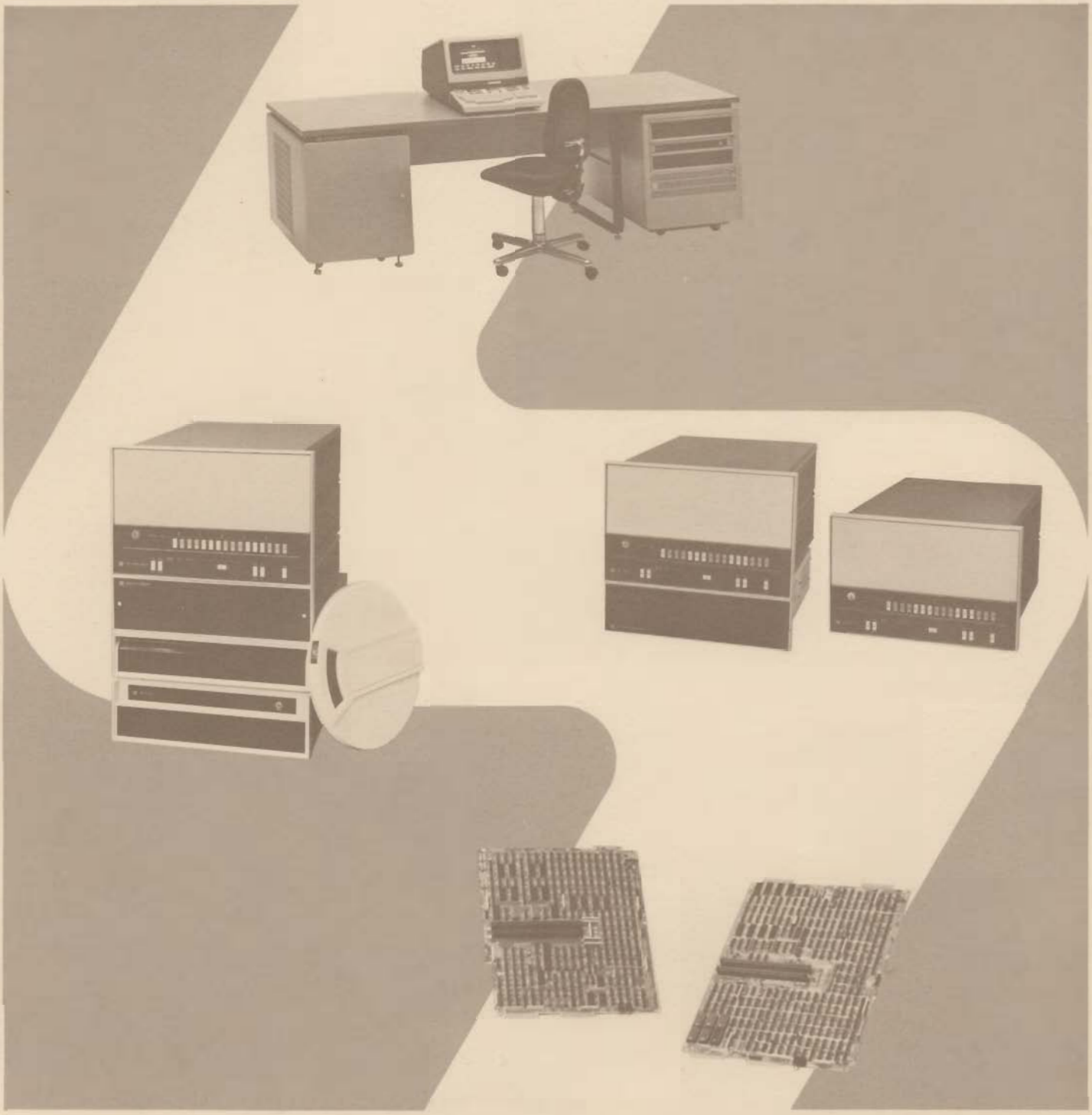
RTE-IV

Sales Training Manual

HEWLETT hp PACKARD



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Preface

A new member of the growing RTE family is born! And it is a biggie . . .

RTE-IV is the new super-star among the minicomputer operating systems. It stands several notches above the competition in capabilities and in price/performance. Just consider that to get DBMS in a DEC system you have to buy IAS and DBMS-11 at cost of $33K! And this does not take in consideration the hardware price.

RTE-IV represents a gigantic step since 2005 and 2300E days. But it has been an evolutionary process that has protected the software investment of our more than 5000 users, instead of the disjointed and uncoordinated pieces of some other products that existed and exist today in the market.

RTE-IV introduces some unique capabilities to the RTE family of products. It increases program space available to the user, by minimizing the amount of memory required for communication with the operating system; it adds more features to improve the man-machine interface; it adds still more failsafe capabilities, designed to keep the system going even when some of the system components fail and last, but not least, it adds the UNIQUE CAPABILITY OF BEING ABLE TO HANDLE PROGRAMS THAT INCLUDE DATA ARRAYS AS LARGE AS 2M BYTES.

All of that combined with the super competitive HP 1000 hardware prices, new high performance F-computer, floating point hardware. Multipoint and Datacap support should make your selling job easier and proud to be a member of the RTE team.

Happy Selling!

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HP 1000 Operating Systems Overview

Hewlett-Packard's Real Time Executive, RTE, provides one upward compatible family of Real Time Operating Systems. Used alone or in networks, they offer a choice for the best operating system for the job plus the growth to larger systems.

Feature	HP's RTE
Family	Memory Based RTE-M for 32K to 2048μ bytes. Flexible disc support. Disc Based RTE-II for 48K to 64K bytes. Cartridge and Top Loading disc support. Disc Based RTE-IV for 64K to 2048K bytes. Cartridge and Top Loading disc support.
Compatibility	Programs and data files are transportable between RTE-M, RTE-II, and RTE-IV systems. One set of operator commands, file manager commands, and interactive editor commands is used throughout.
Multiprogramming	Up to 64 separate programs can execute concurrently in main memory. Thousands of other disc resident programs can share the main memory through automatic swapping.
Multi-terminal Program Development	Concurrent processing and program development from multiple terminals can be accomplished with any mixture of BASIC, FORTRAN IV, Assembly and Microprogramming languages. Unattended batch program development may also be used.
Real-Time	Time, event and program scheduling are available with up to 32,767 priority levels. Privileged interrupts can typically be serviced in 100 microseconds. Most important tasks get attention first.
Microprogramming	A microassembler, micro debug editor, loader utility, and a PROM tape generator are available. The 3K 24 bit words of Writable Control Store hardware can be swapped with a large library of user microprograms stored on disc. Up to 8.5K words total of microprograms can be used at a time.
System Generation	Conversational interactive or unattended batch system generations without any reassemblies can be done concurrent with system operation; often in less than an hour. Several versions of the system can be stored on disc files for use at any time. Different stored generations can be tried for system optimization with a switch utility program.
Data Management	File management with named and protected files and with random and sequential access is standard. Optional at just $2500 is IMAGE/1000 data base management with the English-like QUERY language.
Spooling	Spooling is a capability for a program to read or write to a disc instead of a slower peripheral. Both input and output spooling can be used to temporarily store data on spool files so that large programs are in memory for shorter periods of time.
System Integrity	All programs and the system are protected by hardware fences from inadvertent destruction. Files are protected by security keys. Non-responsive peripherals are detected via timeouts. Power failures are detected and critical parameters are saved until automatic restart when power returns. If a memory parity failure is detected in a user partition, the partition becomes unavailable and operation proceeds in the other partitions.
Transaction Processing	Multiple terminals including intelligent 9600 baud CRT's with forms, soft-keys, and dual mini-cartridges may be used. Also, data collection terminals with high speed hardwired communications are available. A Mailbox Data Exchange facilitates the communication between terminals and programs.

RTE-IV

Man Machine Interface	The operator's interface with the system is aided by automatic system start-up at power-on; pre-programmed soft-keys (that can be loaded from a user file) for selection of often used functions with a single stroke of a soft key; and procedure files for canned sets of commands that are frequently used and eliminates repeated re-entry of long procedures.
Measurement and Control	HP-Interface Bus (HP-IB), HP's implementation of IEEE-488, allows simple link to instruments. Proven with over 5 years experience. Complete software support includes driver, formatters, and message subroutines for easy use with FORTRAN, BASIC, and Assembly languages. ISA FORTRAN and Real Time BASIC for measurement data acquisition and manipulation. Linearization routines for thermocouples.
Networking	Distributed Systems with RTE-M and IV Network Nodes. Modems or high-speed hardwired communications. Four years experience with over 300 networks installed and running Worldwide. Also, RJE/1000 2780 emulator at 9600 baud.

Press Release

Palo Alto, CA—May 1978—Hewlett-Packard Company today announced a new real time, multifunction operating system—RTE-IV for the HP 1000 family of computers.

RTE-IV is designed to support large programs and data areas extending up to 2M bytes of memory. **A unique feature in the minicomputer market**.

RTE-IV is a real time, multifunction operating system that enables the concurrent execution of real time, interactive and batch programs on the HP 1000 computers.

RTE-IV offers multi-terminal and multi-language operation; FORTRAN IV, BASIC and HP 1000 Assembler are the languages supported. There is also extensive support of microprogramming via a microassembler and microdebug utilities.

With RTE-IV an extensive set of data management tools are supported. Besides file management and input/output spooling capabilities, a full Data Base Management System—IMAGE/1000, including a conversational QUERY language is provided.

RTE-IV provides an extensive set of failsoft capabilities that are designed to keep the system running in the event of a power failure, device failure, memory parity, individual program malfunctions, etc. The RTE-IV operating system is available in a choice of media at a price of $5,000.

A full set of support services—software subscription service, phone-in consulting, etc., are also available.

Bob Puette, DSD marketing manager, said that the new RTE-IV extends the capabilities of the widely used upward compatible RTE family.

"In addition to the comprehensive resource management capabilities of the former RTE products, RTE-IV memory management capabilities extends the application areas of the HP 1000 family to many computation applications that could formerly be only tackled by larger computers", Puette said.

A pioneer in the development of real time operating system software, Hewlett-Packard Company offers in addition to RTE-IV a family of upward compatible operating systems for dedicated or multi-use systems that can be used stand-alone or can be interconnected in a network via the widely used—DS/1000—Distributed Systems Software.

RTE-IV—The Resource Manager/Product Description

The 92067A RTE-IV is the new disc-based real time operating system used for management of the resources of the HP 1000 Model 40 and 45 computer systems and user assembled systems based on HP 2108, 2109, 2111, 2112, 2113 and 2117 computers.

RTE-IV manages the total 2 **Megabytes of memory** of the HP 1000 computer, using the facilities of the Dynamic Memory System hardware. Up to 64 memory partitions can be defined, each one with up to 54K bytes of user's program code; in the case of "Mother" partitions that make use of EMA, they can be as large as physical memory, i.e., nearly 2 Megabytes.

RTE-IV is based on the field proven RTE-II and RTE-III operating systems, of which there are over 5000 installations.

RTE-IV is upward compatible with the RTE-II/III systems. Table 1 presents a summary of product distinctions.

RTE-IV is the best general purpose minicomputer operating system on the market. You can compare it, without any fear, with any other in the market.

The most significant competitive advantage of RTE-IV is the management of LARGE data arrays that can be as large as 2 Megabytes. The management of all these large data areas is transparent to the FORTRAN programmer. He can just write **A(20000,20) = 100 or do a WRITE (1,100) A(20 000,20)!**

In previous RTE systems and in competitor's systems the handling of large arrays entailed laborious segmentation of disc resident data that are brought to memory buffers whenever required. **THIS MEANS EXTENSIVE REPROGRAMMING** of computation algorithms used in linear programming, matrix manipulation, etc.

RTE-IV allows the implementation of these functions with great program ease and thus brings many new **COMPUTATIONAL** applications that could be handled before only in large computers (or with great pain in small computers).

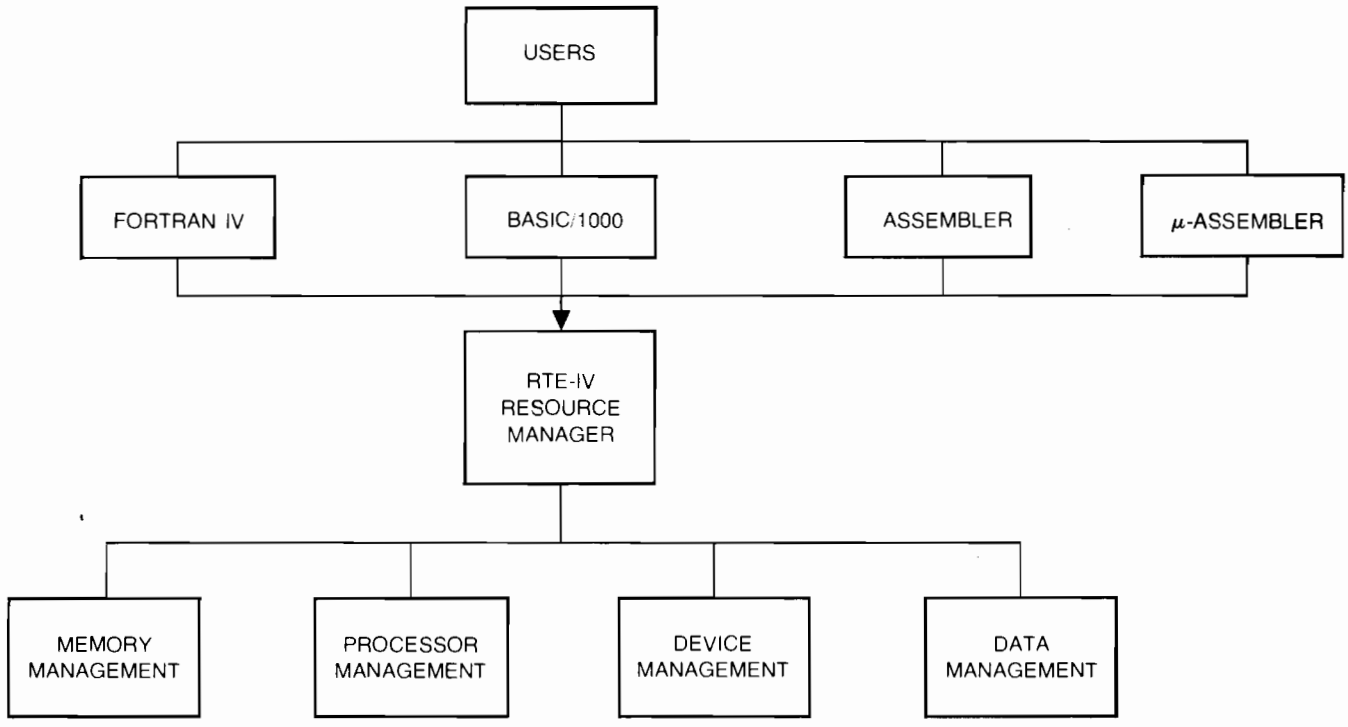


Table I. Product Differences

	RTE-II	RTE-III	RTE-IV
# Partitions for disc resident programs	2	64	64
Memory supported (bytes)	64K	2048K	2048K
Program partition size-maximum	≈20–24K*	≈30K*	56K
Mother partition size-maximum (bytes)	N/A	N/A	≈2 Mega
LS/LG bottleneck	Yes	Yes	No
Action on parity failure in program partition	Halt	Halt	Down Partition
Reconfiguration at Boot-up time	No	No	Yes
BASIC/1000	Yes	Yes	Yes
IMAGE/1000	Yes	Yes	Yes
DS/1000	No	Yes	Yes
Multipoint	No	No	Yes
Datacap	No	No	Yes
2313 Support	Yes	Yes	Yes**
6940 Support	Yes	Yes	No***
ISA FORTRAN (EXEC Calls)	Yes	Yes	Yes
ISA FORTRAN (I/O Calls)	Yes	Yes	No
RJE/1000	Yes	Yes	No

*Varies with O.S. size
**Fully supported in local and remote operation (summer)
***N.J. Division will support an RTE-IV compatible driver

RTE-IV—The HP 1000 Resource Manager

The RTE-IV operating system assists in the construction and execution of user programs. Through a repertoire of instructions or job commands (Exec and FMP calls), the RTE-IV operating system is capable of handling the acquisition, storage, retrieval and maintenance of data, allocating the use of hardware resources, and scheduling computer activities.

RTE-IV manages the system's resources, namely, memory, processor, devices and information (program and data). All these resources are valuable, and it is the function of the operating system to see that they are used efficiently and to resolve conflicts arising from competition among the various user programs.

RTE-IV must keep track of the status of each resource, decide which program is to get the resource, allocate it and eventually reclaim it.

RTE-IV manages the following distinct resources: memory, processor, I/O devices and information (data).

Memory Management Functions

RTE-IV manages the 2M bytes of main memory of the HP 1000. It uses the Dynamic Mapping System to divide the memory in up to 64 partitions. Partition sizes are fixed at generation but can be changed at boot-up time.

RTE-IV keeps track of this resource (memory partitions) and allocates it when a program requires it for its execution.

What is a Dynamic Mapping System (DMS) and How RTE-IV Uses It?

The DMS hardware extends the HP 1000 64K bytes logic address space. This hardware adds to the basic instruction addressing of the HP 1000 extra bits that allow the addressing of up to 2M bytes of memory organized in "maps" of up to 64K bytes each. This facility is used to extend the 2 partitions for disc resident programs in RTE-II to a maximum of 64. By providing many multiple disc-resident partitions, RTE-IV gives you response nearly as fast as if all programs were in memory simultaneously. By providing swapping, RTE-IV extends the system's program capacity to include that of the disc, which ranges from 5 to 400M bytes.

The Concept

Individual memory maps for each program are generated and entered into the dynamic mapping system as part of initiating program execution. Each program's map addresses the section of physical memory which that program will use during execution. Of course, several different disc-resident programs may use the same memory partition at different times.

The DMS hardware contains 4 separate sets of "map" registers; each one defining a 64K byte address space.

One map is permanently used by the system; one is used to define the partition currently in use and two others are used for defining the maps for DCPC data transfer. The existence of separate maps for the user partition and DCPC data transfers allows for simultaneity of user program execution in partition 10, for instance, and disc loading of a program in partition 31 and high speed data acquisition in partition 45.

Simultaneity Maximizes Throughput

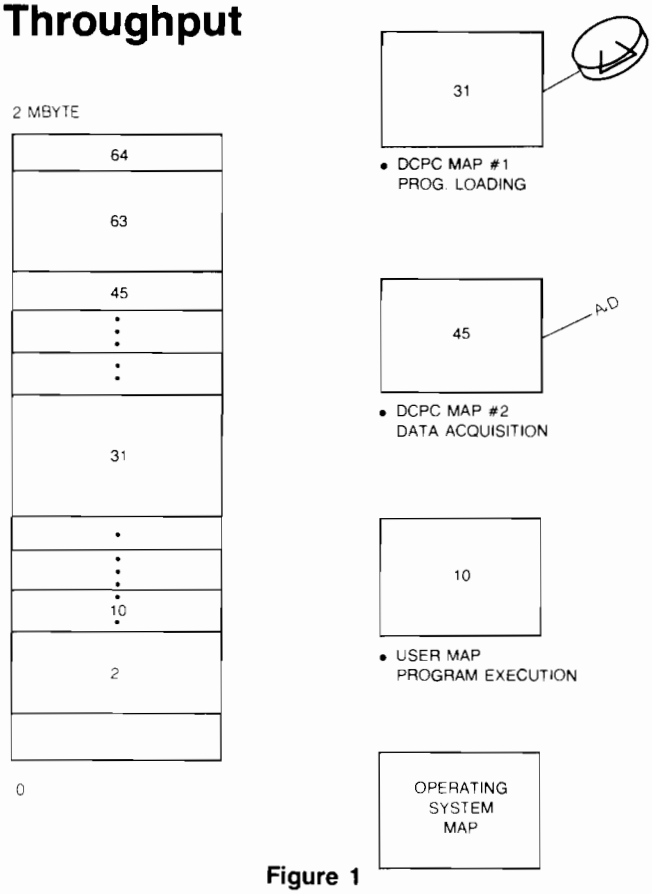


Figure 1

Furthermore, separate maps for the user and the operating system means faster context switching, i.e., the time that it takes to transfer execution from a user program to the system itself is minimized.

Figure 1 gives a representation of physical memory and four partitions that are presently loaded in the 4 DMS map registers, and pictorially indicate the simultaneity of operation.

The diagram of Figure 2 shows a simplified diagram of the physical memory of the HP 1000; it includes the operating system, buffers used for input-output, mailbox data transfers, etc., driver partitions, partition for permanent memory resident programs and, last but not least, the 64 partitions for disc resident programs. Figure 2 also shows a user partition. As it can be seen in the diagram, only a *fixed* 10 kilobytes are used for communication with the system and for drivers. In RTE-IV THE USER SPACE IS UP TO 54K BYTES AND IT DOES NOT DEPEND ON OPERATING SYSTEM SIZE,

Dynamic Memory Mapping

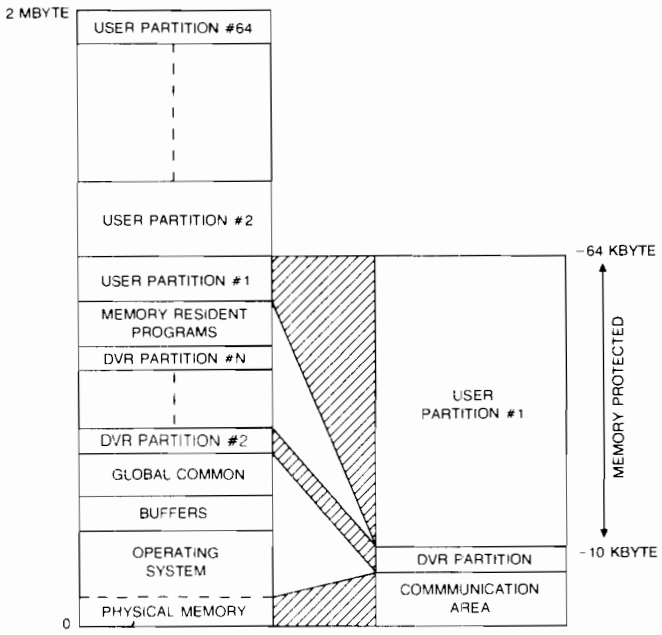


Figure 2

AMOUNT OF DRIVERS, ETC. Drivers are mapped when needed and they occupy two memory pages (4K bytes) of the communication area.

Memory Partitions

Program Partition

Memory partitions are defined during system generation and are not changed ordinarily. **Partition may be redefined, however, at system boot-up.** Program partitions in RTE-IV can be up to the available amount of physical memory. Partitions can be all of the same type or they can be divided in foreground and background partition. Disc resident programs, when scheduled for execution, will be loaded in the smallest available partition, or, if none is available, will force the swapping of the lowest priority program in the partitions. To further increase throughput, programs can be associated with a particular partition and will thus only be loaded in such partition, or a program can even be made memory resident. The maximum partition size is 54K bytes.

Mother Partition

A partition that is larger than the maximum logical address space is called a "mother partition". A mother partition allows for sub-partitions. RTE-IV will use mother partitions to dispatch programs that use an Extender Memory Area (EMA). Subpartitions of a mother partition have the same characteristics (real time or background) as the mother partition; they allow the user the capacity of using the large amount of memory belonging to the mother partition to run many smaller programs, when the mother partition is not in use.

Extended Memory Arrays

Extended memory area (EMA) is an area for arrays limited only by the size of the physical memory. Note that one or many arrays may reside in the EMA and that these arrays may be small or very large. An EMA can extend well beyond the maximum program addressable space. It occupies the available memory in the program's partition that extends beyond the program's logical address space, Figure 3.

A section of the EMA, two pages or more, must be included within the program's logical address for the mapping of a window segment (MSEG) of EMA. When a program accesses an array element that is not in the program logic address space, a window around this element in EMA is mapped into MSEG, inside the program logic address space.

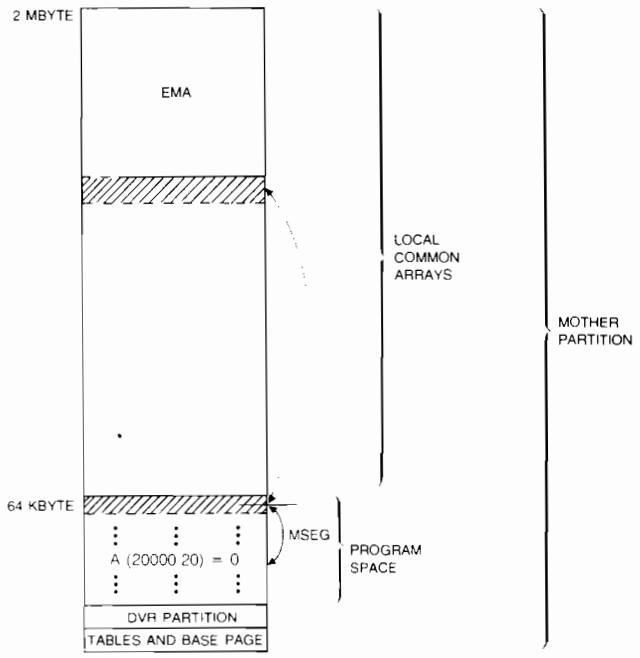


Figure 3

This mapping requires no disc swaps; therefore, it is very fast. **STANDARD FORTRAN I/O AND ARRAY ACCESSES USING SUBSCRIPTS ARE HANDLED WITHOUT ANY SPECIAL ACTION** by the user. In FORTRAN, EMA arrays are used just like any other array. Several sub-partitions can be defined on the area occupied by the mother partition. Thus, once the EMA use is finished, the memory is available for other uses. A segmented program may use EMA. This allows many separate operations to be performed on the same EMA, e.g., one segment reads the data, a second processes it and a third saves the results. Figure 4.

Extended memory areas are used for large amounts of data storage, acquisition and processing. Accessing data within EMA does not involve any disc access, therefore, it is quite fast. EMA's are useful for data acquisition from fast devices at real time rates. EMA's would also be very useful in data processing that requires a lot of data accessing from random locations (e.g., sorting). **Scientific applications using large matrices,** like inverting a matrix, can be performed with ease and speed.

The beauty of EMA is that you can write programs in FORTRAN, using large data arrays, without any special user coded data management functions. In this respect we have an unmatched advantage over DEC or DG.

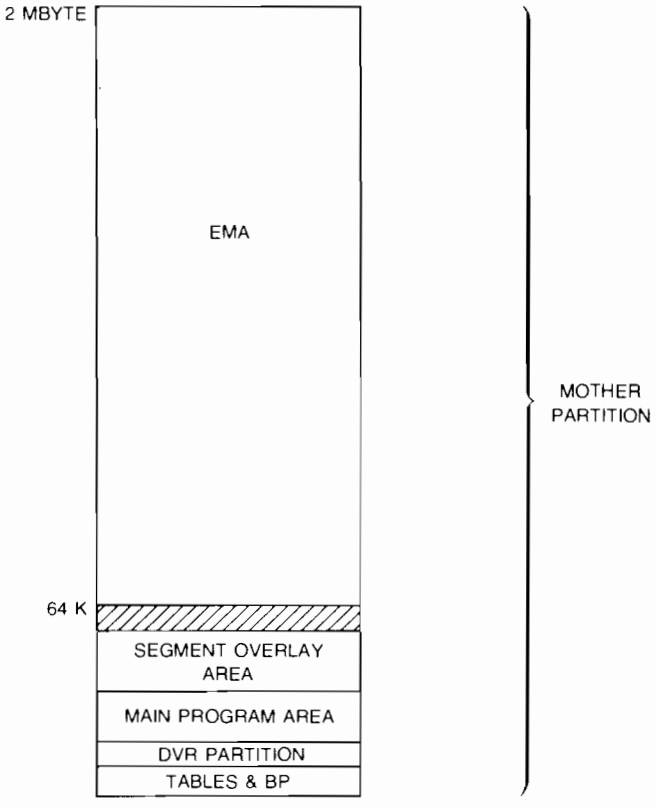


Figure 4

It should be noted that programs using data in EMA will not always run faster than programs using data on disc. It is possible via special user-coded data management functions to have programs with data stored on disc, running faster than FORTRAN programs using EMA.

However, the comparison here is not straight apples-for-apples, because all EMA programs can be made to run faster than disc programs if the user does his own mapping in assembler language.

This word of caution is added here because a user may convert an existing program, using some specially coded virtual data management scheme and expect that the program will, in all cases, run faster using data in memory.

The features of EMA can thus be summarized as:

- Easy FORTRAN coding of large array manipulation programs.
- Fast retrieval of random access data
- Virtual data in memory is faster than virtual data on disc
- Fast retrieval of sequential data with user custom mapping

An Analogy

The EMA data area can be looked at as a secondary data storage area, i.e., very much like disc storage. As such, data in EMA is not directly addressable but must first be brought into the logical address space of the program, i.e., small chunks of it are brought into MSEG. Here again the disc analogy holds because when we want to read/write a data item from/to a record, "chunks" of data (1 or more) are brought into main memory. However, for the FORTRAN programmer using EMA, all of that is **TRANSPARENT**. He can address 2M bytes of data.

Parity Errors Handling

In RTE-IV, the system will continue execution if a parity error is encountered in a user program; memory parity aborts only program encountering it, system notifies operator and automatically downs affected partition.

Memory management capabilities at a glance.

Feature	RTE-IV	RTE-II	RTE-M
Dynamic Mapping System	Required	No	Optional
No. of partitions for execution of user programs	1-64	2	1-64 with DMS, 1 without DMS
Maximum physical memory (bytes)	1.8M	64k	2M with DMS, 64k without DMS
Memory used by executive software (approx., in bytes)	34k[1]	32k[1]	12-34k[1]
Maximum user space (bytes per partition	54K	32	32-56
Downing of a partition on parity error	Yes	Halt	Halt

Note
1. Includes memory required for typical assortment of I/O drivers, program-to-program communication and I/O buffering

Processor Management

RTE-IV keeps track of the resources, decides who will have the chance to use the processor; the RTE-IV scheduler chooses from all the programs that are waiting for execution in priority lists. Programs are placed in these lists when requested by the operator, when it is time for them to run on a regularly scheduled basis, when an external event interrupt calls for program execution, or when requested by another program.

Program Dispatching

The process used for dispatching disc-resident programs is designed to optimize system response and throughput, by minimizing disc accesses and system overhead. The system also works to fit each program into the smallest partition it needs.

When dispatching a disc-resident program into memory for execution, RTE-IV (1) checks for program type (real-time or background), (2) checks if the program is assigned to a partition, and (3) checks if the partition is available or contains an overlayable or swappable program, then dispatches the new program to its assigned partition and updates the memory allocation table.

The memory allocation table, set up during system generation, contains the status of all partitions. Free and allocated partition lists provide running inventories of available and allocated partitions. The system gives you the ability to generally reserve real-time partitions for the exclusive use of real-time disc-resident programs, to help assure most timely dispatching of those programs, or you can reserve specific partitions at generation time for **exclusive** use by certain programs.

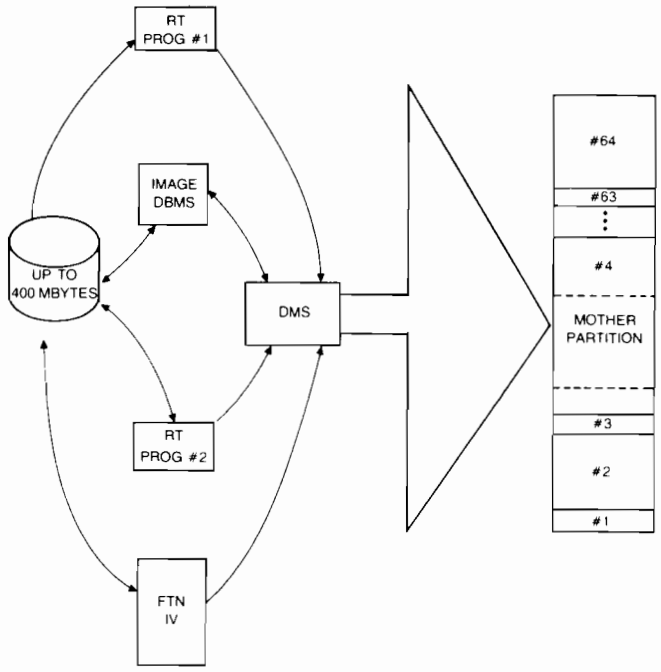


Figure 5

If the program's partition was not specified at load time, the system checks the memory allocation table. If the program is still resident in the partition it most recently used, no overlaying or swapping is needed. If not, the system scans the free list to find the smallest free partition in which the program can run.

If the program cannot otherwise be dispatched, the system scans the dormant list to locate program in memory. If no dormant program qualifies, the system scans the allocated list for the lowest priority program that can be swapped, and dispatches the new program into the partition occupied by that program.

After a partition has been selected for the program, the system enters the appropriate memory protect fence position

Program scheduling capabilities at a glance.

Feature	RTE-IV	RTE-II	RTE-M
Concurrent execution of multiple programs	Yes	Yes	Optional[1]
Program priority levels	32,767	32,767	32,767
Disc memory program swapping	Yes	Yes	No
Program scheduling			
by operator	Yes	Yes	Yes
by time-of-day	Yes	Yes	Optional[1]
by event interrupt	Yes	Yes	Yes
by another program	Yes	Yes	Yes
Concurrent batch processing with input/output spooling	Yes	Yes	No

Note
1. RTE-M software includes modules for these capabilities. Useability depends on hardware configuration.

Figure 6

into the fence register. It then modifies the user map to address the partition, common (if used), the resident library, and the system. Figure 5.

The same dispatching methods apply to mother partitions and sub-partitions of a mother partition.

I/O Management

After processor and memory management, the next major responsibility of the operating system is to supervise data transfers between system resources.

RTE-IV was designed to maximize the system throughput and give the fastest possible response to real time devices, such as analog-to-digital converters, digital interfaces, etc.

The features of I/O Management provided with RTE-IV are seldom encountered in other systems. A summary list is shown in the table below.

I/O control capabilities at a glance.

Feature	RTE-IV	RTE-II	RTE-M
Output buffering	Yes	Yes	Optional
Re-entrant I/O	Yes	Yes	Yes
Input output spooling	Yes	Yes	No
'Mailbox' data exchange	Yes	Yes	Optional
I/O device timeout	Yes	Yes	Optional
Resource number	Yes	Yes	Optional[1]
Multi-terminal monitor	Yes	Yes	Optional[1]
Multi-point operation	Optional	No	Optional

Note
1. RTE-M software includes modules for these capabilities. Usability depends on hardware configuration and operator preference.

File management capabilities at a glance.

Feature	RTE-IV	RTE-II	RTE-M
Sequential and direct access	Yes	Yes	Optional[1]
Automatically extendable named files with individual security codes	Yes	Yes	Optional[1]
Procedure files	Yes	Yes	Optional[1]

Note
1. RTE-M is available with either of two file managers. The first is for use in systems that have flexible-disc storage and includes the capabilities marked 'optional' above. The second file manager is for use in systems that rely on Mini-Cartridges for data storage and does not include 'optional' capabilities.

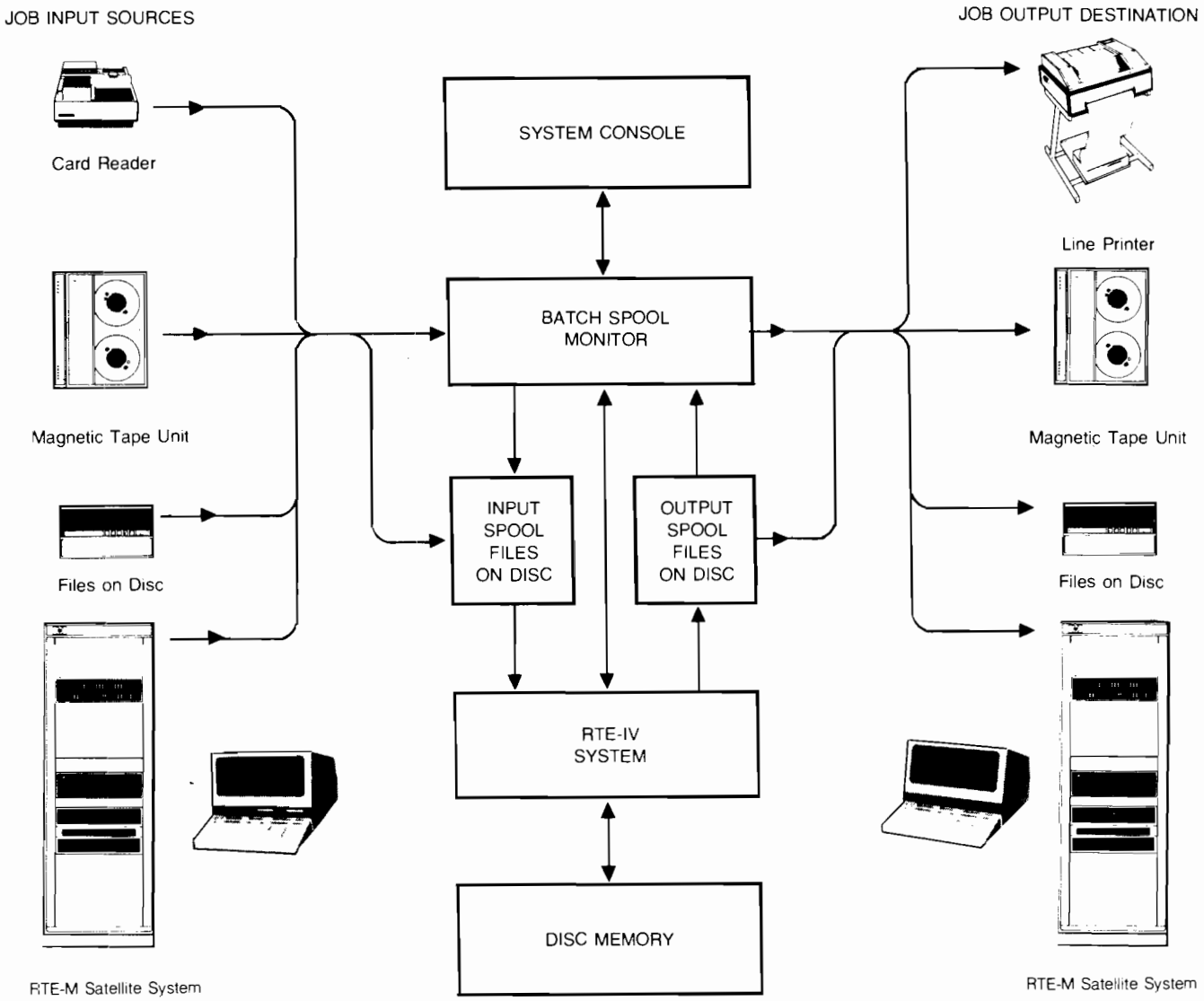
Data Management

Data Management facilities of RTE-IV are provided by the BATCH-Spool Monitor and the optional IMAGE/DBM's.

The BATCH-SPOOL Monitor provides functions of file management, processing batch jobs with/without I/O spooling and spooling of user I/O data.

An important competitive advantage here is the transfer or procedure file feature. These transfer files are canned procedures of file manager commands that can execute a complete set of operations such as FORTRAN compile—load—and go operation.

Batch and Spooling Operations



RTE-IV User Interface

RTE-IV provides a user interface that is friendlier than previous RTE Systems. The following features are of note:

- Multi-language—FORTRAN IV and BASIC
- **Multiterminal enhancements**
- **Multipoint**
- Comprehensive utilities, editor, debugger and back-up programs
- Comprehensive on-line generation and switching of operating system
- SOFTKEYS Utilities
- Procedure files
- **Partition and I/O re-configuration at start-up**

Multiterminal capabilities have been improved considerably in RTE-IV. Now all program development packages such as FORTRAN, Assembler, Loader, etc., are all interfaced to files thus facilitating the use of the system by multiterminals. The

multi-user capability has been considerably enhanced by the addition of the optional multipoint hardware/software system.

A new symbolic debugger has also been included, providing for tracing of program execution tracing, examination and change of memory contents, etc.

But it is in the system generation facilities that RTE-IV is really the winner! Ask anybody that has DEC's RSX-11M how long does it take to regenerate their system? With the on-line generator, you can generate a new system concurrent with other system activities. Furthermore several system configurations can be generated and stored on disc for future use. A special utility program allows for easy switch-over when required.

Additionally, RTE-IV provides the capability of reconfiguration of partitions, I/O select codes and identification of faulty pages of memory at boot-up time, saving many extra regenerations.

Program development capabilities at a glance.

Feature	RTE-IV	RTE-II	RTE-M
Program development concurrent with other system activities	Yes	Yes	Optional[1]
Program development by several users at same time	Yes	Yes	Optional[1]
Programming languages			
FORTRAN II	Yes	Yes	Yes
FORTRAN IV	Yes	Yes	Yes
ALGOL	No	Yes	No[2]
Real Time BASIC	Optional	Optional	Optional
HP 21MX Assembly	Yes	Yes	Yes
Interactive editor	Yes	Yes	Yes
Libraries			
Relocatable	Included	Included	Included
I.S.A. FORTRAN	Optional	Optional	No[3]
Sensor-Based DAS	Optional	Optional	Optional
Drivers for			
Peripheral computer equip.	Included	Included	Included
HP-IB* I/O Subsystem	Included	Included	Included
Other test measurement equip.	Optional	Optional	Optional

Notes

1. *RTE-M software includes modules for these capabilities. Useability depends on hardware configuration.*
2. *RTE-M system, can execute ALGOL programs compiled on an RTE-III or -II system.*
3. *The I.S.A. FORTRAN library can be used on RTE-M systems if the necessary tables are generated on an RTE III or II system.*

**The Hewlett-Packard Interface Bus (HP-IB) is HP's implementation of IEEE standard 488-1975 Digital Interface for Programmable Instrumentation.*

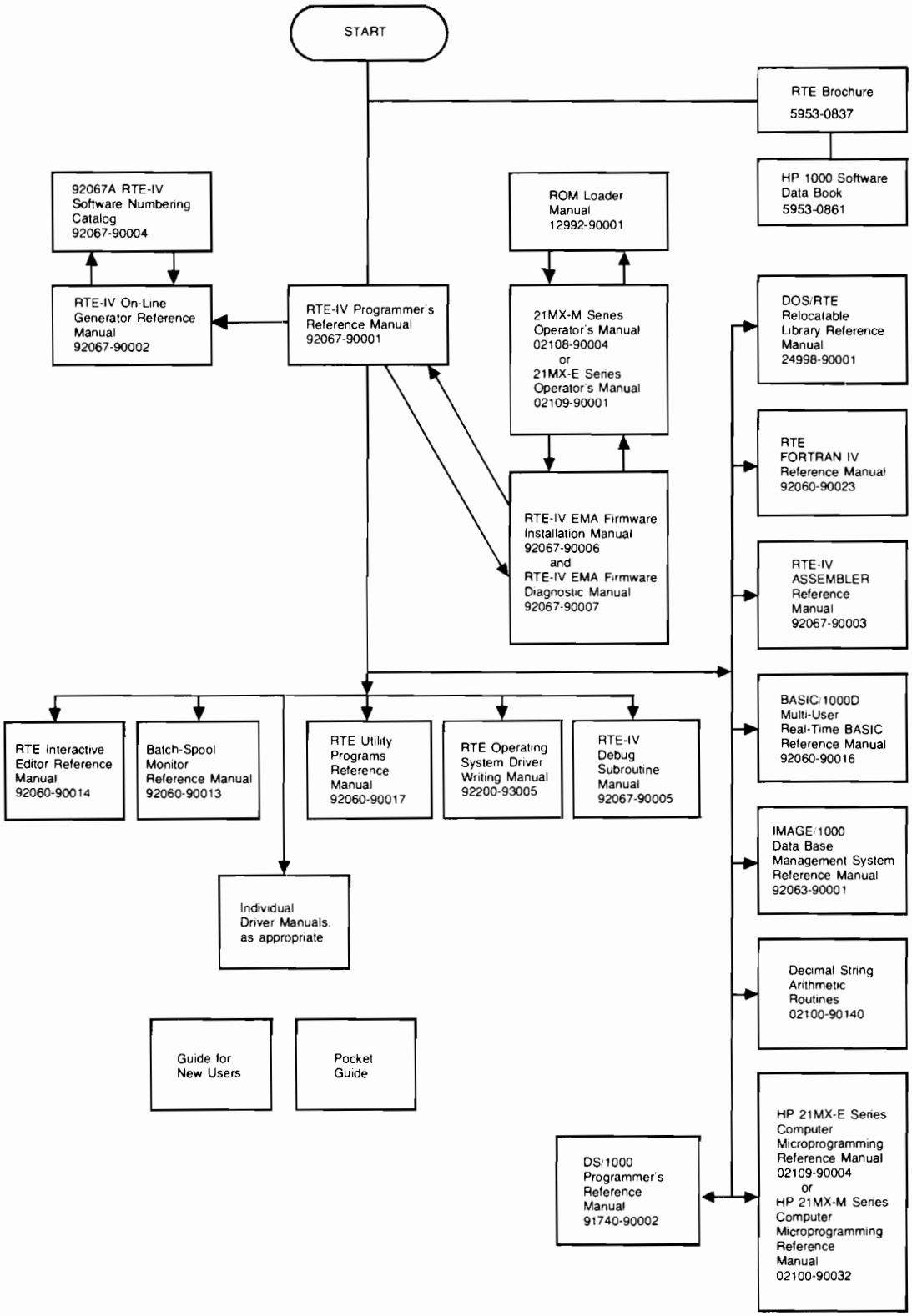
RTE-IV Failsoft Features

RTE-IV is a real time system and as such was designed to keep going, day in, day out, even when failures occur. The set of these failsoft features are impressive. Discuss them with your client! He will like them!

The failsoft provisions of the system are:

- Auto re-start after power failure
- Programs and system protection against programming crash
- Device time-outs
- **Failsoft parity failure**
- File Protection

RTE-IV Documentation Map



RTE-IV

Check These Features and Benefits

Memory Management

Features

- Up to 64 fixed partitions in up to 2 Megabytes of memory.
- Standard partitions can be as large as 54K bytes.
- EMA partitions can be as large as physical available memory.
- A choice of memory dispatching methods.

Benefits

RTE-IV memory management provides fast, efficient ways of dispatching programs into partitions. This combined with the large number of available partitions provides for better system throughput because more programs can be in main memory at the same time, decreasing swapping overhead.

Mother partition for large EMA programs that can be as large as 2 Megabytes allow easy implementation of application programs that require large arrays such as linear programming, matrix inversion, etc. A large computer capability at minicomputer prices.

Scheduling and Interrupt Processing

Features

- Schedule by time, program, or operator command or external interrupt.
- 32K priority levels
- Swapping
- Privileged interrupts

Benefits

Provides flexible ways of granting processing time to higher priority tasks. Gets the whole job done in the most efficient manner possible, yet never neglects real-time needs.

Efficient Input/Output

Features

- I/O concurrent with program execution
- I/O suspension and device timeout
- Exclusive device assignment
- Multi-terminal data entry and retrieval
- Device independence

Benefits

Optimizes the utilization of expensive peripherals. Increases efficiency through concurrent processing to get your finished results faster, yet protects against stalling the system by device failure.

File Management and Batch Spool Monitor

Features

- File handling and file integrity
- Batch operations with simple job control language
- Device independence
- Input/output spooling
- Multiple input job streams

Benefits

Provides for easy storage and retrieval of vital information necessary for management with full protection of files. Unattended automatic batch operation frees the user to do other tasks. Any device can be used for input or output stream which increases device utilization. Spooling makes efficient use of processor time thus increasing the number of tasks completed in a given time.

Multi-Lingual Concurrent Program Development

Features

- Multi-user BASIC
- FORTRAN Assembly languages
- Interactive EDITOR
- Loader and drivers
- DAS and ISA FORTRAN library (only the executive and bit manipulation functions)
- DEBUG

Benefits

Allows the user to get his project implemented quickly through concurrent program development, which is made easy for the programmer through the use of high level, easy to use software tools.

RTE-IV Editor is praised as one of the best editors around.

Ease of System Generation

Features

- Interactive or Batch on-line System Generation.
- Switch
- Reconfiguration at system boot-up time.

Benefits

Saves time and money in getting the operation up and going. When operating system requirement changes the user can generate his system concurrently with other system activities, with consequent better system availability.

If desired, several system configurations can be stored on disc for different application requirements and switched over when required. Also generations for different systems can be done at a central location and I/O configurations changed to suit specific local I/O configurations.

System Integrity

Features

- Power fail/Auto restart
- Memory protect fences
- Disc and track protocol and file security
- Partition protection
- Parity failure protection
- Device time-out

Benefits

Prevents time and information loss in case of system failure and protects programs from destroying each other or the system, thus eliminating time consuming recovery and re-programming procedures.

Support of Distributed Systems

Features

- Many types of satellites
- Down-loading programs developed at control
- Remote file access
- Network communication
- Redundancy

Benefits

Inexpensive memory-only systems can be dedicated to specific jobs, yet have access to the resources and information of the central. Reliability is increased in that if one system goes down, other processing continues.

RTE-IV Ordering Information

RTE-IV can be ordered in three ways:

1. As integral part of the HP 1000 Models 40 and 45
2. As a software product, 92067A
3. As a right-to copy product, 92067R

Furthermore we have included a complete array of support products that can be ordered through HEART; they are:

92067S — Software Subscription Service

92067T — Comprehensive Software Support

92830A — Software Notification Service

Information regarding 92067R, 92067S, 92067T and 92030A are included in the Policies and Support Training Manual. Listed below is the description of the 92067 product and options.

92067A RTE-IV operating system for user-assembled systems

$5,000

RTE-IV consists of:

1. The following software on one of media options 030, 031, 032, 050, 051, 052, or 053, which must be ordered:
   - RTE-IV operating system
   - On-line system generator, system switch, and boot-up reconfigurator
   - Multi-Terminal Monitor
   - RTE FORTRAN IV compiler, RTE-IV Assembler, Cross-Reference Table Generator, Interactive DBUGR utility, Interactive RTE Editor, Relocating Loader, Relocatable Library, and Decimal Arithmetic Library
   - EMA software routines
   - Batch-Spool Monitor
   - 92062B RTE Drivers Package software
   - Update and backup utilities
2. EMA Firmware ROMs (92067-80001 through 80003).
3. RTE-IV Programmer's Reference Manual (92067-90001).
4. RTE-IV Generator Manual (92067-90002).
5. RTE-IV Assembler Manual (92067-90003).
6. RTE-IV Software Numbering Catalog (92067-90004).
7. RTE-IV Debug Manual (92067-90005).
8. RTE-IV EMA Firmware Installation Manual (92067-90006).
9. RTE-IV EMA Firmware Diagnostic Manual (92067-90007).
10. Decimal String Arithmetic Manual (02100-90140).
11. ROM Loader Manual (12992-90001).
12. 7261 Card Reader Driver Manual (07261-90010).
13. DVR11 Card Reader Driver Manual (09600-93010).
14. CalComp Plotter Driver Manual (12560-90023).
15. DVR33 Flexible Disc Driver Manual (12732-90001).
16. 7210A Plotter Driver Manual (17210-90004).
17. RTE/DOS Relocatable Library Manual (24998-90001).
18. DVR00 Multi-device Driver Manual (29029-95001).
19. DVR37 HP-IB Driver Manual (59310-90063).
20. DVA13 TV Monitor Driver Manual (91200-90005).
21. DVA12 Line Printer Driver Manual (92001-90010).
22. DVR05/DVA05 264x Console Driver Manual (92001-90015).
23. Batch-Spool Monitor Manual (92060-90013).
24. RTE Interactive Editor Manual (92060-90014).
25. RTE Utilities Manual (92060-90017).
26. RTE FORTRAN IV Manual (92060-90023).
27. DVR12 Line Printer Driver Manual (92200-93001).
28. Driver Writing Manual (92200-93005).
29. DVR23 Mag Tape Driver Manual (92202-93001).
30. 3070 Driver Manual (92900-90005).

92067A RTE-IV options

030: Provides all RTE-IV system software on 92067-13001, 12869A (2.5M byte) disc cartridge for 12960A (4.9M byte) Cartridge Disc Subsystem.
$100

031: Provides all RTE-IV system software on 92067-13101, a 12940A (10M byte) disc cartridge for 12962A/B/C/D (14.7M byte) or 7906M + 13175A (20M byte) Cartridge Disc Subsystem.
$100

032: Provides all RTE-IV system software on 92067-13201, a 13394A (50M byte) disc pack for 7920M + 13175A (50M byte) Disc Subsystem.
$500

050: Provides all RTE-IV system software on 92067-13501, an 800 bpi, 9-track mag tape in image format for 2.5M byte disc cartridge, plus 92067-13301 (Mini cartridge) and 92060-16044 (paper tape) off-line disc backup utilities for copying the mag tape to 12869A disc cartridge in a 12960A Cartridge Disc Subsystem from an 800 bpi, 9-track HP Mag Tape Subsystem.
N.C.

051: Same as 050, above, but with RTE-IV system software on 92067-13601, a 1600 bpi, 9-track mag tape for copying to 12960A Cartridge Disc Subsystem from a 1600 bpi, 9-track HP Mag Tape Subsystem.
N.C.

052: Provides all RTE-IV system software on 92067-13502, an 800 bpi, 9-track mag tape in image format for 10M byte disc cartridge and 50M byte disc pack, plus 92067-13301 (Mini cartridge) and 92060-16044 (paper tape) off-line disc backup utilities for copying the mag tape to 12940A disc cartridge in a 12962A/

B/C/D or 7906M + 13175A Cartridge Disc Subsystem or to a 13394A disc pack in a 7920M + 13175A Disc Subsystem from an 800 bpi, 9-track HP Mag Tape Subsystem.
N.C.

053: Same as 052, above, but with RTE-IV system software on 92067-13602, a 1600 bpi, 9-track mag tape for copying to 12962A/B/C/D or 7906M + 13175A Cartridge Disc Subsystem or to 7920M + 13175A Disc Subsystem from a 1600 bpi, 9-track HP Mag Tape Subsystem.
N.C.

001: Provides a discount to customers upgrading from 92001B RTE-II or 92060B RTE-III system and for previous releases of 92067A. It does not give right to purchase 92067R.
-$2000

RTE-IV operating system in HP 1000 Computer Systems

The 92067A RTE-IV system with media option appropriate to the disc ordered is included in HP 1000 Model 40 and 45 (2176A/B and 2177A/B) Computer Systems.

92067R Right to duplicate RTE-IV for use on an additional computer system
$2000

92067R consists of:

1. The right to make one copy of software purchased with the 92067A RTE-IV system.
2. The right to make one copy of software updates supplied by Hewlett-Packard under the 92067S or 92067T support services for the purpose of updating item 1, above.
3. All manuals furnished with 92067A and EMA firmware for use on 2109B, 2111B, or 2117B Computer, items 2 through 30 of 92067A, above.

92067S Software Subscription Service
$100/mo.

The 92067S Software Subscription Service provides software and manual updates as required to keep your RTE-IV system current with respect to enhancements and other design changes as they are released by Hewlett-Packard. The 92830A Software Notification Service is also included. The 92067S service is ordered in monthly units for at least six months, billable quarterly. A media option, selected from those listed following 92067T, must be specified when ordering 92067S.

92067T Comprehensive Software Support
$175

The 92067T Comprehensive Software Support includes the Software Subscription Service, as described under 92067S, above, and a Phone-In Consulting Service for discussion of questions on your RTE-IV software with a qualified HP Systems Engineer. The 92067T service is ordered in monthly units for at least six months, billable quarterly. A media option must be selected from those listed below.

92067S and 92067T Media options

020: Software updates on Mini cartridges for read-in via 2645A+007 or 2648A+007 CRT Terminal.

050: Software updates on 800 bpi, 9-track mag tape in image format for 2.5M byte disc cartridge (used with 12960A Cartridge Disc Subsystem and 800 bpi, 9-track HP Mag Tape Subsystem).

051: Same as 050, above, but with updates on 1600 bpi, 9-track tape (used with 12960A Cartridge Disc Subsystem and 1600 bpi, 9-track HP Mag Tape Subsystem).

052: Software updates on 800 bpi, 9-track mag tape in image format for 10M byte disc cartridge or 50M byte disc pack (used with 12962A/B/C/D, 7906M + 13175A, or 7920M + 13175A disc subsystem and 800 bpi, 9-track HP Mag Tape Subsystem).

053: Same as 052, above, but with updates on 1600 bpi, 9-track tape (used with 12962A/B/C/D, 7906M + 13175A, or 7920M + 13175A disc subsystem and 1600 bpi, 9-track HP Mag Tape Subsystem).

92067T option 200
-$65

92067T option 200 provides a discount for comprehensive software support of an additional copy of RTE-IV (purchased as right-to-duplicate product 92067R) that is used in the same building as the original (purchased with 92067A). This discount is available on the basis specified in the Software Support data sheet under the *Support of duplicated software (software copies) at multi-system sites* heading.

Competition

How Do Our Capabilities Stack Up?

Feature	RTE-IV	RSX-11M	MRDOS	AOS
Memory Size bytes	128K–2048K	56–256K	48–256K	512K
Partition Size	54K	56K	64	64K–O.S.
Large Memory Arrays	2,048K-user space	N.A.	N.A.	N.A.
Memory Protection	For each partition	Each task is protected	Yes	Yes
Memory Type	Semiconductor	Core/semiconductor	Both types available	Semiconductor or core
Partitioning	Up to 64 fixed partitions	Up to 16 fixed partitions	Only 2 progs can run at a time	Dynamic relocation of up to 32 non contiguous pages
Swapping	Independent in both B/G & F/G	Yes	User must write own program to facilitate swapping	Yes
Priority levels	32,767!	250	256	255
Languages	FORTRAN, BASIC, ASSEMBLER	FORTRAN MACRO-11 FORTRAN +	FORTRAN, RPG, BASIC, Assembly	Extended BASIC FORTRAN FORTRAN V
DBMS	IMAGE	NO	INFOS	No
Batch	Fully automatic	Yes	Yes	Yes
Spooling	Input and Output	Output only	Output only	Output only
System Generation	Interactive or batch; on-line; O.S. switching; Reconfiguration	Requires re-assembly of the executive	Interactive	Interactive
Multi-terminal Support	Yes	Yes	BASIC only	Yes
Device Time-out	Yes	Not all devices	Disc only	No
Class I/O and Resource Numbers	Yes. The best "mail-box" communication.	No	No	No
File Management	Very good	Yes	Yes	Yes
Editing	Super editor	Yes	Poor editor	Fair source editor
Distributed Systems	Leaders in industry	Yes		No
On-line concurrent microprogram development/execution	Yes	No	No	Very limited
Soft-keys support	Yes	No	No	No
Parity error downs partition	Yes	Yes	No	No

User Ratings of Software Packages—Datapro Report

As you can see we are "the best" in **overall satisfaction** regarding minicomputer operating systems. The added friendliness we included in RTE-IV (system reconfiguration without regeneration; better multiterminal operation, better debugging facilities, better support services, etc.) will give us even a better standing. And we have not stopped. More good things are already in the mill . . .

Here is a summary of the "User Ratings of Software Packages" from the 1977 Datapro report that was published in the December issue of *Datamation*.

	RTE-III	RDOS	RSX-11	RT-11
Users reporting	13	6	32	.23
Overall satisfaction	3.2	2.5	3.0	2.9
Throughput/efficiency	2.7	2.8	3.0	2.7
Ease of installation	3.1	2.3	2.6	3.1
Ease of use	2.7	3.2	2.8	3.2
Documentation	2.7	2.5	2.4	2.6
Vendor technical support	2.9	2.3	2.0	1.8
Training	2.7	2.3	2.2	2.2

But just look at the price of these packages!

ADABAS	$132,000
DATACOM	$ 40,000
DMS-II	$ 12,000 to $24,000
DLI/E	$ 315/mo.
IDMS	$ 42,000 + $4,200/year
SYSTEM 2000	$ 35,000
TOTAL	$ 13,500 (for small computers)
IMAGE/1000	$ 2,500

As you can see the **overall satisfaction** with our system is better than with the other systems.

And with the new RTE enhancements that we will be introducing this year we will be even better!

HP is still the only small computer company that has a Data Base Management System listed in the report. A summary of the ratings is given below.

How Users Rated The Popular Data Base Management Systems

Package & Vendor	Number of users reporting	Weighted Average User Ratings: Overall satisfaction	Throughput/ efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training
ADABAS, Software AG of North America	12	3.5	3.5	3.6	3.7	2.9	3.5	3.1
DATACOM/DB, Insyte Datacom Corp.	11	3.3	3.2	3.0	3.4	2.4	3.2	3.2
DBOMP, IBM Corp. DPD	33	3.1	2.9	2.4	2.8	2.4	2.6	2.3
DMS-II, Burroughs Corp.	21	3.1	3.3	3.3	3.6	2.4	2.5	2.7
DOS/VS DL/1, IBM Corp. DPD	23	2.7	2.4	2.5	2.6	2.5	2.9	2.6
IDMS, Cullinane Corp.	16	3.5	3.2	3.5	3.1	3.0	3.8	3.5
IMAGE, Hewlett-Packard Co.	24	3.3	3.2	3.6	3.5	3.1	3.1	3.1
IMS, IBM Corp. DPD	28	2.8	2.4	2.5	2.6	2.7	3.1	2.9
SYSTEM 2000, MRI Systems, Inc.	20	3.2	2.5	3.0	3.1	2.4	2.8	2.8
TOTAL, Cincom Systems, Inc.	91	3.3	3.0	3.2	3.2	2.8	2.9	2.9

Virtual Memory Systems on Competitive Systems

Digital:

There exists no virtual memory system on either DEC RSX 11/M or RSTS/E operating systems. A user must segment to address more than 64K bytes. Segmenting is not transparent and also not trivial. But segmenting can handle both code and data. Multiple arrays with random accesses would thrash the DEC segmenting scheme while it would not effect RTE-IV with EMA.

Data General:

With the AOS operating system a user can directly access up to 64K bytes. By using overlay techniques the user can use a maximum of 512K bytes. The overlay techniques are fairly easy to use and are flexible to allow for different memory management schemes, (i.e., shared and unshared). The operating system is designed to make segmenting as easy and efficient as possible without incurring the overhead of a full blown virtual memory system.

Knock-Off Points

RTE-IV Wins over the competition on:

1.	Managing large 2M byte memory	11/34 and 11/60 only goes to 256K bytes.
2.	64 partitions and flexibility of partition allocation.	Nobody here!
3.	EMA partitions	Nobody here!
4.	INPUT/OUTPUT Spooling	Competition only has output.
5.	Procedure (Transfer) files.	DEC has a weak capability.
6.	Console softkeys capability with file loading utility.	IBM S/1 is the only one approaching this.
7.	Good EDITOR	Everybody praises it!
8.	System integrity features including Parity error handling.	Impressive array of failsoft capacities.
9.	On-line system generation, interactive or batch with switch program to select the right configuration.	Nobody here!
10.	Partition and I/O reconfiguration without regeneration.	Nobody here!
11.	IMAGE/1000 DBM's @ $2500	RSX-11M does not support DBMS/11. IAS on PDP-11/70 supports DBMS-11 @ $16,500.
12.	DS/1000	More than 200 installations.
13.	Support of FAST DISCS!	DEC RKO5 transfer rate is 180K bytes/sec. 7906 is 938K bytes/sec.
14.	Complete Microprogramming development package.	
15.	Multipoint.	Nobody here either!

Comments by a Large Manufacturing Company on RSX-11M/RTE Comparisons

Pro's

- RTE-III is 30% faster than RSX-11M on executive services.
- File manager is fast and provides more direct control.
- Transfer files capabilities very powerful compared to RSX-11M.
- Good Batch.
- Good input spooling capability.
- Very good editor.
- On-line generator—very good concept.
- RSX-11M is very difficult to generate.

Con's

- . . . no one is perfect!

Questions and Answers

In this section we will discuss topics that may present problems in the proper application of RTE-IV or try to answer as many questions you may have as possible.

Will my customer require a hardware upgrade?

RTE-IV is compatible with the HP 2108B and 2112B Computers, serial prefix 1810A and later, 2109B and 2113B serial prefix 1812A and later, and all 2111B and 2117B computers. Accessories shipped with computers that meet this serial prefix requirement are also compatible. Compatibility of earlier computers can be checked via the attached Table II. Two service products are available to provide a fixed price upgrade. The 92852E and 92852M service products include material and labor to do the required update.

The CE organization has been advised of this program by the technical marketing group. Please, discuss this upgrade program with your CE support or call technical marketing if you still have further questions.

Table II. Revisions of Hardware Required for Proper RTE-IV Operation

Description	New Assembly	Exch Assembly	Date Code	M	E
CPU BOARD	5061-1341	5061-1390	1736		X
CPU	5060-8352	5060-8371	1706	X	
DMI ROMs	13307-80021-26	—	N/A		X
4K ROM BOARD (BASE SET)	5161-8400	5061-1320	1630	X	
MP (12892B)	12892-60003	12892-69003	1727	X	X
DCPC (12897B)	12897-60004	12897-69004	1649	X	X
MEM CONTROLLER (2102B)	02102-60001	02102-69001	1728	X	X
MEM CONTROLLER (2102E)	02102-60002	02102-69002	1720		X
FAB BOARD (13304A)	5061-1339	5061-1370	1701		X
¼K WCS (12978A)	12908-60006	12908-60007	1708	X	
MEM (12731A)	12731-60001	12731-69001	1652	X	X
DISC CONTROLLER (7905/6/20)	13037-60023 or 13037-60025	13037-69023 or 13037-69025	— —	X X	

Can I share my large EMA data areas among several programs? i.e., can I use it as a large global common area?

No. The EMA data area can only be used as part of the program (or program segments) that are running in a mother partition.

Are the M-series computers supported with EMA firmware?

No. Firmware is only provided for the E-Series computers. A software routine is provided for the M-series computers.

Will the 91000/2313 hardware work with RTE-IV?

Yes, the present RTE-III driver is going to be updated to RTE-IV. It will be available in the summer.

And what about the 6940?

The support of the 6940 drivers has been transferred to New Jersey Division; they are going to support the driver and the ISA FORTRAN calls. Please consult N.J.D. if you need more information.

Can I have program code that is as large as the largest mother partition, i.e., about 2M bytes?

No. The maximum memory resident code size that you can have is about 54K-bytes. This amount is independent of the operating system size, drivers used, etc. This is 12 to 18 bytes more than you could have in RTE-III.

What About RTE-II and RTE-III?

RTE-II is going to continue to be marketed as a component and as part of the HP 1000 Model 30. RTE-II is classified as a mature component.

RTE-III will be withdrawn from the price list in the summer and we will start its obsolescence about 8-10 months later; RTE-II will also be obsoleted at that time.

For ATS customers RTE-III will continue to be available until the present software is made compatible to RTE-IV.

What should I watch for when I write FORTRAN programs, to execute under RTE-IV management?

As far as FORTRAN is concerned, RTE IV offers two main advantages over RTE III. These two are:

1. Increased program partition size of up to 56 bytes (26K for code with EMA)

2. The addition of EMA

EMA allows a data size equal to the amount of physical memory less memory taken up by the operating system, common, memory resident programs and drivers. In other works, RTE can support almost 2M bytes of data in memory.

Increased program partition size allows the user to run larger programs before he must worry about segmenting. Typically, this gives 10K more code space over RTE III. But, the real improvement involves the Extended Memory Area (EMA). With EMA, FORTRAN IV can now support programs which were originally only written for large mainframes. Sales situations may occur where a customer would like to see his large program, or a suitable example, run on RTE IV. So, included here, is a brief guide on converting programs to run on RTE IV.

1. General Conversion to HP FORTRAN:

Nothing new in this area. Just change the parts of the programs that would have been changed regardless of RTE IV (i.e., Input/Output; limit to 6 character variable names; add Exec calls, etc . . . . .).

2. EMA & Data Handling:

All variables that are to be put in EMA must appear together in one named Common. Thus, for each program that uses EMA, one, and only one, named common must be declared as EMA. To declare the named common as EMA, a $EMA (common-name) statement must appear, starting in column one, right before the main program statement and right before the subroutine declaration statement of any subroutine which uses EMA common. The name common is then declared as it would be normally. To that extent, EMA is transparent, but there is one catch: EMA variables cannot be passed to subroutines as parameters!! They can still be passed by value, just not by address. There are a few ways to get around this, but it can be a lot of conversion work if a program has many subroutines which perform a specific operation on any passed array.

Local variables and common are not affected by the use of EMA, thus, the use of those variables as subroutines

parameters is still permitted. Double precision and other special variable types are also unchanged, except that variables equivalenced to EMA variables can not be passed as subroutine parameters.

How does EMA data accessing compare to disc methods?

Can disc methods ever be better? To answer that, we must consider two discs cases:

1. The disc method is a virtual memory system which is transparent to the user.

EMA microcode does not do page fault checking, it just remaps on every access regardless of whether it needs to (this is faster than checking to see if remapping is required). Thus, for a given array dimension size, every EMA access takes the same amount of time (45 μsec for 1 dim **plus 10 μsec for each additional** dim. This is not true for a virtual memory system. Every access must be checked for the possibility of a page fault. If the page fault detection is done in firmware, the overhead involved is at best equal to EMA only if there are no page faults. But, every page adds another 25-50 milliseconds for a disc access to the virtual memory scheme and thus, EMA becomes much faster.

2. The user handles his own data segmentation and ensures the proper data is in logical address space when he needs it.

Transparent EMA from FORTRAN can be slower than a disc method in which the user handles his own data segmentation. If a program continually accesses one array, either very locally or sequentially, it can be segmented to keep disc

Data Array Manipulation
EMA vs. DISC

	Comparison Factors / Program Techniques	Relative Execution Speed: Single Array / Sequential Access	Relative Execution Speed: Multiple Arrays / Random Access	Coding
DATA IN EMA	Non-Transparent (user EMA management with assembly routines)	BEST	BEST	HARD
DATA IN EMA	Transparent (FORTRAN only)	3rd BEST	2nd BEST	EASY
DATA ON DISC	Non-Transparent (User data segmenting from disc)	2nd BEST	Not as TERRIBLE	HARD
DATA ON DISC	Transparent (virtual memory)*	WORST	TERRIBLE	EASIEST

*Using firmware to detect page faults.

Programming/Examples:

Single/Sequential: Single array applications where references are extremely local. (Fourier transforms and some sorts)

Multiple/Random: Multiple array applications or extreme random array accesses. (Linear programming and matrix manipulation)

swaps to a minimum without incurring the overhead of page fault detection. In other words, if the amount of time spent by the disc is less than the overhead involved with EMA, the disc version will run faster. Although if you increase the number of arrays or have more random accesses, EMA from FORTRAN will run faster than segmentation from the disc.

Segmentation is not transparent either and EMA can be handled like segmentation (with user EMA management by calling assembly subroutines) so that it will out perform disc segmentation everytime. But, it is important to realize that:

Rewriting a program, using EMA through FORTRAN only, will not always improve the execution speed. Customers can not assume that it can.

Summary of New Features

Support of 2 Megabytes of main memory.

Standard partitions support of up to 56K bytes partition independent of operating system size, number of drivers, etc.

"Mother" partitions that extend the data addressing space to nearly 2 Megabytes. This extended memory area (EMA) is used for large memory resident data arrays.

I/O and array manipulation in FORTRAN of EMA data is transparent to the user.

Mapping of EMA data into user logical address space is via firmware in the 21MX E and F series computers.

"Mother" partitions can be divided in subpartitions for improved memory utilization.

All program development software (languages, utilities, etc.) interface to file manager disc files (instead of the LS/LG areas).

Reconfiguration of partitions and I/O at system boot-up time.

Continued execution on parity error in user partitions.

User debug capability that provides break point, assembly level code tracing, modification and dump.

Enhanced Multiterminal program development.

Multiterminal program development using optional Multipoint hardware and software.

Full support of optional Data capture 3070B terminals via DATACAP/1000 software.

Graphics language support optional via GRAPHICS/1000.

Support of communication with HP 1000's or HP 3000's via DS/1000 software and firmware.

New 3 levels of support services

- Software Notification Service
- Software Subscription Service
- Comprehensive Support Service

New software policies for right-to-copy.

Software distribution in 7900, 7905/7906, 7920 disc cartridges and mag tape.

. . . Plus the Super Existing Features

Support of up to 64 memory partitions for disc resident program.

Concurrent processing and program development in FORTRAN IV, conversational multi-user real-time BASIC/1000D (optional) and assembly language.

Batch-Spool Monitor providing File Management, I/O Spooling and Batch Processing.

Input/Output Spooling to disc to speed throughput with minimal use of main memory for buffering.

Conversational or batch mode on-line system generation.

4-way real time program scheduling, with up to 32K priority levels.

Powerful system integrity features: system and program protections, power failure and restart, device timeouts, memory parity, file protection, etc.

Multiterminal, multilingual program development.

Flexible dispatching into memory partitions:

1. User may specify in which partition a program is to run.
2. Specific partitions may be reserved to be used only with certain programs.

RTE-IV

Self Evaluation Questions

1. What are the major contributions of RTE-IV?
2. What is the major advantage of using EMA arrays?
3. Is it always faster to use EMA arrays than disc storage?
4. List 10 lock-out features of RTE-IV.
5. List all major differences of RTE-IV from RTE-III.
6. What is the largest program size that you can run in a standard partition of RTE-IV? And in a mother partition?
7. In an application, memory is divided in 4 non-EMA partitions, each with 24K bytes and 1 mother partition with 256K bytes, the operating system, drivers, System Available Memory is 65K bytes long. How much memory is required for the system?
8. The application above changes and 2 extra drivers are added. What is now the maximum size of each non-EMA partition?
9. What is the difference in handling parity errors in RTE-II/III and RTE-IV?
10. List all system integrity features of RTE-IV.
11. Why was the LS/LG a bottleneck for a program development? How was that avoided in RTE-IV? Does the LS/LG continue to be available?
12. What is contained in the right-to-copy product? Does the customer with the right-to-copy product have to purchase the 92067S?
13. What should be bought additionally to the 92067S if the customer wants to have its EMA firmware updated by HP?
14. List the ways that spooling can be used.
15. Why are system generation facilities so great?
16. Why are fixed partitions good? Why does RSX-11M require memory garbage collection?
17. List all major disadvantages of RSX-11M working with 11/34 and 11/60 (the machines we compete with).
18. Does RSX-11M support DBMS-11? What is the price of DBMS-11?
19. Both AOS and RSX-11M use dynamic relocation of programs in memory. Define and give advantages and disadvantages of the method.
20. If the user has an EMA partition of 512K bytes, how long does it take to swap it to the HP 7906/20 disc?
21. What are subpartitions?
22. Do programs that run in RTE-II/III run in RTE-IV? List some exceptions.
23. What is privileged interrupt operation? When do you use it?
24. If you view the RTE-IV as the resource manager, what are its managing functions?
25. Define transfer files. Why are they super?
26. What happens when you turn on the HP 1000 system?
27. What are the functions of the softkey utility program?
28. In what media is the RTE-IV grandfather disc provided? And the software subscription service? How often does the software subscription service mail updates?
29. Are the EMA subroutines provided in firmware for the M-Series computer?

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