device of any type can be used immidiately by all application systems by providing only one driver for that device.

Documentation
The RC9000-10 Graphic Support includes the following documentation:

- UNIGKS Reference Guide
- UNIGKS Tips
- UNIGKS Installation Guide
- UNIGKS Driver Installation Guide
- UNIGKS Special Design Concepts
- UNIGKS on RC8000

7. System Configuration

This chapter contains information on the configuration and upgrading of RC9000 Systems.

The basic building blocks are the RC9000 Models and it is described how to upgrade these into high-performance systems as regards specific requirements of processing power, backing storage, communication, etc.

The following topics are covered:

- **7.1 RC9000 Models**
  Gives an overview of the models and describes the possible upgrades to maximum limits.

- **7.2 General Topics**
  Describes some general considerations involved in upgrading a system: System Console, Tape Unit Access, Possible Combinations of Cabinets & Modules.

- **7.3 Processing Units**
  Various hints.

- **7.4 I/O Channels**
  Various hints.

- **7.5 Local Area Networks**
  Describes the LAN attachment of Processing Unit, Non- RC Hosts, Communication Control Unit and Devices. Overview of typical uses. Overview of network cabling and transceiver types.

- **7.6 Local Attached Devices**
  Describes mainly the RC9310 Local Control Unit.

- **7.7 Remote Attached Devices**
  Describes mainly the RC9330 Communication Front End.

- **7.8 Remote Host Communication**
  (Pending)

7.1 RC9000 Models

The tables below gives an overview of the basic RC9000 Models as well as of the ways in which they can be upgraded, including the maximum limits for expansion.

Characteristics	RC9000C	RC9000MR	RC9000FT
Architecture	Tightly coupled	Loosely coupled	Loosely coupled
Multi Processing	Yes Max. 4 x RC8500 70% additional processing power per additional CPU	Standard 2 x RC9010	Standard 2 x RC9010
Linear Growth	No	No	Yes Max. 32 Processing Units can be loosely coupled
Fault Tolerance	No	No	Yes

System Upgrade	RC9000C	RC9000MR	RC9000FT
To RC9000MR	F920		
To RC9000FT		F921	

PU Upgrade	RC9000C	RC9000MR	RC9000FT
No. of slots available for upgrade	**10**	**10**	**9**
SIB High-Speed Channel	**No**	**No**	**Yes** **Max. 2 x RC9315 per PU** Total band width 40 Mbit/s Thin Ethernet (occupies 2 slots)
CPU	**Yes** **4 x RC8500** **(occupies 8 slots)**	**No** (Standard CPU) (occupies 2 slots)	**No** (Standard CPU) (occupies 2 slots)
Memory	**4 MEGA Words** (12 MB) **as maximum** **2 x RC9110** **1 x RC9112** (occupies 1 or 2 slots)	**128 MB as maximum** **8 x RC9112** (occupies 8 slots)	**128 MB as maximum** **8 x RC9112** (occupies 8 slots)
I/O Channel	**4 x IPI Channels as maximum** **4 x RC9120** (occupies 4 slots)	**4 x IPI Channels as maximum** **4 x RC9120** (occupies 4 slots)	**4 x IPI Channels as maximum** **4 x RC9120** (occupies 4 slots)
RcLAN Controller	**4 x RcLAN Controller as maximum** **4 x RC9130** (occupies 4 slots)	**4 x RcLAN Controller as maximum** **4 x RC9130** (occupies 4 slots)	**4 x RcLAN Controller as maximum** **4 x RC9130** (occupies 4 slots)
	Standard Options: RC9130 is equipped with Thin Ethernet F930 Upgrade to Ethernet F931 Upgrade to RcMicronet		

Controllers	RC9000C	RC9000MR	RC9000FT
No. of Tape/Disk Controllers per channel	8 RC9210 or RC9220	8 RC9210 or RC9220	8 RC9210 or RC9220
No. of Tape Units per Tape Controller	2 RC9250 or RC9255	2 RC9250 or RC9255	2 RC9250 or RC9255
No. of Disk Drives per Disk Controller	4 RC9230 or RC9235	4 RC9230 or RC9235	4 RC9230 or RC9235
Dual porting of Disk Control Module	Yes	No	No
Dual porting of Disk Drive	No	Yes	Yes
Dual porting of Tape Controller	Yes	Yes	Yes

Tape Units	RC9000C	RC9000MR	RC9000FT
Horizontal Tape Unit RC9250	only for L-version	only for L-version	only for L-version
Vertical Tape Unit RC9255	only for H-version	only for H-version	only for H-version

Communication	RC9000C	RC9000MR	RC9000FT
Max. no. of Com. Contr. Units per PU	Limitation depends on LAN configuration		

Printers	RC9000C	RC9000MR	RC9000FT
Max. no. of Printers	1 system printer per RC9310 CCU		

7.2 General Topics

System Console

Each Processing Unit (PU) requires 1 console.

A system console is included in the models. When a model is upgraded with additional PUs (RC9000-10, RC9000-30 or RC9000-40), however, a console must be ordered separately for each PU.

Possible Combinations of Cabinets & Modules

The tables below gives an overview of the possible expansions within the system cabinets of the models and shows which combinations of modules that can be accommodated in additional cabinets in general.

Tape Unit Access

Each Processing Unit (PU) requires access to a Tape Unit (RC9250 or RC9255) for load and save purposes.

Two PUs can share a Tape Control Module (RC9220).

Modules additionally	RC9000C-L	RC9000MR-L	RC9000FT-L
RC9210 Disk Control Module	1	1	2
RC9230 Disk Drive	3 (+ 1 x F905)	3 (+ 1 x F905)	6 (+ 3 x F905)*
RC9310 CCU (Local Devices)	4	4	4

Modules additionally	RC9000C-H	RC9000MR-H	RC9000FT-H
RC9210 Disk Control Module	3	3	None
RC9230 Disk Drive	7 (+ 3 x F905)*	7 (+ 3 x F905)*	2 (+ 1 x F905)
RC9310 CCU (Local Devices)	4	4	4

*** 4 x RC9230 (+ 2 x F905) replaceable by 2 x RC9235 (+ 1 x F906)**

F901-2 Low Cabinet Extension

The table below shows all legal combinations of equipment that can be installed in the F901-2 Low Cabinet Extension.

RC9000 (10/30/40)	RC9210	RC9220	2 RC9230 = 1 F905	2 RC9235 = 1 F906	RC9250	5 RC9310 = 1 F908	3 RC9330 = 1 F909
F901-2 Cabinet extension provides possible combinations as follows:							
		1			1		1
						1	1
1							1
							2
	2		2				1
	1			1			1
						2	
1						1	
	2		2			1	
	2			1		1	
		1			1	1	
1	2		2				
1	2			1			
1							
	4		4				
	4		2	1			
	4			2			
	2	1	2		1		
	2	1		1	1		
		1			1		

F902-2 High Cabinet Extension

The table below shows all legal combinations of equipment that can be installed in the F902-2 High Cabinet Exension.

RC9000 (10/30/40)	RC9210	RC9220	2 RC9230 = 1 F905	2 RC9235 = 1 F906	RC9255	5 RC9310 = 1 F908	3 RC9330 = 1 F909
F902-2 Cabinet extension provides possible combinations as follows:							
							3
						1	2
						2	1
1							2
	4		4				1
	4		2	1			1
	4			2			1
		1			1		1
						3	
1						2	
	4		4			1	
	4		2	1		1	
	4			2		1	
		1			1	1	
2							
1	3		4				
1	3		2	1			
1	3			2			
	2	1	2		1		
	2	1		1	1		
	4		4				
	4		2	1			
	4			2			
		1			1		

7.3 Processing Units

The processing units have 9-10 slots free for additional modules.

RC8500
If the load on RC8500 CPU/FPU is larger than 85%, the PU should be upgraded with another RC8500 CPU/FPU. An upgrade of an RC9000-10 PU with an additional RC8500 must be accomplished by an additional RC9110 8 MB Memory board as well.

RC9000-10 can hold max. 4 RC8500 CPU/FPUs

RC9010
RC9000-30/40 Processing Units **cannot** be upgraded with additional RISC processor modules - Processing Units must be added!

RC9110 / RC9112
RC9000-10 Processing Units can hold max. 2 RC9110 8 MB Memory boards. If the processing unit is equipped with more than 8 modules, the RC9112 16 MB Memory board is recommended in order to reduce the load on the power supplies and to allow further upgrading.

RC9000-30/40 Processing Unit can be equipped with max. 128 MB of memory - the use of RC9112 16 MB Memory boards is strongly recommended if more than 16 MB of memory is to be installed.

RC9120
Attaching more than 4 tape/disk control modules, requires an additional RC9120 I/O Channel Controller.

A processing unit can be equippped with max 4 RC9120 controllers.

RC9130
Processing units can be equipped with max. 4 RC9130 RcLAN Controllers.

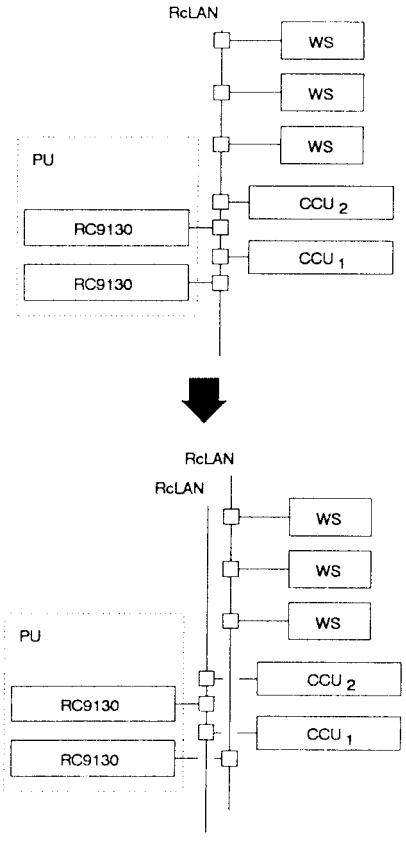
If the load on the RcLAN controller becomes a bottleneck, it is recommende that installation of additional RcLAN controllers is accomplished with a new RcLAN network - not by attaching two RcLAN controllers to the same RcLAN network.

RC9135
Only RC9000-40 Processing Units can be upgraded with RC9135 SIB-Bus Interface Modules. One additional SIB Interface Module can be added. - Giving a maximum of 2 RC9135 SIB-Bus Modules in each RC9000-40.

RC9000-30 Processing Units can be upgraded to an RC9000-40 with one SIB-Bus Interface Module by means of the F921 Upgrade Kit, which includes an RC9135 SIB-Bus Interface Module.

All RC900-30 Processing Units in a system must be equipped with the same number of RC9135 controllers.

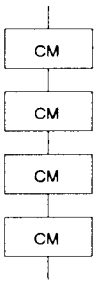
RC9140 / RC9142
Each processing unit must be equipped with one and only one RC9140 System Support Processor and the neccesary RC9142 SSP Floppy Disk Module. These modules must be placed in 1st and 2nd slot position.



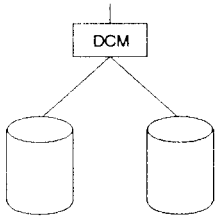
7.4 I/O Channel

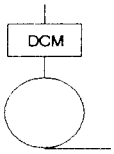
Every processing unit must be equipped with at least one RC9120 I/O Channnel Controller - and as maximum with 4 controllers.

It is recommended **not to** exceed a total of four tape/disk controllers per I/O channel.



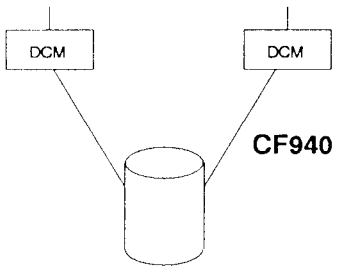
It is recommended **not to** attach more than 2 disk drives to each RC9120 Disk Controller Module and 1 tape drive to an RC9220 Tape Control Module.





Dual Access of Disk Drives

In RC9000 Systems equipped with RC9000-30/40 Processing Units, the disk drives can be attached to two disk control units by means of the CF940 Cable option.



Dual access of disk drives is not possible with the RC9000-10 systems.

7.5 Local Area Network

The Processing Units must be connected to a local area network, RcLAN, by means of the RC9130 RcLAN Controller.

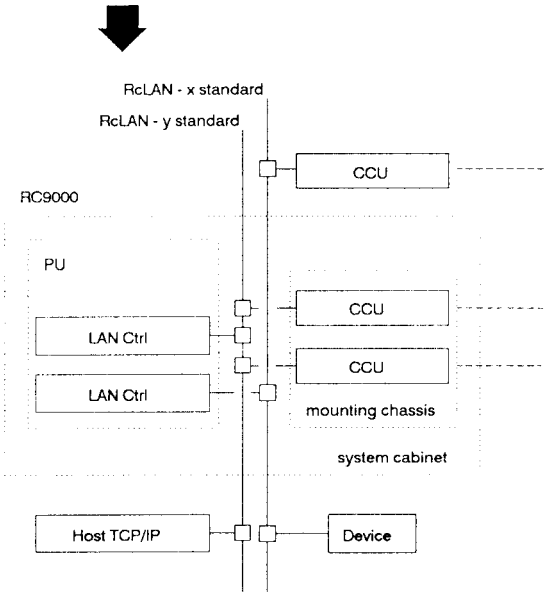
1...4 controllers per PU

As RC9000 standard, Thin Ethernet is used for the local area network cabling. Ethernet and RcMicronet are optional. A mix of network cabling standards is supported by using dedicated RC9130 RcLAN Controllers for each cabling standard.

Controller for each network type

Interconnections of different types of the networks by means of gateways/relays are not allowed.

In general, RC9000 controllers with Ethernet option require external Ethernet Transceivers and MF13x/15x Transceiver Cables. See also description later on.



PU / RcLAN	Controller	Option	Transceiver & Cable
Thin Ethernet	RC9130	None	None
Ethernet		F930	Ethernet Transc. MF13x/15x
RcMicronet		F931	MF107 MF124/125

LAN / Non-RC Hosts

In addition to the RcLAN communication to other RC products, the RC9130 LAN Controller supports communication with other host computers, like DEC and IBM hosts, on the local area network according to the TCP/IP protocol.

LAN / Communication Control Units

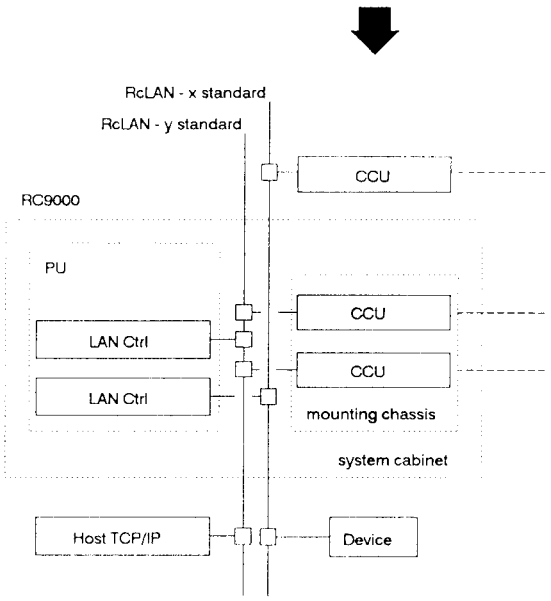
Most devices are attached to the RcLAN by means of communication control units (CCUs). Some CCUs are integrated in the RC9000 system cabinet, while others are externally connected as generally known for the various RC product lines.

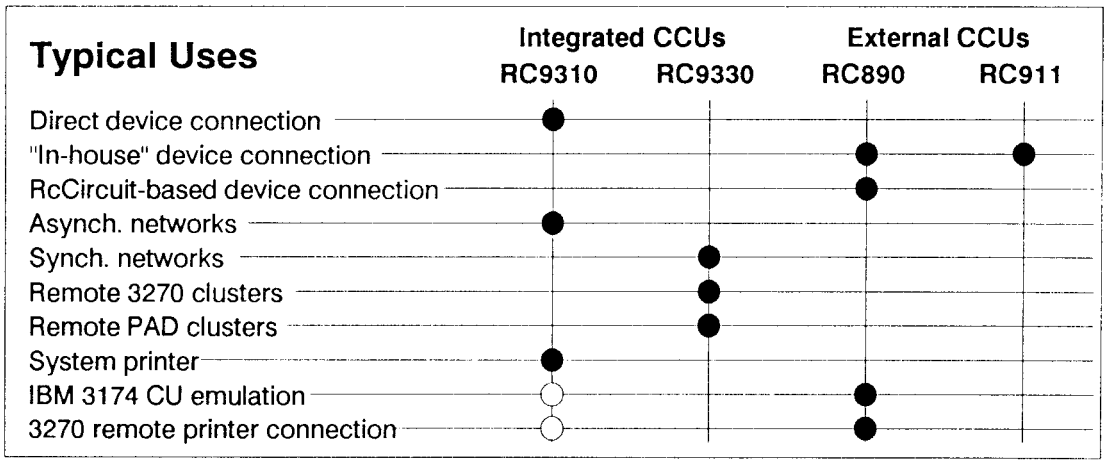
The integrated CCUs, RC9310 and RC9330 are described below in more detail; see also section 7.6 & 7.7.

Among the CCUs available from other RC product lines, the following should be mentioned:

- RC890 Control Unit
- RC900 UNIX Systems
- RC911 LAN MUX
- RC3502 Network Processor

The typical (recommended) use of different CCUs are outlined in the table below.





LAN / RC9310 & RC9330 CCUs

The integrated CCUs are build into the RC9000 system cabinet by means of mounting chassis, which can hold a number of CCUs and which can be equipped for different types of RcLAN network cabling. See tables.

Each of the RC9310 CCUs in a F908 Mounting Chassis can be individually configured for different LAN types.

Mounting Chassis / CCU	F908	F909
RC9310	**1..5**	
RC9330		**1..3**

In contrast, all RC9330 CCUs in a F909 Mounting Chassis **must** be configured for the same LAN type. By default, Thin Ethernet is standard.

(Thin Ethernet for RC9330 is implemented by means of 3 MF117 transceivers included with the F909 chassis; they must all be replaced by external Ethernet transceivers in case Ethernet is to be used.)

CCU / RcLAN	RC9310	RC9330	Transceiver & Cable
Thin Ethernet	None	None	None
Ethernet	**F932**	None	Ethernet Transc. MF134/135
RcMicronet	Not available		

LAN / Device

When furnished with appropriate adapters and software, various equipment of "device-type" can also be attached directly to the RcLAN - so, for instance:

- RC750 Partner PC
- RC900 DOS Computer (or PC/AT compatibles)

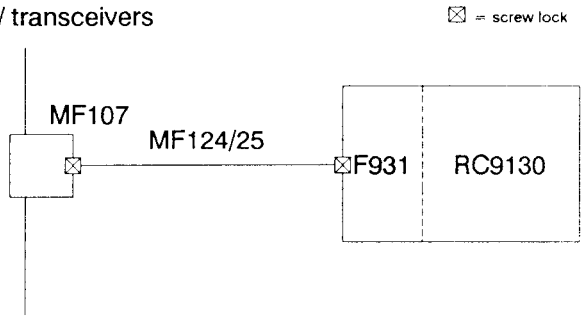
LAN / Transceivers & Cables

Different transceivers and cables are used for the different types of RcLAN network as outlined in the following.

RcMicronet
The integrated CCUs, RC9310 and RC9330, **cannot** be attached to RcMicronet.

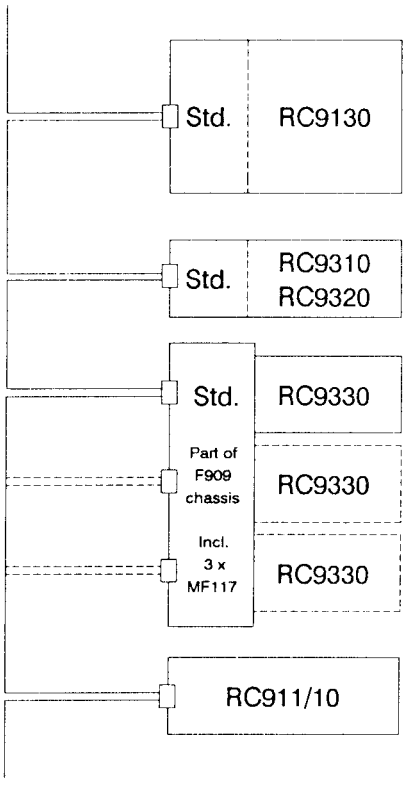
The RC9310 RcLAN Controller for the RC9000 PUs can be equipped for RcMicronet to allow attachment of existing RcMicronet installations.

RcMicronet
w/ transceivers



Thin Ethernet
RC9130 RcLAN Controller and RC9310 & RC9330 CCUs are by default equipped with interfaces for direct attachment to Thin Ethernet.

Thin Ethernet

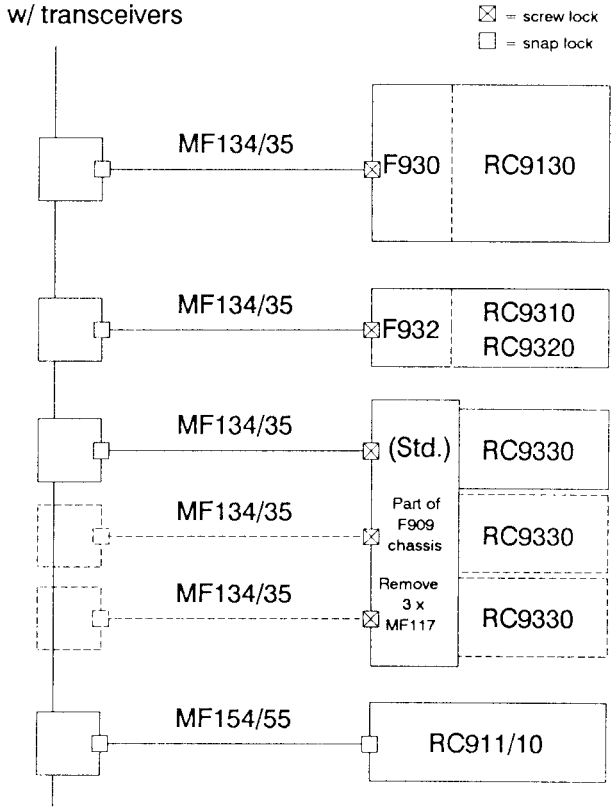


Ethernet

The RC9000 modules for LAN attachment can all be equipped for Ethernet operation by means of options. The use of Ethernet requires that the standard LAN interface boards are replaced and that external transceivers are used.

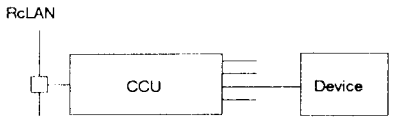
Ethernet

w/ transceivers



7.6 Local Attached Devices

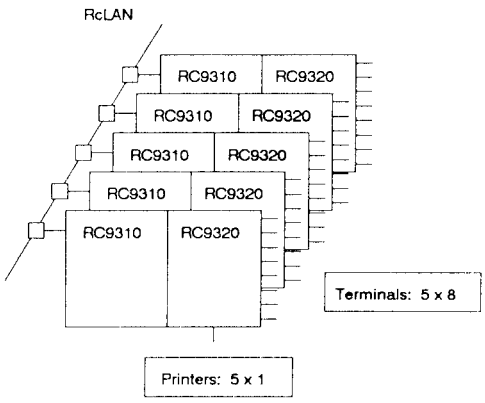
Local attached devices are terminals and printers connected "directly" to some Communication Control Unit (CCU). The CCU can be integrated in the RC9000 system cabinet or be externally connected. (Cf. 7.6)



The devices fall in two groups: character-oriented and format-oriented.

Character-oriented	Equipment	No. of devices
Asynch. Terminal (V.24)	RC9310 + RC9320	8
	RC911	8
	RC890-30	4
RC45 Terminal (RcCircuit II)	RC890-30	16 (...32)
Parallel Printer (Centronics)	RC9310 + RC9320	1

Format-oriented	Equipment	Limitations
RC45 w/ IBM 3180 Emulator (RcCircuit I)	RC890-30	Max. 32 terminals Max. 16 printers
RC900 w/ 3270 TERMINAL SW	RC9310 + RC9320	Max. number of sessions in RC9310

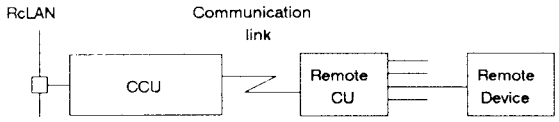


7.7 Remote Attached Devices

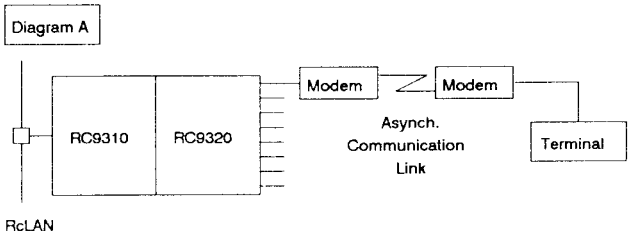
Remote attached devices are terminals and printers connected via som kind of communication link - typically via a public network.

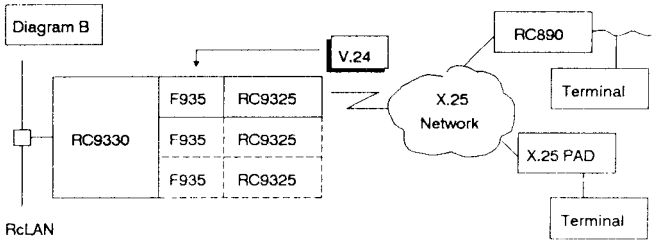
Communication control units are required to connect the communication link to the RcLAN network and, at the remote location, to connect the devices to the communication link. (Cf. 7.6 for a description of the RcLAN connection.)

The remote devices fall in two groups: character-oriented and format-oriented.



Character-oriented	CCU	Remote CU
Asynch. Terminals (V.24)	RC9310 + RC9320 + Asynch. MUX / Modem + SW9310	Multiplexer / Modem only
Cf. Diagram A		
	RC9330 + F935 RC9325 + SW9330 + SW9335	Triple-X PAD (RC890-30) (RC3502)
Cf. Diagram B		
RC45 Terminals (RcCircuit II)	RC9330 + F935 RC9325 + SW9330 + SW9335	RC890-30 w/ Triple-X PAD
Cf. Diagram B		
System Printer (Centronics)	Not possible	





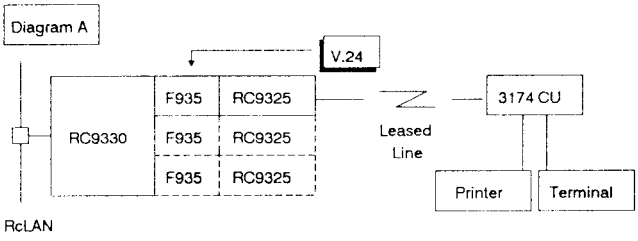
Format-oriented devices

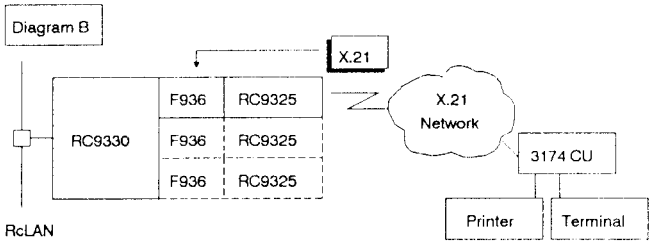
The only way to connect remote format-oriented terminals and printers is through the RC9330 Communication FrontEnd with the SW9336 3270 SNA Subhost software installed.

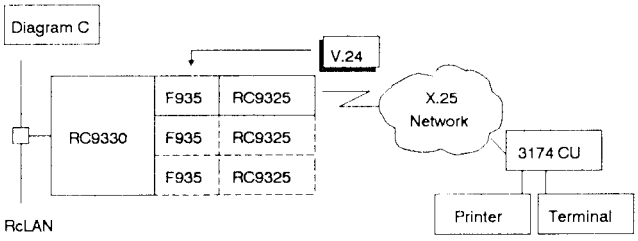
The RC9330 can be equipped with two different types of line controllers, either a type with V.24 interface (F935) or a type with X.21 interface (F936).

The number of terminals that can be attached through each line controller on the RC9330 very much depends on the traffic pattern and to mention specific numbers would be inappropriate

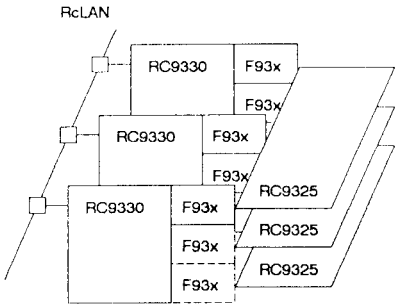
Interface & Protocol	Line Controller	Software
3270 / SNA V.24 / V.28 / SDLC Leased Line Cf. Diagram A	F935 V.24 line controller	SW9330 SW9336
3270 / SNA X.21 / SDLC Cf. Diagram B	F936 X.21 line controller	SW9330 SW9336
3270 / SNA V.24 / V.28 / X.25 / QLLC Cf. Diagram C	F935 V.24 line controller	SW9330 SW9336







RC9330 Configuration



RC9330 Upgrading	V.24 / V.28	X.21
Previously installed equipment gives point of entry to table of required equipment for upgrade		
RC9330 not installed **F909 chassis fully occupied**	**F909 Mounting Chassis** **RC9330 + RC9325** **F935 V.24 Line Controller**	**F909 Mounting Chassis** **RC9330 + RC9325** **F936 X.21 Line Controller**
1 x RC9330 installed		
No free slot for line controller	**RC9330 (2nd)** **F935 V.24 Line Controller**	**RC9330 (2nd)** **F936 X.21 Line Controller**
Free slot(s) for line controller(s)	**RC9325** **F935 V.24 Line Controller**	**RC9325** **F936 X.21 Line Controller**
2 x RC9330 installed		
No free slot for line controller	**RC9330 (3rd)** **F935 V.24 Line Controller**	**RC9330 (3rd)** **F936 X.21 Line Controller**
Free slot(s) for line controller(s)	**F935 V.24 Line Controller**	**F936 X.21 Line Controller**
3 x RC9330 installed		
No free slot for line controller	Same as F909 fully occupied	Same as F909 fully occupied
Free slot(s) for line controller(s)	**F935 V.24 Line Controller**	**F936 X.21 Line Controller**

8.1 Adresses

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8.2 RC Computer in brief

Very few companies in the data processing field have more years of experience than RC Computer A/S (RC or Regnecentralen in Danish), founded back in 1947 as an institute under the Danish Academy of Applied Sciences. In 1955 RC became an independent organization.
In 1955-56 RC developed the first Danish computer, DASK, short for Danish Arithmetic Sequence Calculator. DASK was based on tubes.
In 1960 RC took part in the commitee defining the Algol language in the Algol-60 report. Since this period RC has used Algol intensely, especially on the high-end system, and today RC has the most refined Algol system in existence.
Very performance-demanding application, such as the Directory Assistance System and the Library Information System, are written in Algol.

Also in 1960, RC introduced GIER, a fully transistorized computer developed in cooperation with the Danish Geodetic Institute.
From 1963 and onwards RC created a number of products, especially with relation to conversion, media handling and communication, and a product like the fastest ever paper-tape reader, RC2000, was sold in large numbers all over the world. In the late sixties and during the seventies RC introduced a series of new systems.
In the area of support and communication systems the 16 bit mini- computer based systems RC3500 and RC3600 was introduced.
In the high-end class the RC4000 (1969) and the RC8000 (1976) was introduced.

This product base and a number of associated system solutions gave RC a reputation as a highly qualified supplier of computers for database management and communications.
RC has been very active in the data communications field since the beginning of the seventies. Virtually all types of remote batch protocols have been developed followed by the implementation of the major interactive terminal protocols.

In addition to this, RC has implemented packet switching networks with the first installations taking place in the late seventies. The first network JTNET was put into operation at Jutland Telephone Company in 1974. Followed by a nationwide on-line network (with channel connections to IBM main-frames) servicing 2500 banking terminals for the Austrian Savings banks SPARDAT. In 1979 a nationwide packet switching network servicing 25.000 terminals was put into uperation at the computing centre for the German tax auditors, DATEV.

In 1980-82 the second generation of packet swithing network hardware & software was developed, named PAXNET. This network was applied as the university ressource sharing network in Denmark, as the backbone for the Alarm Transmission Network offered by the telephone Companies, as a ressource sharing network interconnecting more than 1000 terminals to several different host computers at the Copenhagen Telephone Company and finally in 1987 PAXNET was put into operation as the public Danish X.25 and X.28 network.
The network systems are constantly improved, and new standards are incorporated as soon as they have been defined in the standardization organizations, where work is followed closely by RC Computer. RC is furthermore involved in EEC projects (CARLOS and CACTUS) implementering higher level ISO protocols, X.25 based procducts and X.400 E-mail Services.

Since 1980 microcomputers have constituted a steadily growing part of RC Computer's revenue and product range. There is the professional 16-bit microcomputer RC750 Partner which is among the most sold personal computers in Denmark. The XENIX based RC39 was introduced as an office automation/small business system with advanced communication facilities.
A vital part of RC Computers system solutions involved LAN and terminal systems, and since 1982 RC has been offering comprehensive LAN products and terminal systems. This included the RC890 cluster controller/LAN server and the RC45 multi- function terminal. Full IBM3270 (BSC & SNA) and VT220 functionality was optimally merged with a number of value-added facilities.

In 1987 RC came out with a new generation of workstations/multi- user system. Based on Intels iAPX386, UNIX System V and the In teractive VP/IX DOS emulation the RC900 System is a very attractive offering for office automation, small business, CAD and desktop publishing.

Late in 1986 RC signed technology agreements with Tolerant Systems Inc. San Jose and MIPS Computer Systems Inc., Sunnyvale, being important contribution to the development of RC Computers next generation of high-end machines - the RC9000.