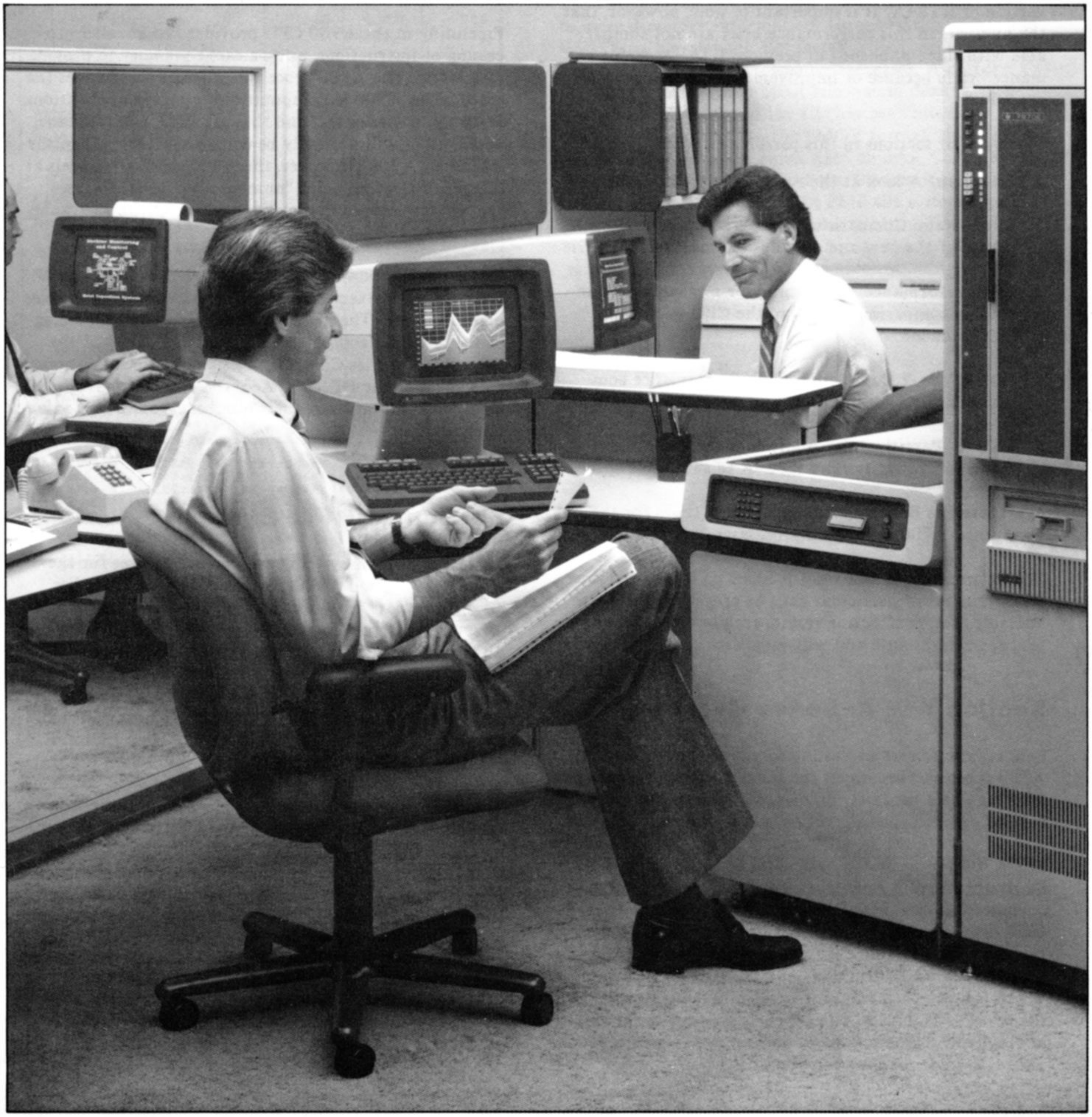
# RTE-A Performance Brief

HEWLETT PACKARD

## A-Series Automators

Data from Tests under RTE-A Revision 2440



## Introduction

RTE-A combined with VC+ and the A600+, A700, and A900 processors presents Hewlett-Packard's most advanced family of real-time computer systems. Effective with revision 2440, RTE-A supports up to 48 I/O channels and optional partitioning of drivers and certain operating system modules to gain more space for tables in large configurations. This brief provides new information and brings information in the previous RTE-A performance brief up to date, based on tests with the 2440 version of RTE-A. It is important to note, however, that the numbers in this performance brief are not comparable with those published in previous RTE-A performance briefs because of improvements in testing procedures.

There are six sections in this performance brief:

1. **Overview.** A look at the A-Series processors.
2. **File System.** Comparison of programmatic performance of the new and old file systems.
3. **I/O Performance.** Logic analyzer measurements, including comparison of I/O in the CPU and in the I/O Extender.
4. **CDS.** (Code & Data Separation) Performance comparisons of scheduling CDS and non-CDS programs.
5. **RTE-A Partitioning.** Additional execution times incurred by partitioning RTE-A to gain table space.
6. **Whetstone Benchmarks.** Benchmark times for the A600+, A700, and A900 processors.

The information in this brief is based on logic analyzer measurements of particular calls or processing intervals. Variable factors affecting results are discussed. The numbers are not absolute and will vary with configurations.

## Section 1 -- A-Series Overview

Base instruction set processing speeds of the A600+ and A700 processors are about the same, although execution time may be a bit faster on one computer or the other, depending upon the instruction mix of the program.

The A700 processor can optionally be equipped with a hardware floating point processor for floating point computation speeds that are more than triple the firmware based floating point speeds of the A600+. This performance difference is further reinforced by Scientific and Vector Instruction Set (SIS and VIS) firmware, which is much faster than the software equivalents in the A600+. The A700 also supports microprogramming of frequently-used software routines by the user for a 3-to-10-fold speed-up for optimizing performance. All A700 data in this performance brief is taken from an A700 Computer with hardware floating point, SIS, and VIS.

Standard hardware floating point and SIS and VIS firmware help make the A900 one of the best price/performance 16/32-bit machines available today. Sixteen-bit external paths make the A900 a compatible member of the A-Series family, while 32-bit internal paths give it the performance to compete against higher-priced wide-word machines.

Pipelining in the A900 CPU provides fast parallel processing of instructions, using a cache memory to provide fast access. The A900 processor provides three times the speed of an A700 in computation-intensive applications. With the A-Series I/O and the fast CPU, I/O intensive applications will normally be equal to or faster than the A600+ or A700. However, the A900 especially excels at integer or floating point "number crunching" for uses that involve loops or repetitions which utilize the cache memory to the fullest.

Table 1 shows how the respective A-Series computers compare when executing various selected system services under RTE-A. The instruction set and execution times of the A-Series computers are listed in Table 4 of the HP 1000 A-Series Computer Design and Specifications data sheet of the HP 1000 A-Series Hardware Technical Data book, literature request number 5953-8761, or a later revision.

## Section 2 -- File System

Table 2 shows file system performance figures for the A600+, A700, and A900 processors using a 7912 disc. To differentiate between the file calls and hierarchical directory structure introduced with RTE-A revision 2326 and the structure used in previous versions of RTE, and still supported, the new is referred to as FMP and the old as FMGR. Table 2 compares all possible permutations, including new (FMP) file calls to new (FMP) disc LUs, new (FMP) file calls to old (FMGR) disc LUs, and old (FMGR) file calls to old (FMGR) disc LUs.

The create and open times in Table 2 are measured for a file being created or opened that is located in the same directory as the type 6 (program) file, as the first entry in that directory, which has no extents. These constraints minimize disc access time, while providing a consistent basis for measurement. Create and open times will otherwise be longer, varying with directory size and extents, file entry location in the directory, and with the need (if any) to access a different directory.

*Table 1. Logic Analyzer Measurements of Selected System Services (execution times in microseconds)*

| OPERATION | A600+ | A700 | A900 |
|---|---|---|---|
| Write 1 byte to terminal, unbuffered | 4,510 | 4,700 | 2,800 |
| Write 80 bytes to terminal, unbuffered* | 88,110 | 88,360 | 85,660 |
| Write 1 byte to HP-IB, unbuffered | 3,230 | 3,430 | 1,690 |
| Write 80 bytes to HP-IB, HP-IB, unbuffered | 3,430 | 3,620 | 1,790 |
| Schedule Real-Time program resident in main memory with wait (time from Exec9 to entry of son program) | 1,340 | 1,420 | 700 |
| Schedule Background program from Real-Time program without wait (time from Exec10 until return) | 927 | 1,007 | 517 |
| Class GET (1 word) | 700 | 827 | 354 |
| Class GET (80 words) | 800 | 905 | 410 |
| Go priv using $LIBR | 80 | 105 | 51 |
| Go unpriv using $LIBX | 156 | 192 | 76 |
| Go priv using GOPRV** | 93 | 126 | 47 |
| Go unpriv using UNPRV** | 45 | 49 | 18 |
| Dispatchlock | 169 | 211 | 80 |
| Dispatchunlock | 198 | 242 | 93 |
| Time Base Gen overhead with no timeouts | 190 | 223 | 79 |
| Time Base Gen overhead with one timeout entry | 199 | 231 | 82 |

* Transfer of 78 bytes instead of 80 bytes saves 3 to 4 milliseconds (3000-4000 microseconds) over these times because the device driver can send a 78-byte record to the interface driver in one call, vs two required for 80 bytes.

** The new GOPRV/UNPRV services execute about 40% faster than the old (and still supported) $LIBR/ $LIBX combination.

Table 2 read and write times are based on having the Data Control Block (DCB) already in main memory to exclude disc access times and thereby assure consistent data.

A 40-word record size was used because it is most typical of actual usage. Each word written or read accounts for about 1 microsecond of of the read/write times.

The CREATE call for the new file system is slower due to more directory information. However, the READ and WRITE calls are about 30% faster, which can yield significant file I/O performance increases. A performance concern of the FMGR file system dealing with the size of the DCB and the file has been alleviated with the FMP file system. In the FMGR format, the files are pulled into the DCB in equal sized chunks. Consequently, the entire DCB is used only if the file size is an integer multiple of the DCB size. The FMP file system uses all of the DCB regardless of the size of the file, and brings in the remainder of the file on the last access, minimizing the number of disc accesses.

*Table 2. File System Performance Comparison (execution times in milliseconds)*

| | A600+ | | | A700 | | | A900 | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of File Accessed =<br>Type of File Call Made = | FMP<br>FMP | FMGR<br>FMP | FMGR<br>FMGR | FMP<br>FMP | FMGR<br>FMP | FMGR<br>FMGR | FMP<br>FMP | FMGR<br>FMP | FMGR<br>FMGR |
| 1. CREATE & OPEN FIRST FILE IN DIRECTORY, Type = 2, Size = 2 Blks, Rec = 40 words | 139 | 75 | 45 | 137 | 76 | 46 | 102 | 56 | 42 |
| 2. READ 2nd RECORD IN FILE (DCB already in memory) | 0.343 | 0.344 | 0.527 | 0.399 | 0.393 | 0.504 | 0.145 | 0.152 | 0.223 |
| 3. WRITE A RECORD TO A FILE (DCB already in memory) | 0.340 | 0.340 | 0.516 | 0.392 | 0.388 | 0.496 | 0.142 | 0.143 | 0.185 |
| 4. OPEN A FILE, Update = FMGR, RWOQ = FMP | 28 | 64 | 48 | 31 | 65 | 48 | 12 | 45 | 45 |

## Section 3 -- I/O Performance

Table 3 provides detailed data on buffered, unbuffered, and class I/O within RTE-A. Interrupt response time (time from the occurrence of an interrupt to execution of the first instruction in the driver) is also specified in Table 3. Table 4 compares I/O execution times in the CPUs and I/O Extenders for four different A-Series interfaces.

*Table 3. Detailed Analysis of I/O Processing Overhead Using 64000 Logic Analyzer*

| OPERATION | INITIATION (milliseconds) | | | | | | COMPLETION (milliseconds) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CALL EXEC TO DEV DRVR | DEVICE DRIVER TO I/F DRVR (a&b) | CALL EXEC TO I/F DRIVER | I/F TO START DMA | START DMA TO EXIT SYST (a) | RETURN TO CALLER AFTER INIT. (c) | INTRPT RESP. TIME (Inter. to I/F Driver) (a) | I/F DRIVER TO DEV DRIVER (a & d) | DEVICE DRIVER TO EXIT SYSTEM | I/F DRIVER TO EXIT SYSTEM |
| **RTE-A on A600+** | | | | | | | | | | |
| UNBUF. I/O TO TERMINAL | 0.900 | 1.029 | ---- | 0.243 | 0.335 | (c) | 0.132 | 0.418 | 0.730 | ----- |
| UNBUF. I/O TO HP-IB | (e) | (e) | 1.330 | 0.445 | 0.351 | (c) | 0.132 | (e) | (e) | 0.951 |
| BUFFERED I/O TO TERMINAL | 1.020 | 0.863 | ---- | 0.233 | 0.145 | 2.261 | 0.131 | 0.418 | 0.514 | ----- |
| BUFFERED I/O TO HP-IB | (e) | (e) | 1.287 | 0.435 | 0.163 | 1.888 | 0.130 | (e) | (e) | 0.741 |
| CLASS I/O TO TERMINAL(f) | 1.222 | 0.870 | ---- | 0.240 | 0.145 | 2.478 | 0.132 | 0.418 | 0.552 | ----- |
| CLASS I/O TO HP-IB(f) | (e) | (e) | 1.495 | 0.444 | 0.163 | 2.101 | 0.131 | (e) | (e) | 0.772 |
| UNBUF CLASS I/O TO TER(f) | 1.284 | 1.051 | ---- | 0.253 | 0.145 | 2.735 | 0.130 | 0.418 | 0.578 | ----- |
| UNBUF CL I/O TO HP-IB(f) | (e) | (e) | 1.739 | 0.428 | 0.160 | 2.322 | 0.131 | (e) | (e) | 0.797 |
| CLASS RETHREAD TO TERMNL | 1.135 | 0.867 | ---- | 0.240 | 0.145 | 2.388 | 0.130 | 0.417 | 0.648 | ----- |
| CLASS RETHREAD TO HP-IB | (e) | (e) | 1.407 | 0.443 | 0.163 | 2.014 | 0.131 | (e) | (e) | 0.777 |
| **RTE-A on A700** | | | | | | | | | | |
| UNBUF. I/O TO TERMINAL | 0.975 | 1.004 | ---- | 0.256 | 0.349 | (c) | 0.148 | 0.454 | 0.783 | ----- |
| UNBUF. I/O TO HP-IB | (e) | (e) | 1.369 | 0.477 | 0.368 | (c) | 0.148 | (e) | (e) | 1.044 |
| BUFFERED I/O TO TERMINAL | 1.155 | 0.888 | ---- | 0.246 | 0.170 | 2.458 | 0.148 | 0.454 | 0.601 | ----- |
| BUFFERED I/O TO HP-IB | (e) | (e) | 1.433 | 0.467 | 0.192 | 2.086 | 0.148 | (e) | (e) | 0.862 |
| CLASS I/O TO TERMINAL(f) | 1.403 | 0.901 | ---- | 0.256 | 0.170 | 2.716 | 0.148 | 0.454 | 0.651 | ----- |
| CLASS I/O TO HP-IB(f) | (e) | (e) | 1.687 | 0.474 | 0.192 | 2.353 | 0.148 | (e) | (e) | 0.915 |
| UNBUF CLASS I/O TO TER(f) | 1.452 | 1.036 | ---- | 0.271 | 0.169 | 2.926 | 0.147 | 0.455 | 0.683 | ----- |
| UNBUF CL I/O TO HP-IB(f) | (e) | (e) | 1.873 | 0.460 | 0.187 | 2.524 | 0.148 | (e) | (e) | 0.944 |
| CLASS RETHREAD TO TERMNL | 1.300 | 0.892 | ---- | 0.254 | 0.170 | 2.615 | 0.148 | 0.455 | 0.757 | ----- |
| CLASS RETHREAD TO HP-IB | (e) | (e) | 1.580 | 0.474 | 0.191 | 2.245 | 0.147 | (e) | (e) | 0.914 |
| **RTE-A on A900** | | | | | | | | | | |
| UNBUF. I/O TO TERMINAL | 0.524 | 0.426 | ---- | 0.127 | 0.179 | (c) | 0.071 | 0.209 | 0.381 | ----- |
| UNBUF. I/O TO HP-IB | (e) | (e) | 0.703 | 0.225 | 0.179 | (c) | 0.071 | (e) | (e) | 0.501 |
| BUFFERED I/O TO TERMINAL | 0.623 | 0.387 | ---- | 0.126 | 0.092 | 1.225 | 0.071 | 0.228 | 0.289 | ----- |
| BUFFERED I/O TO HP-IB | (e) | (e) | 0.754 | 0.225 | 0.097 | 1.075 | 0.067 | (e) | (e) | 0.378 |
| CLASS I/O TO TERMINAL(f) | 0.658 | 0.388 | ---- | 0.131 | 0.092 | 1.275 | 0.071 | 0.227 | 0.322 | ----- |
| CLASS I/O TO HP-IB(f) | (e) | (e) | 0.795 | 0.236 | 0.097 | 1.128 | 0.067 | (e) | (e) | 0.415 |
| UNBUF CLASS I/O TO TER(f) | 0.681 | 0.436 | ---- | 0.137 | 0.091 | 1.342 | 0.071 | 0.227 | 0.339 | ----- |
| UNBUF CL I/O TO HP-IB(f) | (e) | (e) | 0.872 | 0.224 | 0.094 | 1.187 | 0.067 | (e) | (e) | 0.434 |
| CLASS RETHREAD TO TERMNL | 0.537 | 0.388 | ---- | 0.132 | 0.091 | 1.148 | 0.074 | 0.228 | 0.363 | ----- |
| CLASS RETHREAD TO HP-IB | (e) | (e) | 0.675 | 0.234 | 0.099 | 1.009 | 0.070 | (e) | (e) | 0.399 |

NOTES:

a. Times in this column will increase if there are timeouts.

b. When the I/O Extender is used, additional overhead is incurred for allocation of I/O Port Maps, as follows: 33 microseconds in A600+, 37 microseconds in A700, 18 microseconds in A900.

c. Return to caller after initiation is valid only for buffered calls.

d. When the I/O Extender is used, additional overhead is incurred for deallocation of I/O Port Maps, as follows: 30 microseconds in A600+, 35 microseconds in A700, 18 microseconds in A90.

e. HP-IB operations were tested directly, without a device driver.

f. Class I/O times do not include the time to allocate the class number.

*Table 4. CPU - I/O Extender I/O Performance Comparison (execution times in microseconds)*

| INTERFACE | OPERATION | A600+ EXECUTION TIME | | A700 EXECUTION TIME | | A900 EXECUTION TIME | |
|---|---|---|---|---|---|---|---|
| | | IN CPU | IN I/O EXTENDER | IN CPU | IN I/O EXTENDER | IN CPU | IN I/O EXTENDER |
| 12006A PARALLEL INTERFACE CARD | 1-CHARACTER READ | 360 | 362 | 379 | 386 | 187 | 190 |
| | 80-CHARACTER READ | 373 | 376 | 399 | 403 | 194 | 199 |
| | 1000-WORD READ | 1663 | 1647 | 1812 | 1819 | 1926 | 1936 |
| | 1-CHARACTER WRITE | 359 | 363 | 381 | 385 | 187 | 189 |
| | 80-CHARACTER WRITE | 373 | 374 | 399 | 400 | 193 | 197 |
| | 1000-WORD WRITE | 1938 | 2592 | 2137 | 2868 | 2486 | 3312 |
| 12005B ASYNC SERIAL INTER-FACE CARD | 1-CHARACTER WRITE | 1051 | 1058 | 1060 | 1066 | 1060 | 1067 |
| | 80-CHARACTER WRITE | 83300 | 83340 | 83320 | 83320 | 83320 | 83350 |
| | 128-CHARACTER WRITE | 133300 | 133300 | 133300 | 133300 | 133300 | 133300 |
| 12009A HP-IB INTERFACE CARD | 1-CHARACTER WRITE | 362 | 374 | 388 | 398 | 189 | 191 |
| | 80-CHARACTER WRITE | 374 | 383 | 404 | 411 | 203 | 204 |
| | 1000-WORD WRITE | 1690 | 2434 | 1900 | 2654 | 2275 | 3093 |
| 12040C ASYNC MULTIPLEXER INTERFACE CARD | 1-CHARACTER WRITE | 1446 | 1440 | 1429 | 1425 | 1751 | 1726 |
| | 80-CHARACTER WRITE | 1848 | 1841 | 1831 | 1824 | 2151 | 2128 |
| | 128-CHARACTER WRITE | 2064 | 2057 | 2048 | 2044 | 2367 | 2343 |

NOTES:

A. Times listed represent the time required for the actual transfer of data from the start of DMA until interrupt of RTE-A signalled completion.

B. Additional overhead of I/O Extender on writes as compared to the CPU shows up mainly with transfers of larger blocks of data via fast interfaces, such as the 12006A Parallel Interface and the 12009A HP-IB interface. With slower interfaces, such as the 12005B Async Serial Interface and the 12040C Multiplexer Interface, the additional overhead of the I/O Extender shows very little effect upon overall throughput, regardless of the size of the block being transferred.

C. Tests with the 12005B and 12040C interfaces bypassed the device driver to eliminate subdivision of data blocks into 78 character blocks by the device driver.

D. The test data was the same in either a first I/O Extender or a second I/O Extender.

## Section 4 -- CDS Programs

This section deals with the performance of programs using the code and data separation feature of VC+. The test was done using one program (DOSR) to schedule another program (SR) which terminates, saving resources. It is already in memory when scheduled. The test was run with these permutations of three variables:

1. Scheduling - DOSR schedules SR with wait (EXEC9) or without wait (EXEC10).
2. Priority - SR is always priority 99, and DOSR is higher (priority 90), or lower (priority 101).
3. Execution - The test is done with both programs as non-CDS, both CDS, both CDS and SR shared, and both CDS and both shared.

Table 5 reflects the difference in scheduling time due to priorities and type of scheduling call (with or without wait). Additionally, you can see, first hand. the additional overhead incurred with cross-map calls when the code and data are in separate maps, and with additional table checking when the programs are shared.

*Table 5. CDS Scheduling Times (in microseconds)*

| OPERATION | DOSR EXEC9 to SR entry | | DOSR EXEC9 to return to DOSR | | DOSR EXEC10 to SR entry | | DOSR EXEC10 to return to DOSR | |
|---|---|---|---|---|---|---|---|---|
| DOSR PRIORITY > | 90 | 101 | 90 | 101 | 90 | 101 | 90 | 101 |
| **RTE-A/VC+ ON A600+** | | | | | | | | |
| NON-CDS | 1348 | 1345 | 2474 | 2471 | 1958 | 1264 | 921 | 2303 |
| BOTH CDS | 1575 | 1575 | 2910 | 2921 | 2225 | 1505 | 950 | 2766 |
| BOTH CDS (SR SHARED) | 1585 | 1585 | 2931 | 2931 | 2218 | 1501 | 938 | 2761 |
| BOTH CDS (BOTH SHARED) | 1585 | 1586 | 2953 | 2956 | 2241 | 1501 | 960 | 2784 |
| **RTE-A/VC+ ON A700** | | | | | | | | |
| NON-CDS | 1476 | 1478 | 2671 | 2672 | 2095 | 1334 | 997 | 2434 |
| BOTH CDS | 1602 | 1602 | 2970 | 2970 | 2305 | 1519 | 1024 | 2799 |
| BOTH CDS (SR SHARED) | 1633 | 1632 | 3004 | 3003 | 2331 | 1546 | 1024 | 2825 |
| BOTH CDS (BOTH SHARED) | 1634 | 1634 | 3032 | 3032 | 2353 | 1547 | 1052 | 2849 |
| **RTE-A/VC+ ON A900** | | | | | | | | |
| NON-CDS | 605 | 607 | 1107 | 1109 | 911 | 571 | 431 | 1052 |
| BOTH CDS | 683 | 683 | 1274 | 1274 | 1011 | 656 | 446 | 1213 |
| BOTH CDS (SR SHARED) | 700 | 700 | 1297 | 1299 | 1024 | 670 | 446 | 1227 |
| BOTH CDS (BOTH SHARED) | 695 | 698 | 1300 | 1300 | 1036 | 667 | 454 | 1233 |

NOTE: SR already in memory when scheduled.

## Section 5 -- RTE-A Partitioning

The excellent capabilities of the A-Series computers and RTE-A have led to configuration of increaslingly large systems. With this trend, some users have encountered a problem with limited space for system tables, which occupy the lowest 64k bytes of physical memory along with the RTE-A system itself. To make more table space available, RTE-A revision 2440 provides for the partitioning of drivers and the RTE-A system modules listed in Table 6 outside of the lowest 64k bytes of physical memory. When fully used, this partitioning makes 6 more pages of memory available for system tables than would be available in a non-partitioned system, 3 more pages than are available in the primary system. Memory is gained for table space in this way at the cost of the time required for jumping to and returning from the partitioned routines. These times, which include memory mapping changes, are listed in Table 7.

*Table 6. Partitionable RTE-A System Modules*

| MODULE | ENTRY POINTS | TYPE OF CALL |
|---|---|---|
| CDSFH | $CDSF, $VMAF | Trap |
| | $CDSSO, $CDSX | Jmp |
| | $TOG.CDS | Jsb0, Return0 |
| DSQ | $EX34 | Jmp |
| LOAD | $COMP, $EX08, $EX28 | Jmp |
| | $DREL, $LDAB, $LOAD, $LULK, $PREL, $SORL, $SR13, $TOG.LOAD | Jsb0, Return0 |
| | $SREL | Jsb1, Return1 |
| MEMRY | $EX22 | Jmp |
| | $GBLK, $GFRE, $GTSZ, $MFRE, $SHAREPR, $TOG.MEMY, $UNMK, $XEQ2, $XEQ5 | Jsb0, Return0 |
| PERR | $DMPR | Jmp |
| | $PRTY | Trap |
| | $TOG.PERR | Jsb0, Return0 |
| STAT | $DSRQ, $EX26, $EX33, $PSRQ | Jmp |
| VEMA | $EMCK, $SETMC, $SETMU, $SETVC | Jsb0, Return0 |
| XCMND | CKUSR | Jsb0, Return0 |
| | $ASRQ, $BRRQ, $CDRQ, $DNRQ, $DTRQ, $GORQ, $PRRQ, $SSRQ, $SZRQ, $ULRQ, $VSRQ, $WSRQ | Jmp |

*Table 7. Driver-Operating System Partition Mapping (execution times in microseconds)*

| OPERATION | A600+ | A700 | A900 |
|---|---|---|---|
| DRIVER MAPPING | | | |
| Map Driver | 25.4 | 20.0 | 5.4 |
| Remap Driver | 24.5 | 21.2 | 8.7 |
| MAPPING IN, AND RETURNING FROM, PARTITIONED OPERATING SYSTEM MODULES | | | |
| JSB0 Mapping/Tag routine | 46.8 | 42.2 | 26.0 |
| JSB1 Mapping/Tag routine | 65.4 | 55.2 | 32.2 |
| Return0 Remapping/Tag routine | 40.9 | 38.5 | 18.1 |
| Return1 Remapping/Tag routine | 52.3 | 40.0 | 18.9 |
| JMP Mapping/Tag routine | 26.1 | 23.0 | 14.0 |
| Trap Mapping/Tag routine | 64.3 | 76.0 | 36.2 |

## Section 6 -- Whetstone Benchmarks

A subset of the Whetstone benchmarks is provided in Table 8 for a comparison of the A-Series and F-Series processors and other machines for which this benchmark data is available.

The Whetstone benchmarks were developed by the National Physical Laboratory in England. The B1 and B1D benchmarks shown in Table 8 are referred to in the industry as the Whetstone single and double precision benchmarks, respecctively. The B1 and B1D programs were written in FORTRAN using an algorithm derived from an analysis of one thousand ALGOL60 programs as an attempt to represent an average program instruction mix. The algorithm includes many different operations (floating point and integer calculations, transcendental functions, array manipulation, and conditional jumps). The universality of this algorithm has been substantiated by subsequent analysis of FORTRAN programs. It was designed to be non-optimizable so that it would test the CPU and not the compiler. The execution of the B1 and B1D programs can be expressed in terms of a somewhat arbitrary entity known as a Whetstone instruction.

One loop through these programs represents 1,000,000 Whetstone instructions. Since we loop through the program 10 times, the times for B1 and B1D in Table 8 represent the time to execute 10,000,000 Whetstone instructions. By dividing the total execution times (in seconds) into 10,000, these times can be expressed in thousands of Whetstone Instructions Per Second (KWIPS), as listed in Table 9.

*Table 9. Whetstone Instructions Per Second (KWIPS)*

| | F-Series | A600+ | A700 | A900 |
|---|---|---|---|---|
| B1 | 450 | 225 | 490 | 1042 |
| B1D | 245 | 113 | 340 | 758 |

*Table 8. Whetstone Benchmarks*

| BENCHMARK | | TIME (MINUTES) | | | |
|---|---|---|---|---|---|
| | | RTE-6/VM | RTE-A w/VC+ | | |
| | | F-Series | A600+ | A700 | A900 |
| B1 | Single Precision Whetstone. Tests standard FORTRAN instruction set; not optimizable; tests CPU and not compiler. | 0.37 | 0.74 | 0.34 | 0.16 |
| B1D | Double Precision Whetstone. Double Precision version of B1. | 0.68 | 1.48 | 0.49 | 0.22 |
| B3 | Tests compiler efficiency and Single Precision Floating Point by using Single Dimension Array Access. | 0.88 | 1.30 | 0.82 | 0.25 |
| B4 | Double Precision version of B3. | 0.35 | 0.75 | 0.35 | 0.11 |
| B5 | Tests transcendentals by calling SQRT, SIN, COS, EXP, and ATAN. | 0.40 | 2.09 | 0.27 | 0.17 |
| B6 | Double Precision version of B5 with shorter loops. | 0.10 | 0.23 | 0.04 | 0.02 |
| B9 | Tests Floating Point using Binomial Expansion. | 1.08 | 1.99 | 0.97 | 0.34 |
| B10 | Tests compiler efficiency at analyzing IF statements. | 0.97 | 0.99 | 1.10 | 0.32 |
| B11 | Tests compiler accuracy using Double Precision Floating Point and transcendentals. | 0.97 | 1.50 | 0.60 | 0.22 |
| SP2 | Tests Single Precision Floating Point calculation speed. | 0.53 | 1.17 | 0.48 | 0.17 |
| DP2 | Tests Double Precision Floating Point calculation speed. | 0.77 | 2.38 | 0.66 | 0.28 |

## Configuration of Systems Used for Performance Testing

The tests made for this performance brief were run on systems configured as follows:

**Computers:** 2156B (A600+) w/0.5 MB memory, 2137A+ +001 (A700) w/floating point processor and 0.5 MB memory, and 2139A (A900) w/0.75 MB memory

**Terminals:** One 2626A Display Station connected to the system via a 12005B+005 interface as system console and one 2626A Display Station connected to the system via a 12005B or 12040C interface, as appropriate, for the CPU - I/O extender performance comparison tests and other I/O tests.

**System Disc:** 7912P 28.1 MB CS/80 Disc, connected to the system via a 12009A HP-IB interface.

**I/O Extender:** 12025A/B I/O Extender.

**I/O Interfaces:** In addition to the 12005B interface used for connection of the system console and the 12009A interface to the system disc, a 12005B, a 12009A, a 12006A, and a 12040C interface were used for I/O Extender tests.

**RTE-A Operating System:** Revision 2440 RTE-A operating system, installed as a standard primary system with minimal modifications, as follows:

```
1. Computer Type:   A600+    A700     A900
   Relocated:       %RPL63   %RPL73   %RPL91
```

2. For I/O tests, all drivers were relocated into the system to avoid incurring the overhead of mapping the drivers into a partition.

3. Operating system modules %RTIOA and %IOMOD were relocated next to %EXEC to save base page links.

4. For the partitioning tests, operating system modules %MEMRY and %LOAD were partitioned to provide a basis for measurement of the overhead involved in accessing partitioned RTE-A modules.

HEWLETT PACKARD

Supersedes 5953-8753

Printed in U.S.A. 6/85
5953-8733