HP 3000 Computer Systems

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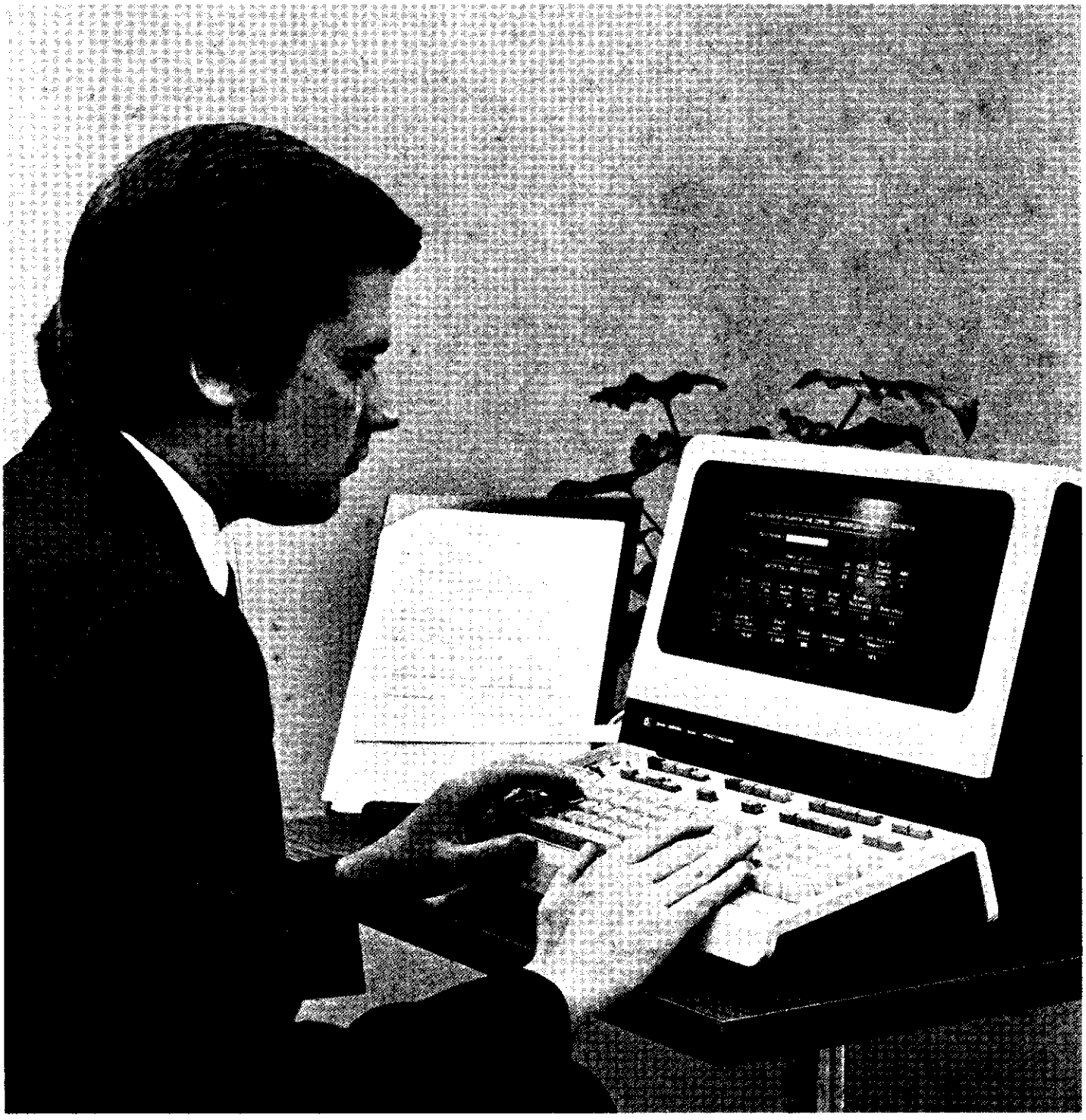
Transaction processing systems for business and industry

Performance guide



Performance — What it means with the HP 3000

Today's business climate demands that information concerning a firm's operations be readily available. Sound management decisions often depend on having accurate data relating to sales forecasts, capital resources, personnel records, production schedules, research projects, and other activities immediately at hand. As a result, many businesses are moving away from batch oriented computer systems to on-line transaction processing systems.

These systems are typified by application programs accessing and modifying data bases and files for users at interactive terminals.

To help you meet your firm's data management needs, Hewlett-Packard offers a complete family of on-line transaction processing business computers—the HP 3000 systems. Specifically designed and tested for today's commercial transaction processing environments, HP 3000 systems are recognized for their versatility and high performance. System features include a large memory capacity, powerful software tools, concurrent interactive and batch processing and a sophisticated multiterminal operating system. The HP 3000 is available in a variety of configurations so that you can choose the one that delivers the level of performance your current applications demand, yet can grow as your requirements change.

What performance can you expect . . .

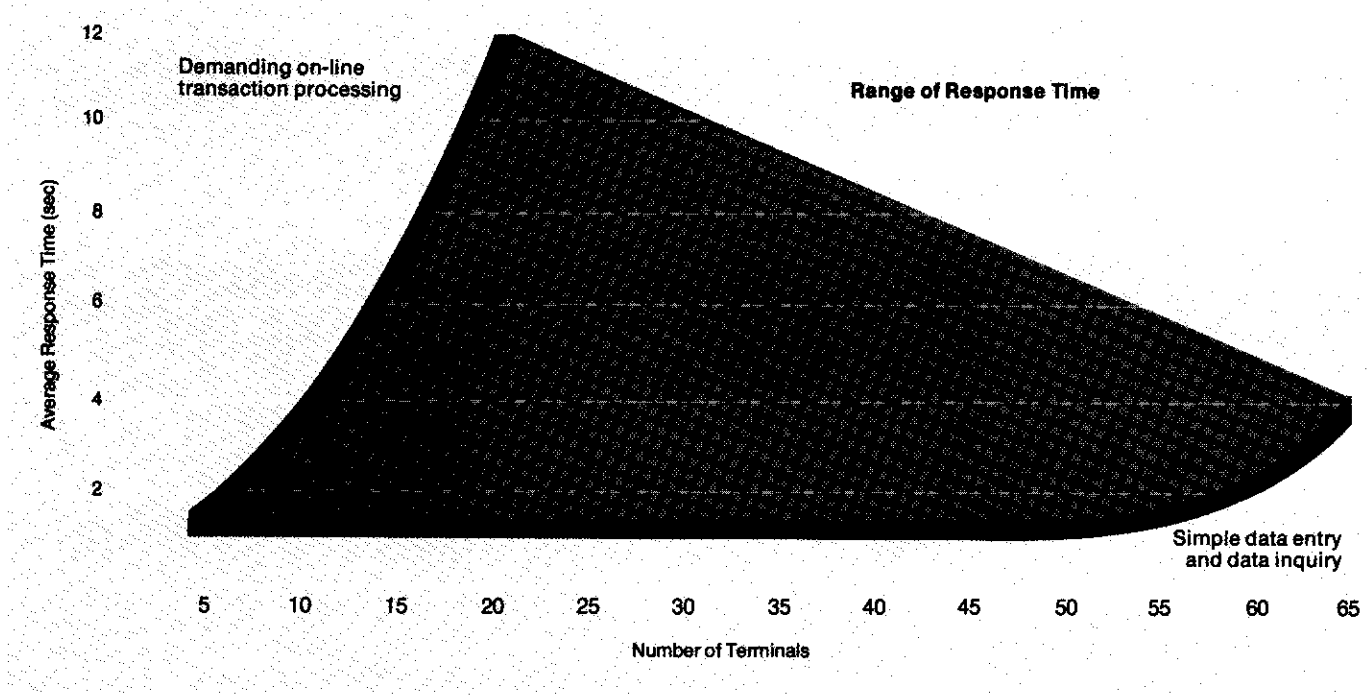
Your application is the key

Choosing the right system with the right performance capabilities is critical to the success of your application. System performance is the result of a number of factors such as CPU speed, I/O transfer rates, memory managment requirements, terminal handling software, system hardware configuration, and user application implementation.

To provide you with a high performance system, Hewlett-Packard optimized HP 3000 operation with these factors in mind for maximum throughput and minimum response time. However, the one factor we cannot anticipate is your specific application. Your application will finally determine the actual response time and throughput your HP 3000 will deliver.

The performance range of HP 3000 systems with two widely diverse application loads is illustrated in the chart below. One limit represents a demanding system load. For this environment the variety of activities included data entry, inquiry, and update to a large data base; program compilations; file sorts; on-line program development; and continuous line printer activity. All these tasks were performed simultaneously. The other limit represents a light application load. The transaction activity for this application involved data entry and data inquiry to a single file that was not locked during each transaction.

Data presented on the following pages is designed to give you a feel for the performance of the HP 3000 computer (under a defined processing load) and the relative performance of the systems within the product line.



The Test Environment

As a guide to assist you in determining the configuration you need, a series of realistic application environments, based on experience from over 1800 installations, were tested on the HP 3000 using various memory sizes.

The goal was to make the tests as representative as possible of real user situations. We designed them to duplicate the level of performance routinely attainable in normal application environments rather than carefully selecting programs which would optimize performance. The three environments tested were small business with data entry, general purpose data processing, and dedicated on-line transaction processing. The small business environment represented a lighter transaction processing application load than the latter two test environments. Details of each environment appear in the following discussions.

Test #1

Small business with data entry: This environment, which may be encountered in a small-to-medium company or a division of a larger corporation, represents a business that replaced a small, batch-oriented system to take advantage of the HP 3000's interactive terminal capabilities and data base management software. The specific tasks include simultaneous batch processing, on-line program development, and interactive data entry and data inquiry to an inventory data base.

Test #2

General purpose: This represents a heavy data processing shop application mix. The specific tasks include simultaneous batch processing, on-line program development, interactive data entry and data inquiry to a manufacturing application data base, and continuous printing to a line printer.

Test #3

Dedicated on-line transaction processing: This environment, which may be encountered in a manufacturing division of a large corporation, demonstrates on-line transaction processing with applications entering data, updating data, and inquiring directly into a manufacturing data base, while continually printing to a line printer. For this environment, additional tests of HP 3000 data communications products are also graphed to help you understand their effects on overall system performance.

During the tests three factors were measured: transaction response time, on-line transaction throughput, and batch throughput.

Response time: Defined as the time between initiating a transaction (depressing the enter key on the terminal) and the completed processing of that transaction (appearance of the first character of output to the terminal). All measurements were taken over at least a 30-minute period. Unless otherwise specified, terminals were run at 2400 baud in block mode, except program development terminals, which ran in character mode.

To duplicate normal terminal activity, a time delay was introduced between transactions to simulate both user typing speed and think time. Recognizing that human factors and data volume requirements vary for the specific activity, different average delays were used for data entry, data inquiry, and data update, as indicated in the following table.

	Typing Speed	#Characters Input	Average User Think Time	Average Total Delay Used
Data Entry	4 characters/sec.	77	1 sec.	20 sec.
Data Update	4 characters/sec.	77	9 sec.	28 sec.
Data Inquiry	4 characters/sec.	8	18 sec.	20 sec.

On-line transaction throughput: An important measure of system performance is the actual transaction volume the system can process. Along with the average response times, the volume of on-line transactions processed was measured in transactions/hour. It is this value that we call on-line transaction throughput.

Batch throughput: To measure this factor, two standard jobs were defined and used in the general purpose tests which are presented later in this brochure. The standard job for test #1 included the following tasks:

- Compile and prepare a 614 line COBOL program
- SORT a 10,000 record (100 bytes/record) file by three keys
- Compile and prepare a 535 line RPG program
- Execute the RPG program to print a 120 line report.

The batch job for test #2 was the same as that of test #1 except that the COBOL program was 3359 lines long, thus creating a job that placed a greater load on the system.

For throughput measurement purposes the completion of the four tasks in either job constituted the processing of one "standard job."

The appropriate job was run repeatedly throughout each test and the batch throughput calculated in terms of "jobs per hour" (the number of "standard jobs" which would execute on the system in one hour of elapsed time). Of course, users' jobs would be different and would produce different throughputs when measured in these units. The job for test #1 takes four minutes to execute when running stand-alone on a 512kb Series II or Series III system with a single HP 7920 disc. The job for test #2 takes nine minutes to execute under the same circumstances, reflecting the larger test load.

The test systems: The two computer systems used for the tests were the HP 3000 Series III and the HP 3000 Series 33, both running the MPE III operating system. The HP 3000 Series II, with a maximum memory size of 512kb delivers the same level of performance as a similarly configured Series III. As the memory was increased in the Series III the line printer and discs were changed to reflect increasing resource demands made on the data storage and data output devices as follows:

256kb to 512kb memory for test #1	.....300 lpm printer and one 7920 disc (50Mb)
512kb memory for tests #2 and #3	.....300 lpm line printer and two 7920 discs (50Mb each)
Over 512kb memory for tests #2 and #3	.....600 lpm line printer and two 7925 discs (120Mb each).

The Series 33 configuration for all tests was:

256kb to 512kb memory for test #1	.....400 lpm line printer and one 7920 disc (50Mb).
512kb to 1Mb memory for tests #2 and #3.	.....400 lpm line printer and two 7920 discs (50Mb each).

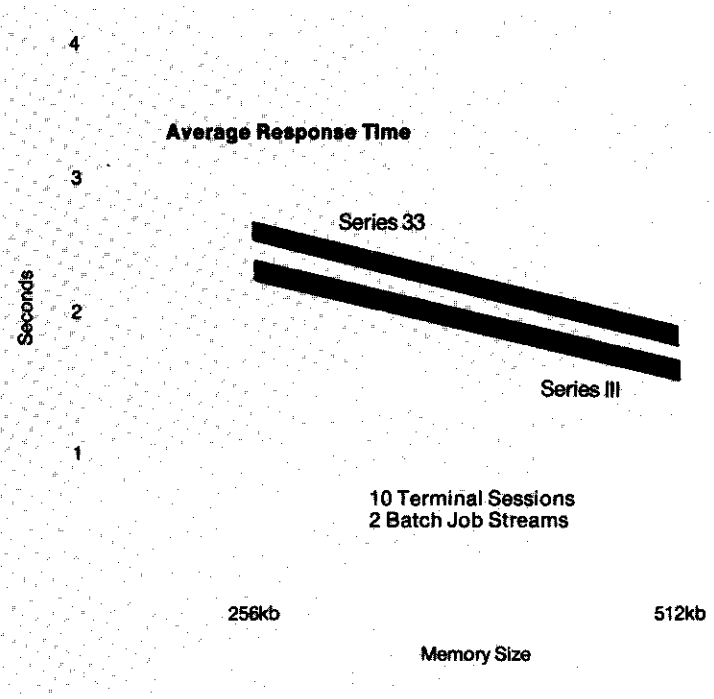
The results of the tests are shown with the graphs on the following pages.

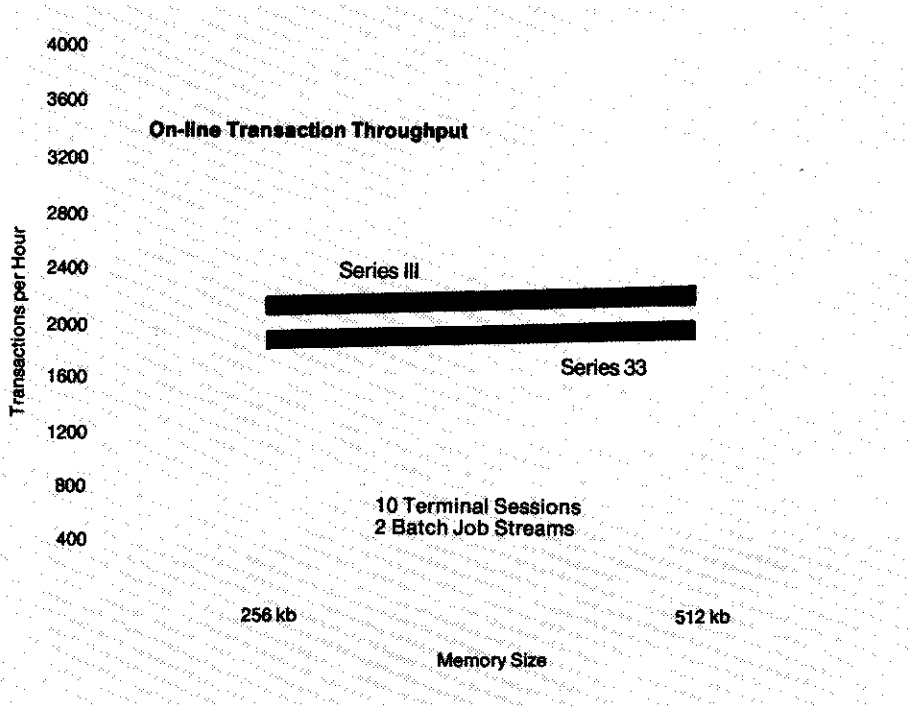
Test no. 1:

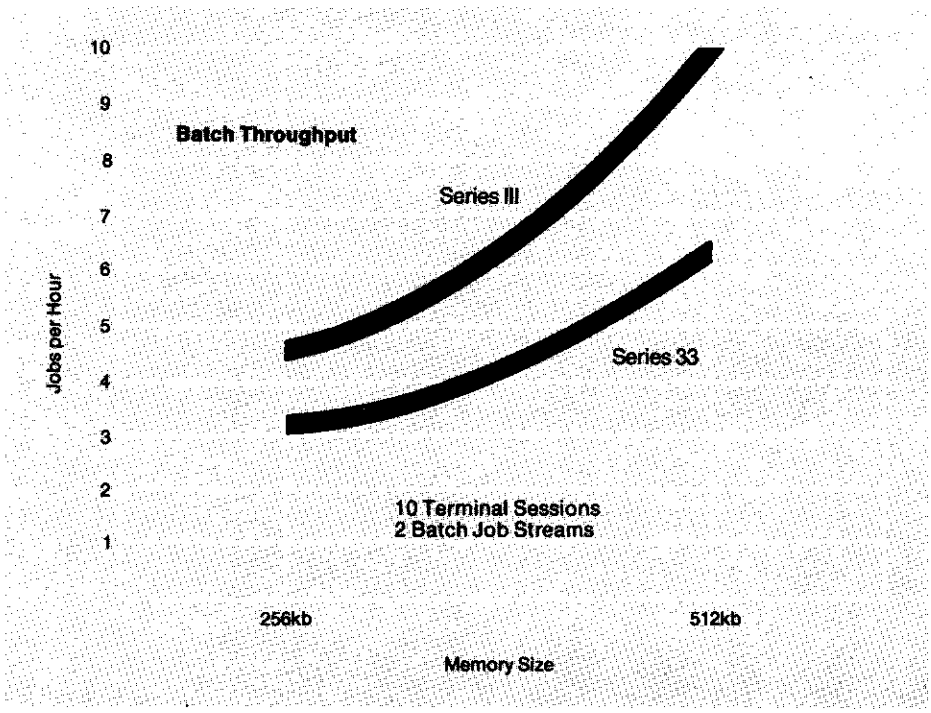
Small business with data entry

museum

This workload, which might be encountered in a small-to-medium business or a division of a larger corporation, represents a user who may have upgraded from a small, traditional batch-type system. Batch processing for this test included performing the standard job for test #1 described previously. Concurrently with the production batch work, two terminals performed new application program development with the EDITOR. Data entry and data inquiry utilized COBOL and the IMAGE Data Base Management System.







Workload summary

On-line transaction processing: Six terminals performed data entry and two terminals performed data inquiry into an inventory data base. The data entry transactions read information from the terminal (line items on an order form) then added new records to the data base which consisted of one automatic master and three details, of which two were being used. Up to 15 line items could be entered, and each item resulted in one record being written to the data base.

The data inquiry transactions involved reading a part number from the terminal and then accessing data in four detail data sets to retrieve scheduling information about the part. The data base for these transactions consisted of seven masters (of which one was being used) and four detail data sets which were all used. This information was then formatted and output to the terminal as a report that was up to 60 lines long.

Interactive Program Development: Two terminals did program development with the EDITOR.

Batch Processing: Two test #1 batch jobs executed concurrently.

Memory size: 256kb and 512kb

Total number of terminal sessions: 10

Total number of batch job streams: 2

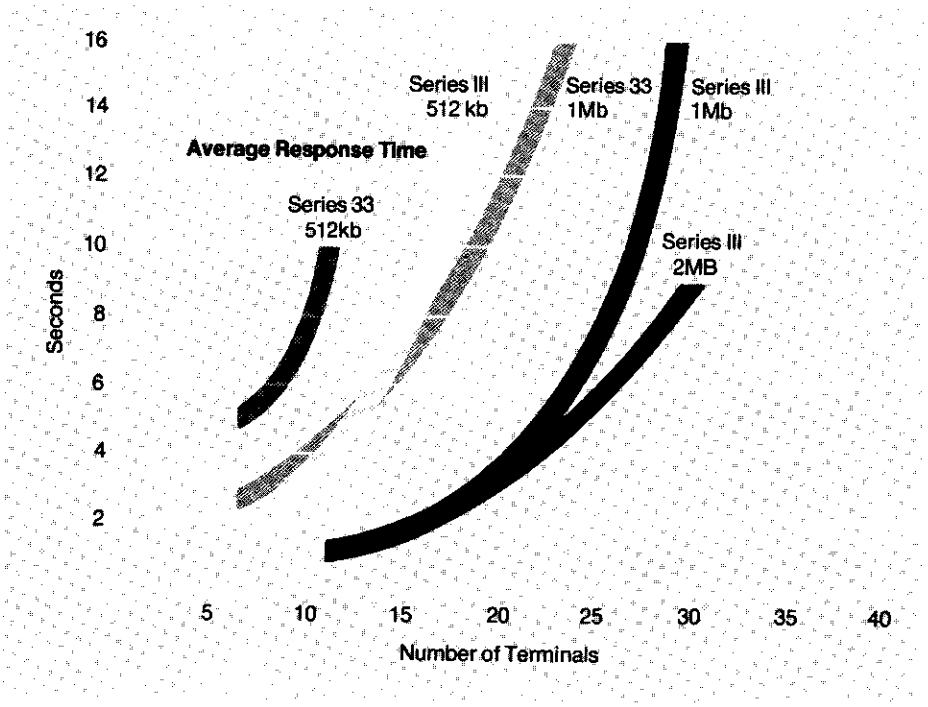
Comments: Terminal response time and on-line transaction throughputs were good with either system at either memory size. Increasing memory has significant impact on batch throughput—better than 2:1 improvement for the Series III, and about 2:1 for the Series 33. Batch throughput requirements should be used to determine memory size in this type of environment. With good response times at 512kb, larger memory sizes were not tested.

Test no. 2:

General purpose EDP environment

This type of HP 3000 system workload might be encountered within an independent manufacturing company or a division of a larger corporation. On-line transaction processing included order entry and order tracking using COBOL, the IMAGE Data Base Management System, and Data Entry Library (DEL), a data entry facility for efficient forms and screen management. Interactive program development used our editing subsystem (EDITOR). Batch processing performed the standard job for test #2 as described previously. A report was continuously printed on the line printer to reflect a typically heavy output load.

In the three graphs the total number of terminals (on-line transaction processing plus program development terminals) is indicated on the horizontal axis while the response time at the on-line transaction processing terminals is shown on the vertical axis.



Workload Summary

On-line transaction processing: The number of terminals ranged from 5 to 27, with 90% doing data entry and 10% doing data inquiry to a manufacturing application data base using a different program from that of test #1. The data entry transactions read information from the terminal and then edited and validated the data against known values. Validated data was then written to the data base which consisted of three masters all of which were used, and five details of which one was used. There were three reads and one write (which updated three chains) for each transaction.

The data inquiry transactions read information from the terminal, validated it, and read one record of information from a detail data set of the data base described above to generate output from 1 to 8 lines long.

In addition, all transactions were logged to a sequential disc file.

Interactive program development: Two terminals did program development with the EDITOR.

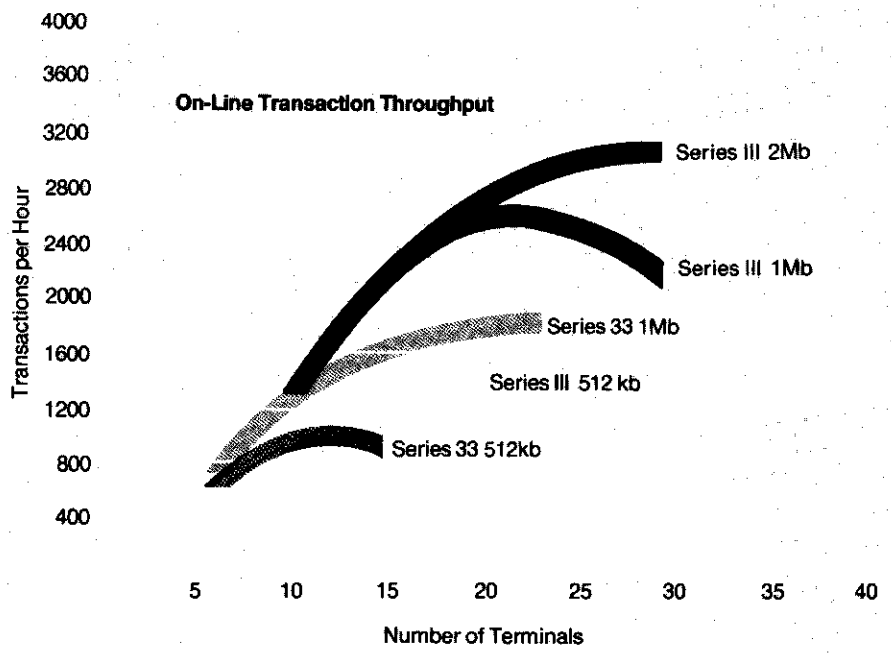
Batch processing: One job stream executed the standard job for test #2. COBOL, RPG, and SORT were used.

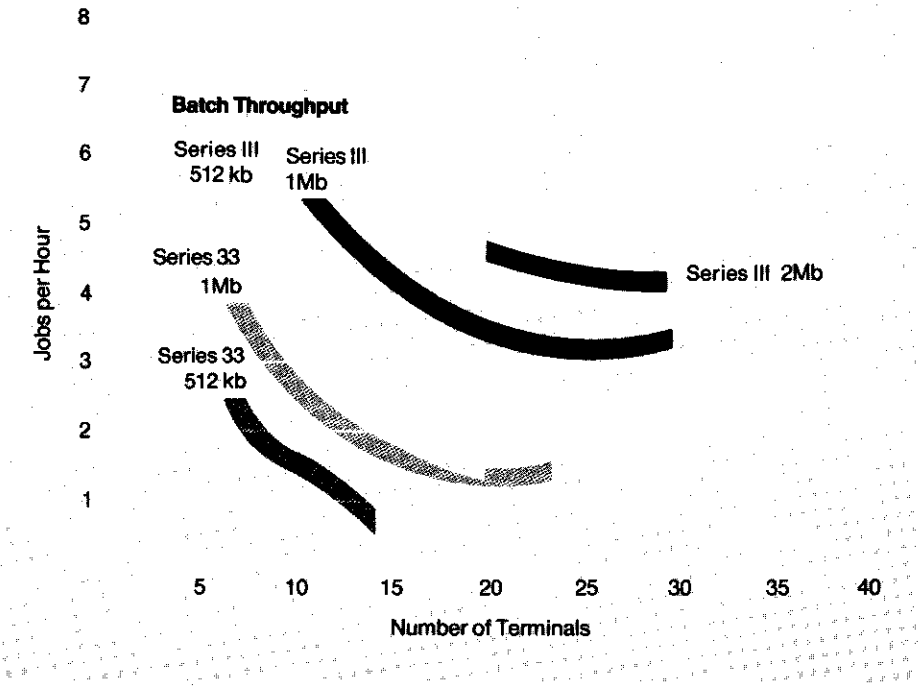
Series III memory size: 512kb to 2Mb

Series 33 memory size: 512kb to 1Mb

Total number of terminal sessions: 7 to 29, which includes on-line transaction processing and program development terminals.

Total number of batch job streams: 1





Comments for Series III: In this application it was possible to maintain response times for twice the number of users by doubling the memory size. Specifically, at 512kb, 11 users received 4 seconds response, and at 1Mb 22 users received the same response time.

For on-line transaction throughput, the benefit of 1Mb of memory versus 512kb begins at approximately 12 terminals; at 20 terminals it is almost a 2:1 improvement. For terminal configurations greater than 20, 2Mb of memory is beneficial.

When the number of interactive users is increased, the system takes resources from batch processing to satisfy the increased terminal load. This effect can be minimized with additional memory as shown in the batch throughput graph by the almost flat curve for a 2Mb configuration.

Comments for Series 33: Again, it was possible to maintain good response time for twice the number of users by increasing the memory size. Specifically, at 512kb seven users received five second response, and at 1Mb 14 users received the same response.

For on-line transaction throughput the benefit of 1Mb of memory over 512kb is apparent at about 10 terminals; at 15 terminals there is almost a 2:1 improvement.

Series 33 batch throughput at 1Mb does not equal that of a 512kb Series III. Since batch jobs are always ready to run (no "think" time involved) the Series 33 CPU with its longer instruction execution times, produces less throughput.

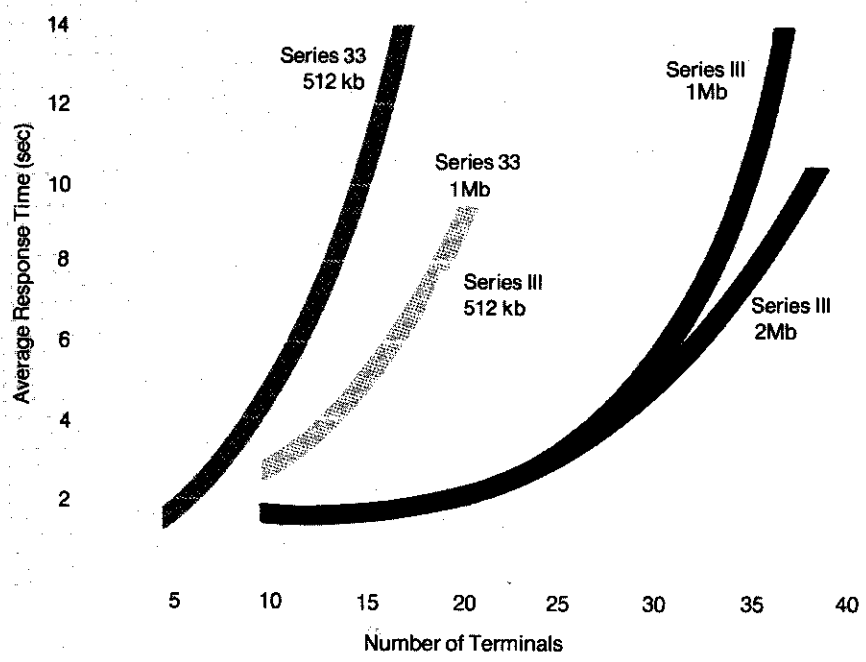
Test no. 3:

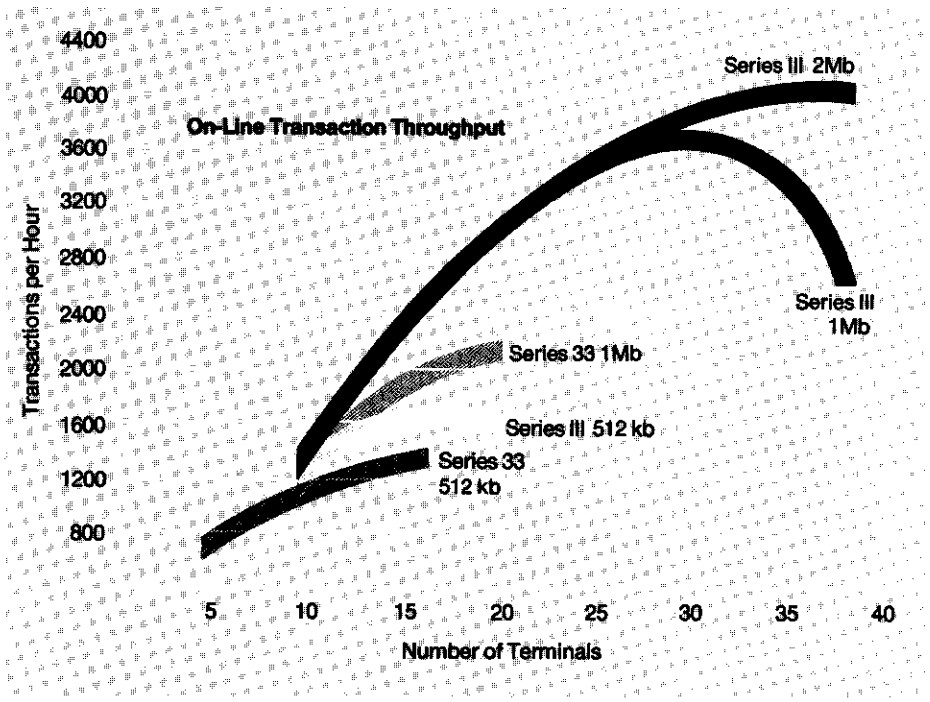
Dedicated on-line transaction processing environment

This workload was designed to model applications where the system operates in a dedicated environment with a large number of terminals. Such a workload might be encountered in a medium-to-large manufacturing company or a division of a large corporation where batch processing and interactive program development are done on a central system. On-line transaction processing included order entry, order updating, and order tracking directly to a data base using COBOL, IMAGE data base software, and Data Entry Library (DEL). To simulate a heavy load for line printer output, a report was constantly being printed on the line printer.

Workload summary

On-line transaction processing: The number of terminals ranged from 4 to 38 with 50% doing data entry directly to a data base, 40% data update, and 10% data inquiry to a manufacturing applications data base. The data entry and data inquiry transactions were the same as those described for Test #2. The data update transactions read data from the terminal and validated it. Following this, there was one record read from the data base which was then updated, causing it to be written back to disc. All transactions were logged to a sequential disc file.





Interactive program development: none

Batch processing: None

Series III memory size: 512kb to 2Mb

Series 33 memory size: 512kb to 1Mb

Total number of terminal sessions: 4 to 38

Total number of batch job streams: None

Comments for Series III: Adding memory beyond 512kb keeps response time low (less than 4 seconds) for more than 15 terminals. Two megabytes of memory maintains quick response time beyond 30 terminals.

On-line throughput for 1Mb of main memory peaks at 30 terminals for this particular application. At 1Mb, with more than 30 terminals, system resources start being applied to handle the extra process overhead generated by these terminals, rather than to processing transactions. This overhead diminishes with additional memory, and at 2Mb, the system is processing over 4000 transactions/hour.

Comments for Series 33: It was possible to maintain response time of five seconds for up to 10 terminals when this application was run on a 512kb system. One megabyte of memory kept the five second response for up to 16 terminals.

With regard to throughput, the benefit of the 1Mb memory over 512kb becomes evident at eight terminals, and the benefit is even more apparent at configurations of 16 or more terminals.

Which System Do You Choose . . .

Let your needs guide you

One of the major criteria in selecting the proper HP 3000 system to meet your data processing needs is performance. We want to ensure that you choose the system that gives you the performance and capabilities you need. Based on the performance data presented thus far, some comments are in order about the relative performance of the Series III and Series 33.

These performance curves indicate that a 1Mb Series 33 can handle the same on-line, non-CPU intensive load as a 512kb Series III. Care should be exercised when using this comparison, as certain on-line applications might place different CPU and I/O loads on the system which would cause a change in the relative performance of the Series 33 and Series III.

The Series III will show greater performance than the Series 33 when running batch jobs or other CPU-intensive jobs because the Series 33 CPU has about one-half the instruction execution speed of the Series III CPU. This means that the more CPU intensive a program gets, the greater the performance difference will be between the Series III and Series 33, with a totally CPU-bound job on the Series 33 taking about twice as long to execute as it does on the Series III. The less CPU intensive a program gets, the closer the performance of the Series 33 and Series III will be. A good example of this is the dedicated on-line transaction processing test.

The amount of memory needed in a system depends wholly on the application load placed on it. Increasing memory can be useful if your system is running several on-line application programs and several batch jobs simultaneously, resulting in a requirement for a larger amount of memory.

From a performance standpoint, the decision between a Series 33 and a Series III should be made by analyzing your batch throughput requirements, as well as your on-line needs (number of terminals and response time needed). Then, with an understanding of your future growth and data processing needs, your Hewlett-Packard Sales Representative and Systems Engineer can aid you in making a decision.

Adding major communications subsystems

Augmenting HP 3000 Series II and III system capabilities with the addition of communications software will be desirable for many customers, especially larger corporations that wish to utilize system resources in several plant locations, sales offices, or distribution centers. As an aid to understanding the performance effects of designing and implementing such an application, Hewlett-Packard's major communications subsystems are discussed and performance results are given. These communications subsystems are:

MTS/3000—Multipoint Terminal Software which permits transmission between an HP 3000 Series II or III and multiple terminals via a single communication line at speeds up to 9600 baud.

MRJE/3000—Multileaving Remote Job Entry software which gives multiple users on a local HP 3000 Series II or III simultaneous batch access to any remotely connected host utilizing a HASP II (version 3.1 or 4.0) or JES2 Job Entry System.

DS/3000—Distributed Systems software which provides the capability to establish interactive communications links between different Hewlett-Packard computer systems in geographically dispersed locations.

Communications subsystem performance data

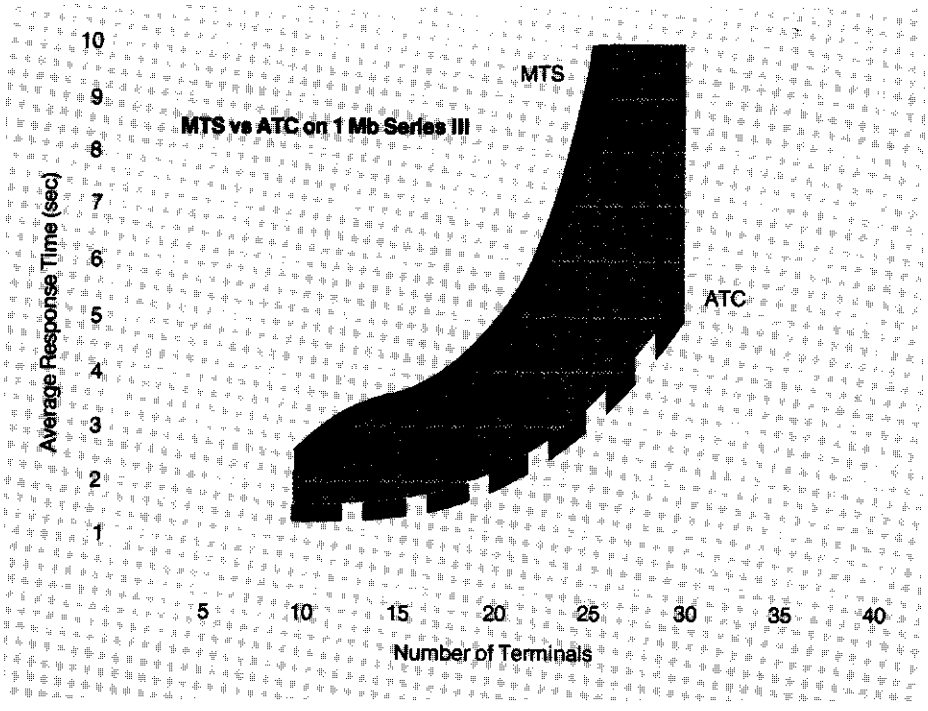
To demonstrate the effect these communications software subsystems will have on overall system performance, these subsystems were executed along with the dedicated on-line transaction processing environment.

A Series III with a 1Mb memory was used as the test system. Results for a Series 33 are not given, since it does not support the communications software.

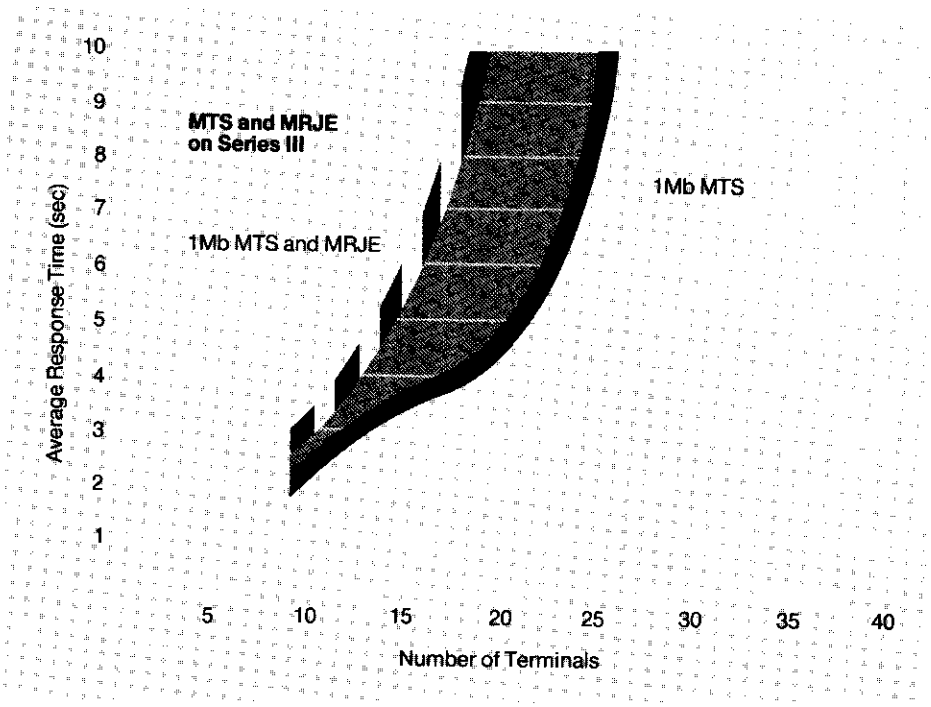
The graphs illustrate the incremental performance effects the subsystems have in such a system environment. Although this does not duplicate your particular environment, it should give you an idea of the relative performance influence and overhead that communications software incurs.

Multipoint (MTS) vs. point-to-point (ATC): The performance effect of using multipoint terminals versus the HP Asynchronous Terminal Controller (ATC) for your application is shown in this graph. ATC is the communication method used for the first series of tests. The dashed line in the graph represents the data from the dedicated on-line transaction processing test using the ATC at 2400 baud for the 1Mb main memory configuration. The solid line is the same workload, but all terminals are connected via MTS. In all cases the number of MTS terminals was split evenly between two MTS lines.

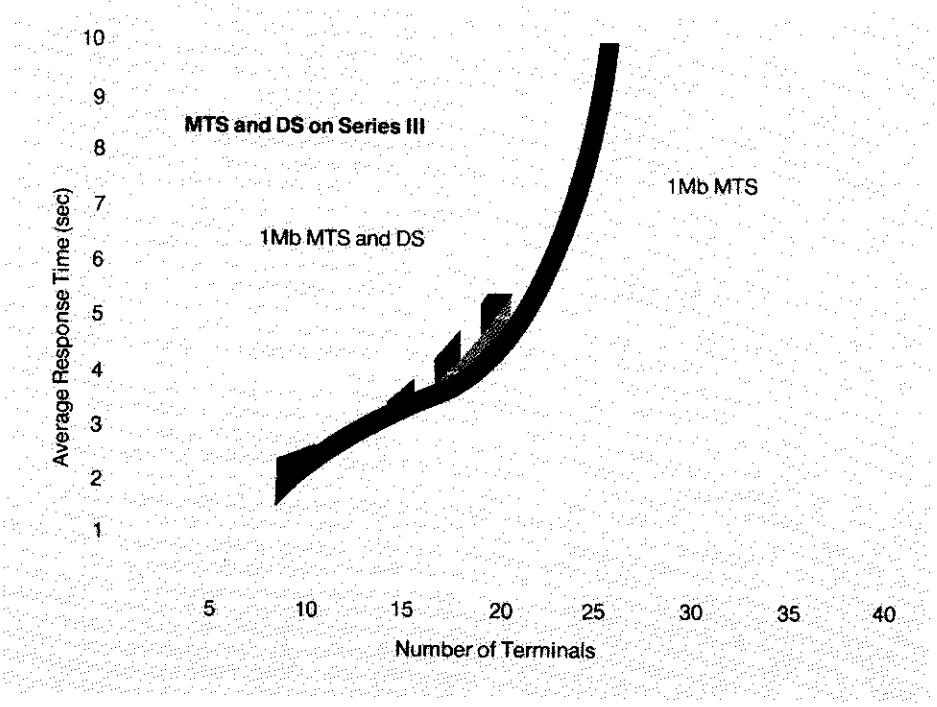
All MTS terminals were hardwired and running at 9600 baud.



MTS with MRJE: This graph shows the performance effect of a constant bi-directional data flow from the HP 3000 Series III to a host computer being applied with the MRJE communication software. While the HP 3000 executed the dedicated on-line transaction processing test, jobs were being continually submitted from the HP 3000 to the host computer for execution. Concurrently, the host computer was sending output back to the HP 3000 from previously executed jobs, and these were printed on the line printer configured to the HP 3000. The solid line in the graph represents the data from the dedicated on-line transaction processing test using MTS on the 1Mb main memory configuration without the MRJE activity. The dashed line represents the incremental performance effect of the same test performed in conjunction with MRJE. The MRJE software was configured with 1 card reader, 1 punch, and 1 line printer.



MTS with DS: This graph shows the performance effect of a constant DS data transfer being applied to the HP 3000 while it executed the dedicated on-line transaction processing test. Each DS transfer (a 500 byte buffer) was through the PTOP (program-to-program communication) option of the DS subsystem. The solid line represents the data from the dedicated on-line transaction processing test using MTS on the 1Mb main memory configuration without the DS activity. The dashed line represents the incremental performance effect of the same test performed in conjunction with DS.



The HP 3000 Computer Systems can be configured with main memory from 256 kilobytes to 2 megabytes. This broad range allows you to select a system tailored to current performance needs and provides a cost-effective growth path to meet increasing future system demands.

To maximize your success in implementing applications on the HP 3000, comprehensive application design assistance is offered:

- System performance and application design consulting is available from HP's highly trained staff of Systems Engineers.
- Customer training courses with comprehensive documentation are available on-site or at regional HP training centers.
- An independent worldwide Users Group, organized for the purpose of exchanging techniques and ideas among HP 3000 users, holds regional, national, and international meetings that provide an atmosphere in which to sharpen your software techniques.

For more information on HP 3000 Computer Systems, contact your local Hewlett-Packard representative, or write

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