Cii Honeywell Bull DPS 7 Series

MANAGEMENT SUMMARY

In 1976, Compagnie Honeywell Bull and Compagnie Internationale pour l'Informatique merged to form CII-HB. The development of the DPS 7 system represents one of the major elements in the UNYSIS program to converge the product lines of the two companies. Designed to provide a common upgrade path for users of CII-HB Level 64 and 64/DPS systems and of CII IRIS systems, the DPS 7 also is aimed at converting users of IBM System/370, ICL 1900 Series, and Siemens System 4004 and Series 77 computers.

The key to CII-HB's solution is extensive use of microprogramming in the DPS 7 systems' distributed internal architecture. CII-HB offers three DPS 7 operating systems—GCOS 64-E, SIRIS 3-E, and SIRIS 8-E—and three instruction sets, providing a direct upgrade path for users now running under GCOS 64, SIRIS 3, or SIRIS 8.

The first two microcoded virtual machines were announced in September 1979 as the DPS 7/80 and DPS 7/82. The 7/80 can use either the IRIS or the Level 64 instruction set, but the biprocessor 7/82, an upgrade only for the IRIS 80, cannot run the GCOS operating system. In January 1980, models 7/60 and 7/70 were introduced, and one year later, CII-HB announced the DPS 7/65 as a replacement for the previous entry-level 7/60. The DPS 7/65 has the same internal performance and throughput as the DPS 7/60, but is more cost effective because it does not include facilities for IRIS emulation. In comparison to the 7/60, the 7/65 has twice the communications lines, supports an additional 5,000 megabytes of on-line storage, and is physically more compact. Moreover, the 7/65, which runs under GCOS 64-E, is capable of running the OS 200/2000 operating systems and can be adapted to existing users of the company's H200 and H2000 computers.

Designed to provide a common upgrade path for users of CII-HB Level 64 and 64/DPS systems and of CII-HB IRIS systems, the DPS 7 Series of large-scale distributed processing systems currently consists of four models running under GCOS 64E, SIRIS 3E, or SIRIS 8E. In addition, the entry-level model is capable of using the OS 200/2000 operating systems and can be adapted to existing users of the company's H 200 and H 2000 computers. Purchase prices begin at 3,410,000 FF.

CHARACTERISTICS

MANUFACTURER: Cii Honeywell Bull, 94, avenue Gambetta, B.P. 33, 75960 Paris, Cedex 20, France. Telephone 360.02.22. Telex 220 898 F.

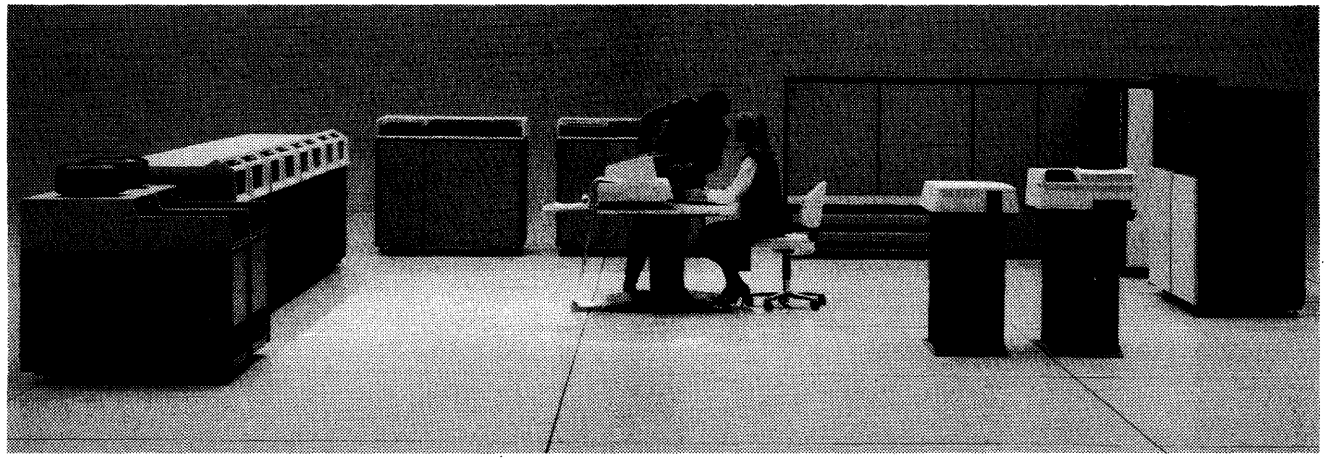
MODELS: DPS 7/65, DPS 7/70, DPS 7/80, DPS 7/82.

DATE ANNOUNCED: Cii Honeywell Bull announced the DPS 7/80 and DPS 7/82 models in September 1979, and the DPS 7/60 and DPS 7/70 in January 1980. One year later, in January 1981, CII-HB announced the DPS 7/65 as a replacement for the previous entry-level Model DPS 7/60.

DATE OF FIRST DELIVERY: The DPS 7/60, DPS 7/70, DPS 7/80, and DPS 7/82 were delivered in the fourth quarter of 1980. The DPS 7/65 was delivered in February 1981. Only a restricted number of DPS 7/60 models will be delivered to a limited number of French IRIS users, most of whom wish to upgrade to a DPS 7/70.

DATA FORMATS

BASIC UNIT: 8-bit byte plus one parity bit. Data paths are four bytes (32 bits) wide, while addresses and commands use an independent 28-bit path. Data can be interpreted as binary, decimal, hexidecimal, or alphanumeric. Data bits are interpreted in groups of four (packed decimal) or eight (alphanumeric EBCDIC), or in strings of 16 to 64 bits (binary



Equivalent in power to the IBM 4341-2 and three times more powerful than the largest 64/DPS model, this DPS 7/70 can run under GCOS 64-E, SIRIS 3-E, or SIRIS 8-E, providing a direct upgrade path for users of CII-HB Level 64 and 64/DPS systems, and of CII IRIS systems.

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CII-HB still is offering the 7/60, but only to a limited number of IRIS users in France, as most of them wish to upgrade to a DPS 7/70 or 7/80.

DPS 7 systems are networks of specialized processors that can operate simultaneously, providing a maximum throughput of up to 25 megabytes per second in the 7/65 and 7/70 models and up to 36 megabytes per second in the larger 7/80 and 7/82 models. Current Mode Logic (CML), a fast, lower power, low heat technology, is used in the main processors, the I/O processors, the cache memories, and, in the 7/80 and 7/82 models, in the control store. Major system functions such as task management, addressing, and data protection are implemented in firmware, providing a further performance boost.

DPS 7 central processors are composed of seven "mini-machines," a control store, a processor bus, and, with the exception of Model 7/65, a 16K-byte cache memory. This processing "system" is connected, via its cache memory, with the central bus, which also services main memory and the input/output processors. The I/O processors, which have their own control stores and main memories, are connected to the peripheral processors, which also have their own control stores and main memories. This distributed architecture enables various subsystems to operate simultaneously, allows subsystems to communicate with each other without tying up the main processor, and provides flexibility in distributed processing network environments.

Each I/O processor has a control store of 4K 48-bit words, a main memory of 2K bytes, and a maintenance interface. Via a common memory interface unit, the I/O processor can transfer data to either the cache memory or the system's main memory. Four I/O processors are standard, and the 7/65 can have up to 8, the 7/70 up to 12, and the 7/80 up to 16. The bi-processor DPS 7/82 can support up to 32 I/O processors.

Via the I/O processors, the DPS 7 systems support four types of peripheral processors: unit record, mass storage, tape, and network. The integrated unit record processor supports the system console, card units, printers, diskette drives, document handlers, and, optionally, a DCC4370 communications controller. Details of the peripheral processors are summarized in the Characteristics table.

SOFTWARE

GCOS 64 Release 1-E, a virtual memory, multi-tasking operating system, is implemented in hardware, firmware, and software in all DPS 7 models except the DPS 7/82. Parts of it reside in the memories of the input/output processors, enabling these controllers to function independently of the central processor.

GCOS schedules the execution of activities, the multiprogramming of job steps, and the concurrent execution of tasks within activities. The Transaction Driven System (TDS) takes advantage of this multi-

digits). The strings can be interpreted as signed or fixed-point operands with single (16-bit) or double (32-bit) precision formats. The optional scientific instruction set, used for floating-point operations, provides the capability for 128-bit quad words.

FIXED-POINT OPERANDS: 1 to 16 bytes (1 to 31 digits plus sign) in packed decimal; 1 halfword (15 bits plus sign) or 1 word (31 bits plus sign) in binary.

FLOATING-POINT OPERANDS: 1, 2, or 4 words, consisting of a sign bit, a 7-bit exponent, and a 24-bit, 56-bit, or 112-bit fraction.

INSTRUCTIONS: The DPS 7 systems are microcoded machines that can serve as upgrades to either IRIS or Level 64 and 64/DPS systems by executing the appropriate instruction set.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

Memory is organized into consecutively numbered byte locations. Four-byte blocks are always accessed regardless of operand size. Halfword (16-bit) operands must begin on even-numbered byte locations, and full-word (32-bit) and double word (64-bit) operands must begin on byte locations divisible by four.

TYPE: 16-bit MOS chips. Current Mode Logic (CML), a fast, low power, low heat technology is used. CML has a propagation time of one nanosecond per logic port. In addition, the DPS 7 uses a multilayer micropackaging technique that allows 10,000 to 15,000 functions per board. The CML technology used is the result of cooperation by CII-HB in Europe, Honeywell in the United States, and the Nippon Electric Company in Japan. Micropackaging is the result of research and development work at CII-HB laboratories.

CYCLE TIME: See characteristics table.

CAPACITY: See characteristics table.

CHECKING: Each item of data stored in memory units, cache memory, and control store is accompanied by a Hamming code (one byte for every 8 data bytes) which permits the correction of single-bit errors and the detection of double-bit errors. Data paths, and particularly, the bus, perform parity checks to ensure data integrity. All registers and calculation circuits include a key check.

Diagnostic microprograms are launched at each system initialization or at the operator's request, by the main processors and by peripheral processors to verify their operation. The support system launches checkpoints when there is an irrecoverable error or a power loss.

In the event of an error, a retry is automatic. The retry can be initiated by firmware for a microinstruction or an instruction, or by software for a group of instructions or input/output commands. Retries can be initiated several times. Whenever an error is detected and a retry is attempted, the event is recorded in an error log. An error report, subsequently produced, indicates the origin of each error and speeds up diagnosis and allows fast, corrective intervention.

STORAGE PROTECTION: A system of keys at the page level is used in the SIRIS 3 and SIRIS 8 environments. In the GCOS 64 environment, to avoid artificial restrictions on the placement of segments in memory, the DPS 7 protects every segment individually with an automatic system of rings and protection levels. This protection system, implemented by hardware and firmware, protects segments on the basis of the information they contain rather than their physical location.

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CHARACTERISTICS OF THE DPS 7 SERIES

Model	DPS 7/65	DPS 7/70	DPS 7/80	DPS 7/82
Date announced	January 1981	January 1980	September 1979	September 1979
Date of first delivery	July 1981	4Q 1980	4Q 1980	4Q 1980
Principal operating systems	GCOS 64E	GCOS 64E SIRIS 3E SIRIS 8E	GCOS 64E SIRIS 3E SIRIS 8E	SIRIS 8E
MAIN PROCESSORS				
Processors	1	1	1	2
Processor cycle time (nanoseconds)	140	160	110	110
Levels of internal simultaneity	5	7	7	7
CACHE MEMORIES				
Cache memories	None	1	1	2
Cache memory capacity (bytes)	—	16K	16K	2 x 16K
Cache memory access time (nanoseconds)	—	160	110	110
MAIN MEMORIES				
Memory units	1	1	1	1 or 2
Throughput per unit (millions of bytes per second)	18	18	19	19
Double-word (eight-byte) read time (nanoseconds)	710 (355 single-word)	960	660	660
Double-word write time (nanoseconds)	580 (290 single-word)	880	550	550
Main memory capacity (millions of bytes)	2, 3, or 4	2, 3, or 4	3 or 4	4 or 8
SYSTEM BUS				
Bus cycle time (nanoseconds)	140	160	110	110
Bus width (data and address transfers are simultaneous)				
● Data (bytes)	4	4	4	4
● Addresses (bits)	28	28	28	28
Bus throughput (millions of bytes per second)	25	25	36	36
INPUT/OUTPUT PROCESSOR GROUPS				
Number of groups	1	1	1	1 or 2
Maximum throughput per group (millions of bytes per second)	11	18	19	29
Input/output channel throughput (millions of bytes per second)	1.25	2.5	2.5	2.5
Number of input/output processors	4 to 8	4 to 12	4 to 16	4 to 32
SERVICE, UNIT RECORD AND COMMUNICATIONS PROCESSORS				
Integrated Service and Unit Record Processors	1	1	1	1
Additional Unit Record Processors (optional)	1	1	2	5
Maximum connections supported	10	13	21	45
Communications Processor (optional, uses one connection)	1	1	1	—
Lines supported	15	15	15	—
NETWORK PROCESSORS				
Datanet 7100 front-end network processors (optional)	1 or 2	2	3	4
Total lines supported	128	128	256	512
MASS STORAGE PROCESSORS				
Integrated processors	1	1	1	1
Additional processors (optional)	Up to 4 single-channel or 2 dual-channel	3	3	7
Maximum disk units supported	36	36	36	72
Maximum online mass storage capacity (millions of bytes)	21,000	21,000	21,000	42,000
MAGNETIC TAPE PROCESSORS				
Single-access processors	Up to 2	Up to 4	Up to 4	Up to 8
Dual-access processors	1	Up to 2	Up to 2	Up to 4
Maximum tape units supported	16	32	32	64

tasking facility to run multiple Transaction Processing Routines as tasks within a single job step.

GCOS supports two file management systems and a data base management system. The Basic File Access System (BFAS) handles 360/370 DOS and DOS/VS direct, sequential, and indexed sequential file formats. The Unified File Access System (UFAS) handles indexed random, relative, and sequential files of variable-length records. The Integrated Data Store (IDS II) system is a subset of the data base management system developed for the Level 66 systems.

The COBOL, RPG, FORTRAN, APL, and PL/1 compilers divide programs into variable-length segments. CII-HB says these segments are more efficient than fixed-length pages because programs can be divided into logical entities that require less swapping. Code is never put in the same segments as variables and data, so it never has to be written back to disk. The compilers also assign protection levels to the segments to prevent unauthorized or improper use.

GCOS provides a two-level data communications control system that buffers applications programs from the nuts and bolts of network support and message handling.

The Basic Terminal Network Support (BTNS) system and the Front-End Network Processor Support (FNPS) system respectively support the Communications Processor and the Datanet 7100 front-end processor. They run in their own job slots and provide the interface between the network and the Message Access Method system which interfaces with the applications programs. BTNS and FNPS also provide an interface for the TDS monitor.

To provide DPS 7 system users under SIRIS 3-E with the specific advantages of the GCOS 64-E operating system, a set of migration tools called SIRIS 3 TRANSIT is available. This software contains automatic translators for files, volumes, and RPG and COBOL source programs. A manual for each translator describes all operations necessary for a complete conversion. Automatic translation minimizes the work required for conversion, reduces the risk of error, and simplifies the move to GCOS 64-E.

The SIRIS 8 environment provides SIRIS 8 users with compatibility between IRIS 80 and DPS 7 systems. It allows the transfer of applications, files, and operating procedures from the IRIS 80 without conversion. Compatibility is ensured for all application programs at source, object, or executable level and for the command language processed on IRIS 80 under SIRIS 8C 10/VCAM.

SIRIS 8 environment firmware supports the execution of "user" instructions in IRIS 80 code, as well as the management of IRIS 80 format memory addressing and associated protection.

The main processor, while executing a process, may be at one of four levels of privilege, called "rings." Rings are numbered from zero to three, with zero being the most privileged. A ring number is allocated to each segment when it is created and, when the process is entered, the main processor adopts this ring number. Each segment is allocated three protection levels, one for each possible use: read, write, or execute. Each level can be anywhere within the range of zero to three. At every reference to an address in a segment, the protection level for the relevant type of use is checked against the current ring number of the main processor. Access is only allowed under the following conditions: for read and write access, the ring number is less than or equal to the protection level; for execute access, the ring number is within the range between the write and execute protection levels. At linking time, the programmer specifies protection levels; this permits him to control access to his program segments from other active programs.

An extension to the protection system is the ability to flag segments as completely unwritable. This feature guards against the most frequently encountered programming errors. The compilers always generate code and data in separate segments. By flagging the code segments as unwritable, the system prevents the code from being modified during execution.

RESERVED STORAGE: There is a reserved area in main memory for channel programs and tables describing the actual configuration. The boundary address is held in a special register (BAR). This reserved area is of variable length, approximately 20K bytes.

CENTRAL PROCESSOR

DPS 7 central processors are composed of seven "mini-machines," a control store, a processor bus, and, with the exception of Model 7/65, a 16K-byte cache memory. This processing "system" is connected, via its cache memory, with the central bus, which also services main memory and the input/output processors. The I/O processors, which have their own control stores and main memories, are connected to the peripheral processors, which also have their own control stores and main memories. This distributed architecture enables various subsystems to operate simultaneously, allows subsystems to communicate with each other without tying up the main processor, and provides flexibility in distributed processing network environments.

The seven mini-machines in the main processor are as follows:

- **Pilot machine (PIM): The PIM retrieves micro-instruction sequences from the control store and routes them to the appropriate mini-machines. Microprograms are composed of two or more 56-bit words, each protected by an 8-bit autocorrection code.**
- **Address Calculation Machine (ACM): The ACM handles all address translations and includes the base registers and an associative memory that stores up to 128 descriptors. The ACM also handles data protection by checking rings (under GCOS) or keys (under SIRIS).**
- **Data and Instruction Management Machine (DIM): The DIM provides the interface between the cache memory and the other mini-machines and includes a 32-byte lookahead buffer that often allows it to begin interpreting another instruction while a previous instruction is still being executed.**
- **Arithmetic and Logic Machine (ALM): The ALM includes the data registers and executes fixed-point, decimal, and logic operations.**

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It also includes privileged instructions different from the IRIS privileged instructions, mainly enabling access to microprogrammed functions such as management and synchronization of processes, input/output operation, etc.

A DPS 7 system can communicate directly with another DPS 7 system or with Level 6, Level 61, Level 64, 64/DPS, Level 66, and 66/DPS systems or with any system linked to a DSA network.

In addition, DPS 7 systems can be configured into dual, coupled systems that can share the same data base and peripherals.

To help assure system availability, the DPS 7 includes special channels that allow diagnostic tests to be run and the system to be reconfigured without interrupting user service. A remote maintenance service allows the console operator to connect the DPS 7 to a CII-HB center, enabling specialists to monitor system performance, initiate diagnostics, and recommend solutions to problems.

COMPETITIVE POSITION

At the low end of the new series, the DPS 7/65 provides about twice the performance of the largest 64/DPS model, the 64/DPS-6, and when running business applications under GCOS 64-E, provides a performance level comparable to the IBM 4341-1. The next model, the DPS 7/70, provides about 1.5 times that performance, equivalent to the power of the 4341-2. The fastest model, the DPS 7/80, provides about 1.3 times the performance

- **Scientific Calculation Machine (SCM): The SCM executes floating-point operations.**
- **Timer: Using the main clock as a reference, the timer transmits a master frequency along the processor bus and also provides various types of information, such as real time, elapsed time, and process time.**
- **Maintenance Interface Machine (MIM): The MIM provides the interface between the main processor and the service processor for system initialization and testing.**

CONTROL STORAGE: Control store contains firmware held in 56-bit words. Each word contains the instructions to be executed by the mini-machines during a single cycle. The sequencing of firmware instructions is controlled by the Pilot machine. Short instructions require two microcode words; more complex instructions can require several dozen.

The control store of the main processor is loaded when the system is initialized. It may contain up to 64K words, enabling the execution of the IRIS 80, IRIS 60, or 64/DPS instruction set. Depending on the model, it employs TTL (transistor-to-transistor logic) or CML (Current Mode Logic) technology. Each firmware word is accompanied by 8 bits of autocorrection code.

Firmware is also used in the DPS 7 to perform functions traditionally performed by software. These include task management, procedure calls, data protection, etc. The use of firmware also permits the DPS 7 to implement the machine instruction sets of the 64/DPS running under GCOS 64-E, and IRIS systems running under SIRIS 3-E or SIRIS 8-E while providing software access to the firmware functions of the DPS 7.

The main processor is capable of recognizing and controlling a task, a unit of a program more significant than a single instruction. A task is a sequence of interdependent instructions. A program can comprise a number of tasks, each able to execute in parallel with the others (multitasking).

The dual-processor DPS 7/82, an upgrade only for the IRIS 80, is not directly comparable to the 64/DPS. Operating under the SIRIS 8-E operating system, the dual processor configuration requires dual keyboard/display consoles.

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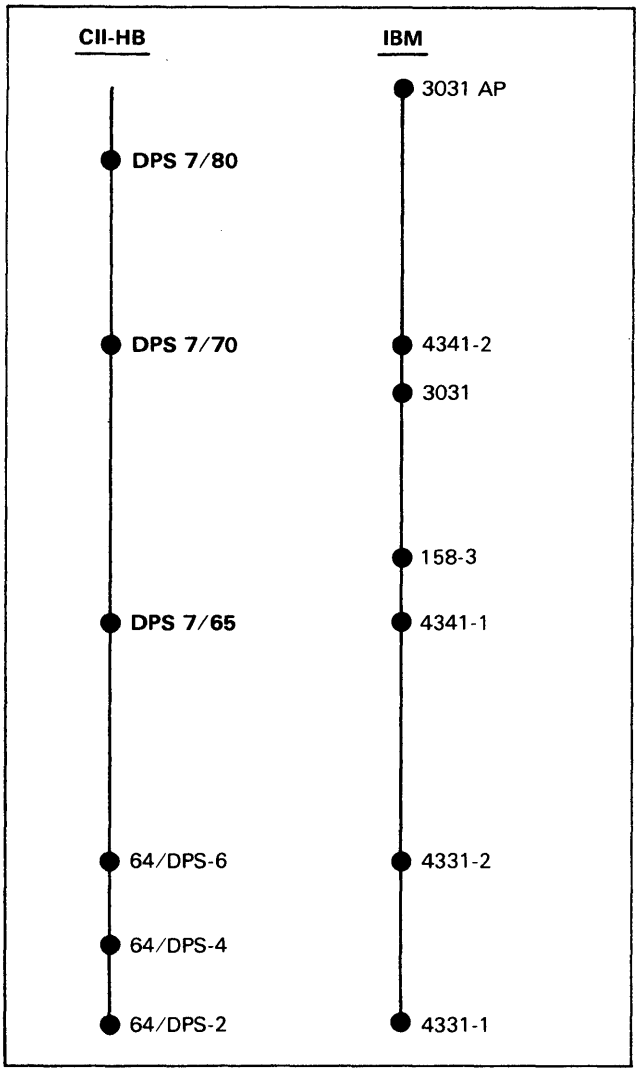
PERFORMANCE COMPARISON CHART



DPS 7 under GCOS Business Applications versus IBM 4300 Series under DOS/VSE. DPS 7/82 not shown since it runs only under SIRIS 8.

of the DPS 7/70. The fourth model, the dual-processor DPS 7/82, is an upgrade only for the IRIS 80 and is not directly comparable to the 64/DPS.□

This parallel execution of tasks requires a dispatching mechanism. On traditional machines, this mechanism required software intervention. On the DPS 7, it is a built-in firmware function of the main processor.

A task may be activated simultaneously by a number of different programs, and it is the activations or occurrences of the task that must be controlled by the system. The DPS 7 recognizes and controls a task occurrence as a "process" needing the services of the main processor.

Many such processes can be simultaneously known to the DPS 7 and their execution synchronized according to a multi-level priority system.

A process consists of all the data and executable code associated with a task plus a process control block, a data structure recognized and manipulated by firmware. When the process stops running for any reason, a snapshot is taken of the main processor's status and stored in the process control block. When the process is restarted, the main processor is reset using the snapshot and the process continues where it left off. The mechanism for storing and reloading the process is completely automatic and works without any software intervention.

The GCOS 64-E, SIRIS 8-E, and SIRIS 3-E operating systems make use of the task management mechanisms implemented in firmware.

The DPS 7 uses firmware-controlled semaphores to interpret external events such as physical input/output termination, peripheral interrupts, operator interrupts and messages from terminals. Using semaphores, it also synchronizes the execution of competing processes, passes messages between processes, and controls competing demands for system services.

A semaphore is a group of words containing a counter and a pointer to an associated queue. When the semaphore counter is negative, all the resources associated with it are busy and processes are awaiting completion. When the counter is positive, all processes are satisfied and resources are free. When the counter is zero, all resources are busy but no processes are waiting. This mechanism can be used in any situation involving processes waiting for the completion of any operation.

The DPS 7 provides an automatic firmware-implemented feature called the "call/exit" mechanism which is available with the GCOS 64-E environment. Between entry to and exit from a procedure, the call to that procedure is represented by a record containing a work area, a save area, and a communications area. Whenever a call instruction is executed, this record is created and placed in a last-in-first-out (LIFO) queue called a stack. Whenever an exit instruction is executed, the last record placed in the stack is removed. There is one stack for each active process, and whenever a process is initiated, it is automatically provided with extra segments for the stack.

After a call instruction, the record placed in the stack contains all the local variables for the calling procedure, the contents of all the main processor's registers at the time of the call, the contents of the main processor's instruction counter at the time of the call, and any parameters to be passed to the called procedure.

When the exit instruction is executed, the registers and instruction counter are automatically restored from the record removed from the stack so that the calling procedures can continue processing.

REGISTERS: There are 8 32-bit Base Registers for internal address computation, 16 32-bit General Registers for data handling and indexing, 4 64-bit Scientific Registers for floating point data handling, 1 32-bit Stack Register pointing to the stack associated with the running process, and 1 28-bit Boundary Address Register holding the lowest absolute main memory address accessible by software.

ADDRESSING: When memory is allocated by the SIRIS 3-E or SIRIS 8-E operating system, the addressing mode is the same as that used on IRIS hardware: partition relative addressing under SIRIS 3-E and virtual memory paging under SIRIS 8-E. In each case, addressing is handled by specialized firmware.

Running under GCOS 64-E, the relative addressing mechanism is based on segmentation and its aim is to make optimum use of memory space. Each program running under GCOS 64-E on the DPS 7 is executed as a collection of fully relocatable segments. A segment may reside in different places. As a program is being executed, its

constituent segments may be moved around memory to make room for other programs, and, at a given point in time, some of its segments may even be temporarily removed from memory and placed on disk.

To avoid having to split a frequently used routine between two segments, segments can vary in size. Machine instructions used in the GCOS 64 environment refer to segment-relative addresses, without reference to the physical location of the referenced operand. The absolute address is calculated as the instruction is executed using a segment descriptor and a displacement within the segment. High-speed registers assist in address development.

The address information is resolved dynamically during execution. A special associative memory within the address calculation machine of the main processor contains the absolute addresses of the last 128 referenced segments to speed up second and subsequent references to a segment.

The compilers available with GCOS 64-E perform the segmentation of programs. This takes place either automatically or under the control of the programmer. It takes place at source level, and the fact that segments can vary in length ensures that a piece of logic, such as a loop, will not be split between two segments. This unusual feature significantly reduces program execution time.

INDEXING: 15 levels.

INSTRUCTION REPERTOIRE: The DPS 7, when running under GCOS 64-E, executes the 64/DPS instruction set. The repertoire consists of 195 instructions, including operations for address computations, and arithmetic instructions for performing decimal and binary operations on packed or unpacked data. Operands can be binary, fixed-point, or decimal in packed or unpacked format; bytes; byte strings; or bit strings. The optional Scientific Instruction Set adds 26 instructions to the standard set. In addition, the microcode of the Model 7/65 can implement the 200/2000 "Program Mode" option, and execute the 200/2000 instruction set.

CACHE MEMORY: Models DPS 7/70, 7/80, and the biprocessor model DPS 7/82 have cache memory units. These units provide very fast access storage for data and instructions. Data and instructions stored in cache can be made available to the main processor up to five times as quickly as would be the case if they were retrieved from main memory.

Cache memory is implemented in CML technology.

Data is held in cache memory in blocks of 16 consecutive bytes accompanied by autocorrection code. The 1,024 16-byte blocks provide a capacity of 16K bytes. For reference purposes, cache memory is divided into 256 areas of four blocks each.

Associated with each 16-byte block is a register containing the most significant bits of the main memory address of the data contained in the block. The total of 1,024 registers constitutes the cache memory directory.

Data is retrieved from cache memory using the main memory address of that data. The middle 8 bits of the address indicate the area (0 to 255) containing the required data. The value contained in the most significant 4 bits of the address is compared with the content of the 4 registers associated with the area.

A request for data from a main processor leads first to a search in cache memory. If the data is not found, the request is sent to the bus and a search is simultaneously launched in the main memory, and, in the case of a dual processor system (DPS 7/82), in the other cache memory. When found, the 16-byte block containing the requested information is placed in the 4-block area indicated by its address. Within this area, it will replace the 16-byte block least recently accessed. The most significant bits of its address are placed in the corresponding register.

Cache memory is used for both reading and writing purposes. If the value of data replaced in cache memory has been modified, a main memory rewriting operation is launched via the bus.

INTERRUPTS: There are no interrupts as such. Any hardware or software event is handled through semaphores, combined with a masking feature used when high priority events occur.

INPUT/OUTPUT CONTROL

I/O CHANNELS: A basic DPS 7 consists of a single central processor, an integrated mass storage processor, and an integrated service and unit record processor. Up to 7, 10, 11, and 25 more peripheral and network processors can be added to a DPS 7/65, 7/70, 7/80, and 7/82, respectively.

A maximum DPS 7/65 configuration consists of the CPU, 8 I/O channels, 2 service and unit record processors supporting 10 unit record peripherals, 1 communication processor supporting 15 lines, 2 dual-channel or 4 single channel mass storage processors controlling up to 36 simultaneous disk accesses and an on-line capacity of 21,000 million bytes, 1 dual-level or 2 single-level magnetic tape processors supporting 16 magnetic tape units, and 1 network processor providing 128 lines.

A maximum DPS 7/70 configuration comprises the CPU, 12 I/O channels, 2 service and unit record processors supporting 13 unit record peripherals, 1 communication processor supporting up to 15 lines (under GCOS 64-E), 4 mass storage processors providing up to 36 simultaneous disk accesses and an on-line capacity of 21,000 million bytes, 2 dual-level or 4 single-level magnetic tape processors supporting up to 32 magnetic tape units, and 2 network processors providing 128 lines.

A maximum DPS 7/80 configuration includes the CPU, 16 I/O channels, 3 service and unit record processors supporting up to 21 unit record peripherals, 1 communication processor supporting up to 15 lines (under GCOS 64-E), 4 mass storage processors providing up to 36 disk access data paths and an on-line capacity of 21,000 million bytes, 2 dual-level or 4 single-level magnetic tape processors supporting up to 32 magnetic tape units, and 2 network processors allowing up to 256 lines.

The largest DPS 7/82 configuration consists of twin main processors, 32 I/O channels, 6 service and unit record processors, supporting up to 45 unit record peripherals, 8 mass storage processors providing up to 72 disk access data paths and an on-line mass storage capacity of 42,000 million bytes, 4 dual-level or 8 single-level magnetic tape processors supporting up to 64 magnetic tape units, and 4 network processors, supporting 512 lines.

Each I/O processor has a control store of 4K-bit words, a main memory of 2K bytes, and a maintenance interface. Via a common memory interface unit, the I/O processor can transfer data to either the cache memory or the system's main memory. Four I/O processors are standard, and the 7/65 can have up to 8, the 7/60 and 7/70 up to 12, and the 7/80 up to 16.

Via the I/O processors, the DPS 7 systems support four types of peripheral processors: unit record, mass storage, tape, and network. The integrated unit record processor

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supports the system console, card units, printers, diskette drives, document handlers, and, optionally, a DCC4370 communications controller. Details of the peripheral processors are summarized in the Characteristics table.

To help assure system availability, the DPS 7 includes special channels that allow diagnostic tests to be run and the system to be reconfigured without interrupting user service. A remote maintenance service allows the console operator to connect the DPS 7 to a CII-HB center, enabling specialists to monitor system performance, initiate diagnostics, and recommend solutions to problems.

An input/output operation is handled by an input/output processor and a peripheral or network processor. The input/output processor controls access to main or cache memory resulting from the execution of a channel program associated with an I/O request and generated by the main processor. The main functions of the I/O processor are consequently the reading or writing of data and the reading of channel commands. The peripheral or network processor controls the exchange of data with the peripheral or network component involved in the request.

Each input/output processor in a DPS 7 system is a fully independent processor controlling the transfer of data in parallel with other I/O processors in an I/O processor group. An I/O processor group can contain up to 16 I/O processors and a DPS 7 system can contain one or two groups depending on the model.

The operation of an I/O processor is managed by firmware held in a control store of 4K words. Each word contains 48 bits plus 8 autocorrection bits.

An I/O processor also has a memory of 2K bytes for holding sequences of channel commands being executed and data in transit. Data can be sent to main memory or cache memory in blocks of 16 bytes, a block size which optimizes the bus. This transfer is independent of the transfer speeds of individual peripherals.

Transfers of data to main or cache memory are controlled by a memory interface unit which is common to a group of I/O processors.

Each I/O processor group also contains a maintenance interface which enables the service processor to initialize and test I/O processors.

Each I/O processor, and consequently each channel, has a throughput of up to 2.5 million bytes per second. The throughput of a group of I/O processors is up to 29 million bytes per second. These rates permit the execution of more than 300 channel programs per second on a group of I/O processors.

A peripheral or network processor is connected to an input/output processor via a PSI (Peripheral Standard Interface) channel. This channel provides a data path for the transfer of one byte of data plus parity and the transfer of a control signal indicating the sending of a byte, acceptance of a byte, etc. The PSI standard specifies the protocol used in a data transfer to start the execution of a channel program, chain commands, multiplex several channel programs, etc.

After generating a channel program and requesting its execution, a main processor does not intervene further. Consequently, input/output operations can be executed in parallel with main processing. When a channel program has terminated, the I/O processor informs the Pilot machine.

Another important feature of the DPS 7 architecture is that there is no direct link between peripherals and main processors. Via the bus, a main processor can launch an input/output operation on any peripheral and the disconnection of a main processor in a dual processor configuration does not affect the availability of peripherals to the other main processor.

Peripheral devices and network components on the DPS 7 are controlled by specialized peripheral and network processors. Each processor is connected via a channel to an input/output processor in the central system. It manages the simultaneous operation of peripherals in complete independence of the main processors.

Four basic types of peripheral processors are used with the DPS 7: *Unit Record Processors, Mass Storage Processors, Magnetic Tape Processors,* and *Network Processors.*

Each processor has its own read/write memory as well as an arithmetic and logic unit. It executes, in full independence, commands sent to it by an input/output processor. The first three processor types are microprogrammed and contain a special connection which allows the maintenance processor to check operation and diagnose errors. The network processor is programmed and has its own means of detecting faults.

UNIT RECORD PROCESSORS: Every DPS 7 system has one unit record processor called the Service and Unit Record Processor (SURP), which performs the following functions: unit record device and communications control, system console control, system initialization and reconfiguration, and maintenance control. Depending on the number of additional URP's, the largest DPS 7 system can handle up to 45 unit record devices. Each processor can transfer data simultaneously with its connected devices (card devices, printers, diskette drives, document handlers, communications controller). It should be noted that the diskette drive, document reader, and communications controller are supported only by GCOS 64-E.

MASS STORAGE PROCESSORS: Every DPS 7 system has at least one Mass Storage Processor. Depending on the DPS 7 model, up to 7 additional MSP's can be connected controlling a total of up to 72 disk drives.

A dual access option permits a single disk drive to be shared simultaneously or alternately between two mass storage processors. Furthermore, dynamic channel switch permits a given MSP to be used by two input/output processors in a coupled configuration.

MAGNETIC TAPE PROCESSORS: Two types of Magnetic Tape Processors are provided on the DPS 7 providing control of up to 16 units.

The MTP4270 controls 9-track tapes with a recording density of 800 or 1600 bpi, controlling simultaneously up to 8 tape units.

The MTP 4470 controls 9-track tapes with a recording density of 800, 1600 or 6250 bpi and controls up to 8 units in its single access version. A dual access version, designated the MTP 4570, controls up to 16 units and is connected to the central system of the DPS 7 via two input/output processors.

Each MTP can be fitted with an optional manual channel switch permitting it to be shared by two DPS 7 systems in a coupled configuration.

SIMULTANEOUS OPERATIONS: The peripheral processing subsystems operate simultaneously with the central processor. Each subsystem operates under control of a microprogrammed peripheral processor. Each peripheral processor contains its own arithmetic and logic unit, read/write memory, and read-only memory and is attached

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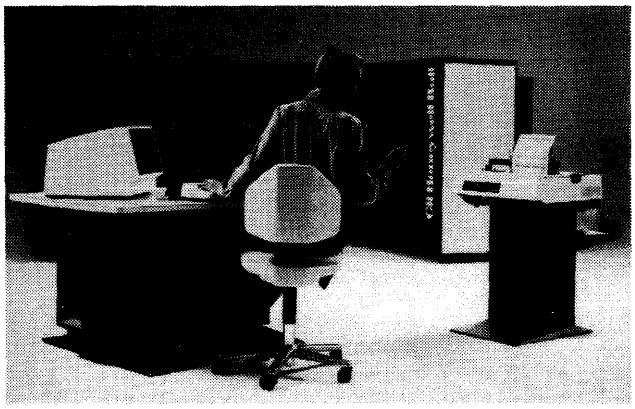

The DPS 7/80 provides about 1.3 times the performance of the DPS 7/70.

to the central system through a high speed channel. The maximum total data rate for each of these systems is listed in the Characteristics table. All devices and terminals attached to a unit record processor can operate concurrently. Mechanical operations on a disk or tape subsystem, such as seek and rewind, can proceed simultaneously with a data transfer on the same subsystem.

MASS STORAGE

CII-HB currently offers three disk-pack drives for the DPS 7 systems. Capabilities range from 100 million bytes to 635 million bytes per drive. Transfer rates range from 806,000 bytes/second to 1,200,000 bytes/second.

MSU0405 MASS STORAGE UNIT: This unit uses packs with 12 disks and 19 recording surfaces to provide 100 million bytes of storage. Average seek time is 25 milliseconds, average rotational delay is 8.3 milliseconds. The transfer rate is 806,000 bytes/second. Rotational speed is 3,600 rpm. During data transfer on one drive, a simultaneous seek operation can be performed on all other drives on the same Mass Storage Processor. Features include the insertion of a checking code in each record during write operations and the provision of a "write protect" capability that allows individual disk packs to be limited to read operations. The drive uses Type M4451 disk packs. Recording format is 411 tracks, including seven spares.

MSU0455 MASS STORAGE UNIT: This unit uses packs with 12 disks and 19 recording surfaces to store up to 200 million bytes of data. Average seek time is 30 milliseconds, average rotational delay is 8.3 milliseconds. The transfer rate is 806,000 bytes/second. Rotational speed is 3,600 rpm. During data transfer on one drive, a simultaneous seek operation can be performed on all other drives on the same Mass Storage Processor. Features include offsetting of heads under system control when initial read attempts fail, the insertion of checking codes during write operations, and a write protect capability. The drive uses Type M4451 disk packs. Recording format is 822 tracks, including 14 spares.

MSU0555 MASS STORAGE UNIT: This unit comprises a cabinet housing two 635-megabyte fixed disk packs, yielding a total unformatted storage capacity of 1,270 million bytes. Each disk pack has 20 data surfaces, with 19,060 bytes per track and 1,676 tracks per surface. Average seek time is 25 milliseconds, average rotational delay is 8.3 milliseconds. The peak transfer rate is 1,200,000 bytes/second. Rotational speed is 3,600 rpm. Each pack is accessed individually by a direct attachment to the mass storage processor. The validity of recorded information is ensured by the insertion of characters of check information (EDAC code: Error Detection and Automatic Correction). In each block of data, data integrity is enhanced by the automatic detection of defective tracks and the bypassing of these areas when writing to disk. A write protect capability allows the user to protect the disk packs individually against inadvertent writing. On-line error and status reporting to the central system allows software-controlled diagnosis of the electronics. A built-in hardware diagnostic capability supports rapid off-line diagnosis and testing.

INPUT/OUTPUT UNITS

MAGNETIC TAPE UNITS: CII-HB currently offers five magnetic tape drives for the DPS 7. All can read/write in any of the following modes: 9-track, 1600 bpi, phase-encoded; 9-track, 800 bpi, NRZ; and 7-track, 200, 556, or 800 bpi, NRZ.

MTP 4270 MAGNETIC TAPE PROCESSOR: This processor controls 9-track tape with a recording density of 800 or 1600 bpi controlling simultaneously up to 8 tape units.

MTP 4470/4570 MAGNETIC TAPE PROCESSORS: These units control 9-track tapes with recording densities of 800, 1600 or 6250 bpi. The MTP 4470 controls up to eight units in its single access version; the dual access version MTP 4570 controls up to 16 units. The MTP 4570 is connected to the central system of the DPS 7 via two input/output processors.

Each MTP can be fitted with an optional manual channel switch permitting it to be shared by two DPS 7 systems in a coupled configuration.

MTU0430 MAGNETIC TAPE UNIT. This unit operates at 75 inches/second and transfers data at 120 kilobytes/second at 1600 bpi. Error correcting features include read after write. Each drive can be equipped for either 9-track or 7-track recording, and up to eight drives can be connected to an MTP4300 controller.

MTU0530 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0430, except that it operates at 125 inches/second and transfers data at 200 kilobytes/second at 1600 bpi.

MTU0335 MAGNETIC TAPE UNIT: This unit operates at 37.5 inches/seecond with a maximum transfer rate of 234,000 bytes/second. Recording mode is 1600 bpi PE (Phase Encoded) or 6,250 bpi GCR (Group Coded Recording).

MTU0435 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0335, except that it operates at 75 inches/second and can attain a maximum transfer rate of 469,000 bytes/second.

MTU0535 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0335 and MTU0435, except that the operation speed is 125 inches/second, yielding a maximum transfer rate of 781,000 bytes/second.

UNIT RECORD PROCESSOR: This integrated controller has five device ports plus ports dedicated to the console and communications. A second processor, the URP 4370, can be added, providing three more device ports plus a second communications port. Each peripheral device connects to a device port via an addressing attachment.

CRU0301 CARD READER: This table-top unit reads at 300 cards/minute and has 1000-card input an output hoppers. Options include IBM and Honeywell mark sensing adapters.

CRU0501 CARD READER: This taple-top unit reads at 500 cards/minute, but otherwise is the same as the CRU0301.

CRU1050 CARD READER: This unit reads at 1,050 cards/minute and has a 3,000-card input hopper and a 2,500-card output stacker. In addition to reading 80-column cards punched in either Hollerith or binary, the unit can be equipped to read 51-column cards and 40-column mark sense cards. Each column is read twice and, in Hollerith mode, characters are checked for validity. When an error is detected, the reader, under software control, can either offset the card in the stacker or stop.

PCU0120 CARD PUNCH: This unit punches 120 cards/minute and has a 1,600-card input hopper and a 1,500-card output stacker. Cards can be punched in Hollerith or binary. When an error is detected, the punch can be told either to offset the card in the stacker or to stop. The unit automatically skips leading blank columns at high speed, resulting in higher punching rates.

DDU4050/4051 DISKETTE DRIVES: These diskette drives are connected to the CPU via the Service and Unit Record Processor or an additional Unit Record Processor. One diskette drive unit may be connected to each Unit Record Processor. The diskette is organized into 77 tracks with 26 sectors per track and 128 bytes per sector. Only 74 of the tracks are used for data. Total data capacity per diskette is 246,272 bytes. Rotational speed is 360 revolutions per minute, and the transfer rate is 32.2 kilobytes per second. The 4051 is a dual density version, providing 402,544 bytes of storage capacity.

PRU0615 LINE PRINTER: Rated at 600 lines/minute when using a 64-character set, this buffered unit uses interchangeable belts containing 480 characters. A belt can include a maximum of 240 different characters. When belts are changed, the operating system must be instructed to load a corresponding belt image into the printer's controller. Forms control, including selection of 6 or 8 lines/inch and skipping, is under program control. Line length is 132 positions, optionally 136 positions. Form widths can range from 4 to 19 inches, lengths from 4 to 16 inches. The unit can print an original and five carbon copies or 10 self-carbon copies.

PRU0845 LINE PRINTER: This is an 800 line/minute version of the PRU0615.

PRU1045 LINE PRINTER: This is a 1,000 line/minute version of the PRU0845.

PRU1600 PRINTER UNIT: Using an interchangeable print belt, this unit operates at speeds up to 1,600 lines/minute. The standard belt contains 63 OCR-B characters, but belts can contain as many as 240 different characters. To increase speed, special belts can be designed so that the most used characters are repeated at different frequencies according to their use. The belts are identified by a magnetic code recorded on their base, and the printer uses this code to make sure it has the correct belt image stored in its buffer. Belt images are loaded into the buffer by the operating system. CII-HB says the unit produces smear-free printing because the fingers containing the characters are so flexible that they are momentarily immobilized when struck by a hammer.

Parameters for number of lines per inch (6 or 8) and vertical form positioning, including skipping, are under program control. An overtemperature control, however, can slow the skipping speed or halt the printer if the operating temperature exceeds pre-set limits. Skipping speed normally ranges from 23.5 inches/second for one to three lines up to 90 inches/second for more than six lines.

Standard line length is 136 positions, optionally expandable to 160 positions. The pitch is 10 characters/inch. Forms can range from 4 to 18.25 inches in width and from 4 to 16 inches in length. By leaving the cabinet door open, forms up to 22 inches wide and 24-inches long can be stacked externally. The unit can print one original and up to five carbon copies or 10 self-carbon copies.

DHU0803/0814 DOCUMENT HANDLER: This device operates on-line for data entry, and reads CMC7 and E13B Magnetic Ink Character Recognition (MICR) fonts, and OMR and OCR-A and OCR-B Optical Character Recognition fonts. The DHU0803 is a 3-pocket handler for on-line processing, and the DHU0814 is a 14-pocket document handler for on-line/off-line processing. The document rate is 830 documents measuring 15 cm per minute. The input hopper holds a 22.8 cm stack of documents, and the output stacker capacity is 8.9 cms of documents.

COMMUNICATIONS CONTROL

An optional Communications Processor using one connection on the DPS 7/65, 7/70, and 7/80, the DCC 4370 Communications Controller interfaces with the Service and Unit Record Processor and supports up to 15 lines at speeds up to 19,200 bits/second in any mixture of synchronous and asychronous modes.

In addition to directly supporting terminals, a DPS 7 system can support one or more remote batch, interactive job entry, or transaction processing Mini 6 satellite systems. DPS 7 systems can also be configured into dual, coupled systems that can share the same data base and peripherals.

The main item of hardware for handling communications on the DPS 7 is the Datanet 7100 network processor, based on the Mini 6. Datanet 7102 and 7103 models include a teleprinter console and a single or double diskette drive. The 7102 controls up to 48 lines, the 7103 up to 128 lines. The models also differ in terms of processing power and minimum memory size (96K and 128K). The 7102 has an option for loading its software remotely; this feature is standard on the 7103.

DATANET 7100: The DATANET 7102/7103 hardware, based on the Mini 6 architecture, provides access to the networking capabilities supported under CII-HB's Distributed Network Architecture (DSA) philosophy. The network software handles the following functions: front-end processing, concentration, switching, and network administration.

The DATANET 7102/7103 Front-End Processors (maximum of 2) are directly connected to the 64/DPS I/O channels. A 7102 or 7103 can be connected to two 64/DPS systems via two simultaneously active I/O channels, with dynamic network sharing.

The 7103 provides higher processing speeds and can support more lines than the 7102. The 7102 controls up to 48 lines, the 7103 up to 128 lines. All systems include a processor and main memory of up to 256K bytes; the Datanet 7103 also includes cache memory. MOS memory is based on 16K-bit chips providing a cycle time of 550 nanoseconds per two-byte word. Each word incorporates EDAC code that allows the detection and automatic correction of single-bit errors and the detection of double-bit and most other errors. One or two memory controllers may be present. Each supports up to 256K bytes, giving a maximum capacity of 512K bytes.

Using the DATANET 7100 makes it possible to respond to and support the following types of terminals and operation:

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- Asynchronous, character mode line procedure

  KSR 33/35
  TN 300/1200
  TTU/8124/8126
  DTU 7172 (DTU 7171 mode)

- VIP synchronous line procedure

  VIP 7001/7002
  VIP 770/7760
  TTU 8221/8223
  STS 2840

- QUESTAR-T Range

  DKU 7001/7005/7007/7008
  TCU 7021/7022/7042/7043

- Satellite Systems

  TTS 7800
  Mini 6 DSS
  61 DPS

OPERATING SYSTEM

CII-HB offers three DPS 7 operating systems—GCOS 64-E, SIRIS 3-E, and SIRIS 8-E—and three instruction sets providing a direct upgrade path for users now running under GCOS 64, SIRIS 3 or SIRIS 8.

GCOS 64 RELEASE 1-E: GCOS 64-E is the principal DPS7/65 operating system, and is also available on models DPS 7/70 and DPS 7/80. It is not available for the bi-processor DPS 7/82.

Release 1-E provides concurrent support for batch job streams, one compatibility-mode job stream (Series 100 or Series 200/2000 emulation), a system input reader, a system output writer, communications, and a transaction processing system. Additional batch job streams can be run in place of other activities up to a maximum of five. The sixth job slot is always taken by the output writer.

Up to 64 jobs can be loaded under Release 1E. Based on their priorities, these jobs will be started as job slots become available. Jobs are divided into job steps (individual programs), and job steps into processes (tasks). Steps of a job are run sequentially, but processes within steps are executed in parallel whenever possible.

Automatic memory management is based upon variable length program segments rather than fixed length pages. The compilers automatically divide a program into segments, placing code (always re-entrant) and data into different segments. Optionally, the programmer can define the segments he wants. COBOL programs normally are segmented by section. FORTRAN programs at natural boundaries, and RPG II programs by logical functions.

GCOS 64 supports any combination of batch, interactive, or service activities, such as multiple output writers. Each program can be divided into job steps, each with its own separate set of segment tables. The maximum number of job steps in the system is 256, effectively providing the nucleus of a virtual memory system with multiple virtual spaces.

GCOS uses segment-relative addressing. Each address includes a segment number and a displacement number. When an address is referenced, GCOS first checks an associative memory containing the absolute addresses of the last eight segments referenced. If the segment is in real memory, GCOS places the real address in an index register. If the segment is on disk, GCOS brings it into real memory. If the segment's address is not in the associative memory. GCOS refers to a complete table of segments to locate it on disk and then brings it into real memory. If there is not enough space for the segment in memory. GCOS first tries to make adequate space by reorganizing memory. If this approach fails, GCOS will remove the least-active segment from memory to create space.

Each segment is protected by a four-level ring system. Rings are numbered 0 to 3, with 0 the most privileged level. Each possible use of the segment—read, write, or execute—is assigned a protection level. When an address is referenced, the appropriate protection level is compared to the current ring number of the central processor. Access is allowed only if the ring number is less than or equal to the protection level. Code is always assigned protection level 0, which effectively makes it unwritable and prevents accidental or unauthorized alterations. Rings 0 and 1 are reserved for system software, 2 and 3 for application programs.

DPS 7 integrity features include error logging, file security, and recovery routines. Whenever the firmware of the DPS 7 system discovers an error, it notifies the appropriate routine. This notification takes place whether the firmware recovered the error or not, so that GCOS is always aware of the state of the system. The routines diagnose the error and update an error accounting area in memory. Error accounting information is used to keep track of the state of all system components and to update a permanent accounting file. This permanent file eases routine maintenance of the system; extensive error accounting information allows failing components to be identified and replaced before they cause problems.

GCOS 64 also includes a variety of file security aids. A save/restore utility is available for taking security copies of files, and both copies and saved generations of a file can be included in the system catalog.

GCOS includes a journal function to speed file recovery. The journal is used to save all the updates to a file since the last security copy was taken. The journal, together with the catalog and the restore utility, provides all the information needed to rebuild a damaged file to its correct state.

To reduce the possibiity of a system failure, GCOS 64 provides a fast recovery facility in rerun support. Rerun support allows processing to be restarted immediately, either at the beginning of the job step or at the last checkpoint. The restart procedure includes automatic repositioning of the user's files and the recovery of all files and queues used by the system, including the input reader and output writer files. The output writer can restart printing at any specified block.

Job flow through the DPS 7 system is controlled by GCOS job management. The input reader reads the job input while other jobs are executing and translates the job control information into an internal format to speed job processing. A job scheduler schedules the execution of the job using a system of job classes and priorities within each class. Resources are allocated at file, volume, and device levels to each job step, and deallocated when each job step is completed. Job accounting information is collected at all stages of the job's passage through the system. Job accounting information, along with the results of the job, is provided by the output writer, asynchronously with job execution.

The file management routines of GCOS handle allocation and deallocation of space for files, automatic label checking, automatic volume recognition, control of multiple concurrent accesses to files, and control of multiple copies and generations of files through the catalog. Additionally, they provide various access methods to different file

organizations and also file and volume utilities to support file housekeeping.

GCOS allocates resources to job steps rather than to whole jobs to ensure effective use of the available resources. Space is allocated for files, and files are assigned to programs at the start of the job step requesting them. The files are then unassigned, and space for temporary files is normally released as soon as the job step has completed.

When assigning a file, the user defines the file as either permanent or temporary. If the user wishes to retain a temporary file for several job steps, a parameter in the ASSIGN statement prevents the file space from being released until the end of the job.

To request space for a file, the user specifies the type of device, the identity of the volume, and the amount of space required. GCOS then searches the specified volume and automatically allocates any space available. Disk space need not be contiguous; GCOS can allocate space for a file using up to five separate areas on any one volume, and can spread the file over a number of volumes if required. On magnetic tape, GCOS supports any number of files on a single tape.

When a new file is created, file management automatically creates the appropriate labels, and these are subsequently checked very time the file is opened for processing. On disk, labels are stored in a special area called the volume table of contents (VTOC). On tape, the labels are created at the head and the tail of each file.

Disk files are sharable under DPS 7 GCOS. However, if file protection is required, multiple access can occur only in read mode.

Volume mounting and dismounting is controlled automatically by the system, and warnings are given if the wrong volume is used. This control is based on the volume label, which contains a unique identifier for each volume. When a volume is mounted, the automatic volume recognition feature reads its label and the identifier is stored. When space is requested or a file is opened on a specific volume, the file management system is aware of its status. If the volume is not mounted, an operator message is issued.

Among the file characteristics recorded in the file catalog are the generation number and copy number of each file. The records for different generations and copies of the same file are linked together, and the catalog automatically controls the numbering and deletion of the file generations to maintain the number of generations specified by the user. Each record also contains a list of the volumes on which that copy of the file resides.

To access the latest generation of a cataloged file, the user's program refers to a file by name. This program internal name is matched to the external name of the required file when the file is assigned to that program, and the external name is used to access the catalog. The catalog automatically provides the latest generation of the required file, and supplies the file access system with the identifiers of the volume(s) on which that generation resides. Since automatic volume recognition has recorded the address of the device on which each volume is mounted, and the file label indicates the extent of the file, access to the file is complete.

The main file access system of GCOS 64, the Universal File Access System (UFAS), replaces random, sequential, and indexed sequential files. UFAS satisfies all the requirements of the ANSI Mass Storage Task Group recommendations for sequential, relative, and indexed access. It is independent of device characteristics, file organization, media addresses, and media formats.

Programs can access data sequentially, randomly by key, directly, or directly by relative position on the same UFAS file. The access method can change every time the file is accessed. UFAS file scan be indexed or non-indexed; if indexes are used, they can be multiple-level, and records with indexes can be intermixed with records without indexes. UFAS can handle fixed-length, variable-length, and dynamically variable records, and a UFAS file can contain a mixture of different record types.

The file organization of a UFAS disk file is based on control intervals and control areas containing embedded freespace, thereby eliminating the need for overflow areas. When records are inserted into a UFAS file, they can be physically located in their logical positions on the file; access time is reduced and the need for frequent reorganization removed. In addition, the physical record sizes in a UFAS file are independent of the lengths of the logical records. When the file is moved from one medium to another, the physical record size can change to adapt to the new medium without affecting the file or the programs using it.

UFAS has been enhanced to include access to specific file items by any one of 15 characteristics without a prior sort. A new dynamic file extension facility allows extension of files as required.

In addition, GCOS offers a very flexible method for file indexing called the Multiple Logic Data Store (MLDS), which has the following characteristcis:

- Random access using the primary index and the symbolic key
- Random access using the secondary index (8 maximum) and the symbolic key
- Sequential access using the primary or secondary index and the symbolic key
- Physical sequential access (by record loading order) RPG II
- Random access by relative address (RPG II)
- Loading of records sorted on the primary key or unsorted
- Automatic update of the primary index at each insertion of a new record
- Independent creation of secondary indexes
- Each secondary index is an independent file
- Deferred update of secondary indexes
- Several logical records can have the same secondary key value
- Management of complementary records dependent on a primary record
- Creation of one or more secondary indexes for complementary records
- Creation of one or more secondary indexes for primary records
- Creation of one or more secondary indexes for primary or complementary records which meet a user-defined criterion
- Primary or secondary index at two levels
- Index (primary or secondary) input by logical record

- Intensive use of the hardware operation for key search
- Global or distributed primary index
- Compatibility with Levels 61 or 62
- Capability to catalog an access path to the file records (access authorization to an index)
- Independence of the file in relation to the medium by use of a type of relative addressing in the indexes
- MLDS is supported by the COBOL and RPG II languages.

GCOS also supports classical files with the Basic File Access System (BFAS). BFAS includes three subsystems:

- Basic Sequential Access, which supports sequential files on disk units EBCDIC code and on tape using either EBCDIC or ASCII code. Records can be fixed, variable, or undefined.
- Basic Indexed Sequential Access, which supports indexed sequential files on disk. Files can have up to six levels of index, with the highest-level index being resident in memory. Overflow space can be reserved within the prime data areas, on separate cylinders within the file.
- Basic Direct Access, which supports access by relative record number and by complete or partial physical address to disk-based files. Basic Direct Access includes a number of established randomizing algorithms.

A fourth set of access methods, the Honeywell File Access System (HFAS), gives full access to files in the format used on Series 200/2000 systems. HFAS includes all the features available with BFAS.

SIRIS 3 RELEASE 1-E: DPS 7 systems provide three paths for users of an IRIS under SIRIS 3:

- Transfer of applications without conversion.
- Evolution toward an operating system that is richer in functionalities by using SIRIS 3 TRANSIT software.
- A transition from SIRIS 3 to GCOS.

On DPS 7 systems, the SIRIS 3 environment ensures IRIS users of the immediate transfer of their programs and files. This compatibiity is guaranteed for all application programs running on IRIS under IRIS 3 V17/VCAM.

SIRIS 3-E manages a continous area of real memory. The maximum size of this zone is defined during generation. The actual size of the area is a SIRIS 3-E initialization parameter.

The disks and tapes are allocated to SIRIS 3-E without sharing with another operating system. These units are allocated during SIRIS 3-E initialization or during operation by an operator's order.

Electromechanical peripherals are allocated to SIRIS 3-E either during SIRIS 3-E initialization or during processing by an operator dialogue. In SIRIS 3 operation, the first case corresponds to units permanently assigned and the second units assigned by the operator (POOL).

To provide SIRIS 3-E users with the advantages of the GCOS 64-E operating system, a set of migration tools called SIRIS 3 TRANSIT is available. This software contains automatic translators for files, volumes, and source programs written in RPG and in COBOL.

SIRIS 8 RELEASE 1-E: The SIRIS 8 environment provides SIRIS 8 users with compatibility between IRIS 80 and DPS 7 systems. It provides for the transfer of applications, files, and operating procedures without conversion. Compatibility is ensured for all application programs, at source, object or executable level and for the command language processed on IRIS 80 under SIRIS 8 C 10/VCAM.

The SIRIS 8 environment firmware allows the execution of "user" instructions in IRIS 80 code and provides management of IRIS 80 format memory addressing and associated protection.

It also includes privileged instructions different from the IRIS privileged instructions, enabling access to micro-programmed functions such as management and synchronization of processes, input/output operation, etc.

SIRIS 8-E is mainly an adaptation of SIRIS 8 C 10/VCAM to the following interfaces: system support, and the DPS 7 input/output system. The interfaces with user applications have been retained to ensure compatibility between IRIS 80 under SIRIS 8-E and the DPS 7 under SIRIS 8 environment. The software functionality provided is that of the SIRIS 8 C 1-/VCAM version.

The physical memory accessible by SIRIS 8-E is 8 million bytes, and the virtual space addressable by each task is 16 million bytes, the same as for SIRIS 8C10. SIRIS 8-E enables bi-processor and bi-system operation. Access to a network is via a DATANET 7100 which uses the VCAM interface of SIRIS 8-E. The terminals of the IRIS line are connected either directly to the DATANET 7100 or to the 7100 via the DN 2640 controlled by MCR3. The IRIS 80 user will have his network unmodified after migration to DPS 7, which supports the DATANET 2640 and all associated terminals.

DATA COMMUNICATIONS SOFTWARE

The GCOS data communications software, together with the communications hardware and firmware, handles networks up to 45 lines, with up to 32 terminals per line on the DCC4100 Integrated Communications Controller. A network can include switched, private, and direct-connect lines as well as a variety of terminal types.

GCOS provides two methods of interfacing the user programs with the communications controller.

The *Message Access Method* handles a system of queues to provide a buffered interface between the data communication s network and the user's programs, allowing serial or selective processing of messages.

The *Transaction Driven System (TDS Standard Processor)* is a conversational system for handling a message entered by a user via a terminal, the initiation of a processing routine specific to that type of message, the processing of the message, and the response sent to the terminal. A library of mostly user-written transaction processing routines (TPR's) correspond to the various types of messages accepted by the system. TDS can handle several dozen different transaction types in a single session. Time and memory space are optimized by utilizing a single copy of a TPR even though the requests for that TPR may come from different terminals. TDS provides a batch interface allowing batch programs to interface with it as though they were terminals. This facility is particularly useful in debugging the transaction system without incurring real-time constraints. TDS has access to all files supported by GCOS as well as concurrent access control, journalization, and file recovery of UFAS files. Security is provided through controlled file access and authority codes. All input messages to TDS are journalized to guard against information loss.

A *TDS Extended Processor* handles access to an IDS II database. Otherwise, specifications are the same as for the standard processor.

The *Remote Batch Facility (RBF)* enables remote job entry from a Level 6 card reader, cassette, or disk file to a DPS 7 and output return to a Level 6 printer or disk file for later printing. RBF consists of RBF/6, which runs under GCOS 64, and RBF/64, which runs on the Level 6 under control of GCOS 6 Mod 400. RBF operates under synchronous transmission using two or four wire connection in half duplex mode up to 9600 bps. The DPS 7 host can support up to six Level 6 systems acting as RBF terminals each on a separate line and on a concurrent basis.

The *File Transaction Facility (FTF)* enables exchange of DPS 7 and Level 6 sequential disk files. FTF provides data compression during transmission, verification of transfer unit sequence number to ensure that units of file transfer are not lost or duplicated, and a file identification security feature. Up to five transmissions can be handled simultaneously by one copy of the DPS 7 utility program. Any number of users in groups of five may be connected serially. FTF operates under synchronous transmission with two-way alternative transmission on half/full duplex lines at up to 9600 bps. Support of multipoint and dedicated, switched, or direct connections is provided.

The *Data Entry Facility/Interactive Entry Facility (DEF/IEF)* provide a DPS 7 host in a distributed systems environment with a clustered, interactive, programmable terminal capability. In this case, IEF is configured as an extension of DEF. DEF/IEF operate under Level 6 GCOS Mod 400 and provide up to 14 VIP7200 Operator Display Stations emulating VIP7700s. The facilities provided for the VIP7200's are enhanced but similar to those of a clustered VIP7700 system. Data entry is interactive with 64/DPS applications. Each operator display station has independent access to all DPS 7 interactive systems, including TDS and IOF. DEF software can validate and preprocess data as it is entered from the VIP7200 before it is transmitted to the DPS 7. IEF uses the Polled VIP Emulator to communicate with a DPS 7 utilizing synchronous VIP 7700 line protocol.

DATA BASE MANAGEMENT SOFTWARE

INTEGRATED DATA STORE II (IDS II): The IDS II data base management system includes a data description language for describing the data base and a data manipulation language for accessing data. Data relationships can be multilevel, multipath, tree, network, and compound network structures. For a complete description of IDS II, see report number 70E-480-01.

QUERY: The Query file inquiry system is a general-purpose system for handling data from terminals, although it is equally well-suited to use in batch mode. Query is available in two versions: inquiry only—which provides features for searching on selected criteria, sorts, calculations, printing standard or tailored reports, creation of sequential files internal to a procedure or for input to a high-level language program; and inquiry and update—where the inquiry-only version is extended by the addition of a module which permits modification to user records. Query supports BFAS indexed sequential and sequential file organizations, UFAS indexed and sequential organizations and an IDS II Data Base.

PROGRAM PREPARATION FACILITIES

In addition to the high level languages (see separate listing below) DPS7 systems under GCOS provide a static linker, an interactive text editing and operation facility (IOF), and program libraries. The static linker combines the output from language processor runs and program libraries to form an executable version of the program called a load module. The processor runs may be from the same or different language compilers.

IOF provides for the interactive use of the GCOS library maintenance routines including the text editor. The text editor permits the user to manipulate lines, characters, and strings of characters with a source data file. IOF also provides for the remote initiation of requests for batch job execution, remote status inquiry and control of job execution, remote scanning of job outputs with control of delivery, and interactive interface with mulitple user programs.

GCOS supports three types of program libraries along with maintenance routines for the libraries. Library types include source, compile unit (output from compilers), and load module.

PRODUCTIVITY AIDS

PREFORMS: PREFORMS is a screen formatting tool for the programmer that provides the following advantages: it saves programming time by eliminating the COBOL screen description, reduces debugging time by eliminating the manipulation of service codes, and saves time by automatically optimizing message lengths.

PREFORMS composes, stores, and modifies the forms of display screens for VIP 7700, VIP 7760, VIP 7001 and compatible terminals connected directly to the DPS7.

PREFORMS can also be used to generate forms for terminal screens connected to Mini 16 remote processors and for the Transactional Terminal System TTS 7800, considered a "virtual" VIP 7700.

FORMS: FORMS provides the programmer with the means to define, build and maintain forms that will be displayed during the execution of transactions. It also handles the display of forms at run time and the transfer of data between the program and the terminal. Running in batch or interactively (under IOF), FORMS creates screen files or lines of source COBOL that can be incorporated into transactions. The images of screens created in this manner are independent of the type of terminal used. It is therefore easy to transfer an application from one type of terminal to another, since personalization is automatic when the application is executed.

WORDPRO: WORDPRO provides functions for editing, formatting, and typesetting documents. An integral part of GCOS 64-E, WORDPRO creates and maintains documents in variable formats, from the simplest to the most complex (letter to complex technical presentation), simultaneously with any other data processing activity. Designed for people with little or no experience in data processing or typesetting, WORDPRO provides them with an easy means of entering and editing text. The security available at the level of WORDPRO is the same as for all information processed in the DPS 7. The documents residing in virtual memory receive the same protection as any other type of work, whether file or program.

PROGRAMMING LANGUAGES

Cii Honeywell Bull provides COBOL, RPG II, FORTRAN, BASIC, PL/1, APL and GPL (GCOS Programming Language) for the DPS 7.

COBOL: DPS 7 COBOL conforms to ANSI 74 standards, including those of the MSTG (Mass Storage Task Group). An optional COBOL Data Communications Extension program module is available.

The DPS 7 COBOL language processor automatically segments the object programs it produces. Users classify each

section of a program's Procedure Division by assigning it a status level between 0 and 99. Sections assigned to level 0 are permanent segments that cannot be overlaid. Sections assigned level numbers between 1 and 49 are fixed segments, and those given numbers above 49 are independent segments and will be selected for overlaying before fixed segments. Unassigned segments are given the default assignment of level 0, and multiple segments may be assigned to the same level. This last feature is important for segments that need to communicate with each other.

Users also control the segmentation process by specifying a maximum size for both procedure and data segements. The compiler produces segments as close as possible to these limits, but they are not regarded as absolute limits. The compiler insures that no data items are split between segments and will override the user-specified limits to reduce the swapping activity that would result. Segment sizes are specified in the Environment Division of the program, enabling fine tuning without the need to change the body of the program.

DPS 7 COBOL data communications capabilities include the Message Access Method, which handles all message flow between user programs and the network by establishing queues and operating from these. The COBOL communications facility consists of a Communications Section to describe the queues, and ENABLE, DISABLE, SEND, and RECEIVE verbs to communicate, via the queues, with the network. The ENABLE and DISABLE verbs are used to open and close the connection between the Message Access Method and a given terminal. The RECEIVE statement causes a message from a specified queue to be passed to the program, and the SEND verb causes a message from the program to be placed in a specified queue. An ACCEPT MESSAGE COUNT statement can also be used to access counts of messages in the queues.

The COBOL Data Communications Extension (CTG/MCS) is an optional extension to the basic COBOL ANS 74 language processor that provides language and functions representing Level 1 support of the Communications Module of the 1974 COBOL ANSI standard. These standards are based on the recommendations of the Communications Task Group (CTG) to the CODASYL Committee, which were subsequently included in the CODASYL Journal of Development for the COBOL language. These language elements include such statements as SEND, RECEIVE, ENABLE, DISABLE, etc., and provide the required prerequisite to use of the Message Access Method (MAM) as well as TDS. In conjunction with Basic Terminal/Network Support (BTNS), MAM serves as the DPS 7 GCOS response to the CTG requirement that the COBOL program interface with a Message Control Supervisor (MCS). These products jointly provide the MCS attributes and functions necessary to conform with the ANS standards.

DPS 7 COBOL is provided with two aids to program debugging. The first is through the use of debugging lines as defined by ANSI. The second is through the use of an interface to the GCOS Debugging Support Processor.

RPG: The *RPG II* language processors used in the DPS 7 system permits the interchange of data files among RPG II, FORTRAN, and COBOL programs. Object programs written in RPG II can also be linked with programs written in COBOL, FORTRAN, or other languages.

The RPG II compiler features automatic file manipulation and disk handling, support for sequential, indexed, and relative file organization, physical sequential reading of indexed files, relative access to index files, device independence of sequential files, dynamic table handling capabilities, and the use of standard data management access routines by object programs.

RPG provides support for sequential indexed, relative (indexed sequential), and direct file organization. File access can be physically sequential, sequential by key, direct by key, direct by relative address, or direct by absolute address. RPG also supports the Honeywell file access methods BFAS, HFAS, and UFAS.

RPG uses five files: two work files; a complete unit library for the generated program; and two input files, one for job control and one for input data. The processor accepts data from card, tape, or disk, and its output can be directed to any device supported by the GCOS output writer.

The RPG language processor features a fixed logic cycle that uses default values and specifications for certain control functions. The need to make many processing decisions (such as file selection, record input, input record formatting, and description of matching fields) is eliminated by the fixed logic cycle. Record selection and output are reduced to operations described by previously defined specifications rather than by individual procedural statements. During each cycle, the fixed logic presents the user with a single input record in the form required for calculations. Any number of output records can be produced by one cycle.

The DPS 7 RPG compiler adapts automatically to the amount of main memory available. If the allocated space is insufficient, GCOS automatic management facilities will allocate more space as it becomes available.

FORTRAN: DPS 7 FORTRAN meets the ANSI standard for FORTRAN IV and provides several Honeywell extensions including those designed to improve compatibility with FORTRAN Y (Series 6000).

The language processor consists of two packages, the FORTRAN compiler and the FORTRAN run-time package. FORTRAN requires the implementation of the scientific instruction set. The language processor executes either in compile-only environment (with or without the production of compile units) or in a compile-and-go environment in which the output is submitted directly to a linking loader and the resulting program is executed as part of the job stream.

DPS 7 FORTRAN produces four levels of diagnostic messages. Level 1 diagnostics point out instances of code usage that could lead to less efficient execution. Level 2 diagnostics warn users of potential error conditions that could result from code usage. Level 3 diagnostics alert users to serious coding mistakes, and Level 4 diagnostics indicate fatal coding errors that would make further processing impossible. Level 4 diagnostics also cause the generation of the object program to be suppressed, but syntax checking continues. All other diagnostics do not affect compilation.

The DPS 7 version segments the compiled output, generating a collection of "compile units" that each represent a program segment, subroutine, or data block. These compile units are written into a temporary library from which they can be cataloged into a permanent library or submitted to a linking loader for execution. The language processor further segments the compile units into code, local data, and global data. This segmentation process permits users to take advantage of the memory management facilities of GCOS and the DPS 7 hardware.

The FORTRAN library contains routines for many mathematical calculations plus run-time packages to handle FORTRAN functions such as STOP and PAUSE and dynamic error diagnostics.

BASIC: DPS 7 BASIC is an incremental compiler, checking syntax and generating object code at the input of each instruction. Under 64 GCOS-E BASIC programs can be developed and executed in either batch or interactive mode.

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Interactive mode requires the Interactive Operating Facility (IOF). BASIC as implemented in the DPS 7 provides 38 standard mathematical functions and these facilities: GO SUB, used to branch to a subprogram within the program; RETURN, used to return from the subprogram to the main program after a GO SUB statement; and DEF, used to define single-line or multiline user functions. DPS 7 BASIC requires the FORTRAN math library.

PL/1: GCOS PL/1 meets the ANSI standard. Also, as developed for GCOS 64-E, PL/1 offers extensions designed to facilitate structured programming: for example, DO...UNTIL. It can also call for routines written in COBOL and manipulate standard GCOS 64-E files (BFAS, UFAS, MLDS). PL/1 is also able to manipulate processing of magnetic tapes containing ASCII files or files of a non-standard format or record through the facilities provided by GCOS 64-E data management.

APL: APL is a GCOS 64-E processor which, like BASIC, is designed to be especially used by non-data processing personnel. It makes it possible to rapidly obtain results within good performance and efficiency conditions.

APL is implemented in a GCOS 64-E interactive environment and from specialized terminals (for example, from the Anderson-Jacobson AJ 832 terminal).

GCOS 64-E APL makes it possible to work on scalar variables, vectors, sets and tables with a maximum of 15 dimensions. The usual functions of APL are available and the user may define and integrate his own functions.

The debugging of programs is facilitated by the ability to display intermediate results, stop the execution of a function, or replace standard error messages with a sequence written in APL which explicitly describes the situation. Finally, the user may interrupt his work and continue later through a "save" function.

Files accessible by APL are sequential files which may be permanent or temporary and which may or may not be catalogued.

GPL: The GCOS Programming Language (GPL) is oriented toward the development of system software. In some ways similar to PL/1, GPL has a free format syntax capable of manipulating strings of bits and list structures and has powerful data declaration and manipulation capabilities.

GPL does not support the processing of floating point numbers. However, it contains instructions necessary for structured programming and also functions for the processing of indexes, bit strings, etc.

CONVERSION AIDS

The TRANSIT software package is a complete conversion package, containing automatic translators for files and source programs written in COBOL and RPG, as well as a comprehensive manual detailing all the steps necessary for complete conversion to a DPS 7 system. The TRANSIT conversion packages allow data files and RPG source programs from IBM System/3 and System/370 to be transferred to a DPS 7 system. In addition, users can migrate from ICL 1900 PLAN to COBOL 74. TRANSIT B and TRANSIT BS-1000 also allow conversion of foreign COBOL and RPG II programs to 64/DPS format. In addition, source COBOL and MiniCOBOL programs can be transferred from Honeywell's Series 200/2000 or Level 64 systems to DPS 7 systems.

REMOTE MAINTENANCE SYSTEM DPS 7: RMS DPS 7 consists of a remote console interface adapter and software diagnostic interface modules combined to provide an extension to the system console for field engineers. The engineers are remotely located and connected via phone lines. Remote Maintenance System DPS 7 provides the ability to troubleshoot hardware and firmware problems as well as software bugs. With this facility, key diagnostic programs that operate under DPS 7 GCOS can be remotely executed and patching of many software difficulties can be accomplished without an on-site visit. Remote Maintenance System DPS 7 operates only when the system is in maintenance mode and provides documentation of all communications via the system console.

APPLICATIONS SOFTWARE

APPLICATIONS: GCOS supports several applications packages that can be run as stand-alone systems or as composite parts of user-designed systems. All of the following packages are written in COBOL and operate under the minimum DPS 7 GCOS configuration.

Distribution Inventory Management System (DIMS)—DIMS is a data-base oriented inventory management system with the following features: seasonal analysis and autoadaptive exponential smoothing forecasting techniques, choice of replenishment policies, order-quantity and service-level projection and optimization capabilities, and multiple warehouse capability.

Industrial Management System-Transaction Driven (IMS-TD)—IMS-TD comprises a set of programs which offer production managers an approach to problems related to the production of manufactured goods. It demonstrates whether production of the enterprise is able to satisfy commercial objectives, and, conversely, it checks that the commercial objectives support production at a satisfactory level. It determines a program for the supply of components (material, parts, ingredients, sub-assemblies), and provides the information required to coordinate manufacturing and to control the use of production means to avoid bottlenecks.

Accounting and Budget Management (COGEB)—COGEB is a general management system for handling accounting information. COGEB is adaptable to each enterprise through a choice of options and parameters corresponding to working habits. It simplifies the work of accounting departments by using a methodology common to accountants and data processing specialists. Exact and coherent accounting results are produced through checks made on the information before processing.

Statistical and Data Analysis (STATPAC)—STATPAC consists of a set of integrated subroutines for handling base processing of input; conversion of data; descriptive statistics and simple tests such as histograms, contingency tables, graphs, base statistics (average, variance, correlation, covariance, etc.), and base tests for comparing averages of populations (t tests, F tests and T2 tests). STATPAC also handles regression and variance analysis for linear regression, step by step regression, polynomial regression, single path variance analysis, and tests on supplementary hypotheses; and multidimensional analysis (main component analysis, factorial analysis, rotation of factors, discriminatory analysis, canonic analysis, etc.).

Project Management (PMCS-X)—PMCS-X aids managers in the complex task of project planning and control. Designed for the end user, PMCS-X includes such project management techniques as multi-network management and PERT or MMP representation.

Mathematical Library (MATHLIB)—MATHLIB is a set of routines with applications in finance, research and development, engineering, production, market studies, etc. The routines handle matrices, differential equations, analytical and tabulated functions, approximation and

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interpolation, statistics, chronological series and forecasts, random number generation, and sorting.

Linear Programming (LPI)—LPI provides optimal solutions for the following problems: determination of the mix of ingredients enabling preparation at minimal cost; determination of optimal allocation of resources; choice or rejection of a project; planning for the machines in a factory; assignment of trucks, aircraft, or boats to the best transportation itineraries; decisions for optimal short-term financing, etc.

Application software can be transferred from Level 64, 64/DPS, and IRIS computer systems, where appropriate.

UTILITIES: DPS 7 GCOS provides utilities to assist users in managing data and testing software. The Sort routine can handle up to eight record classes. All files to be sorted must be on disk and organized as sequential, indexed, or relative. Output files are organized sequentially. The Merge routine can process up to five sequentially organized disk input files and can handle up to eight record classes. Omitted records from either the sort or merge routine can be output to an exception file.

PRICING

EQUIPMENT: DPS 7 equipment is available for purchase or for rent under a 1-year, 3-year, or 5-year lease. The 1-year and 3-year basic monthly rentals entitle the user to 176 hours of central processor usage per month with on-call remedial maintenance between the hours of 8 a.m. and 6 p.m. on Mondays through Fridays. For scheduled usage beyond this period, with on-call maintenance service, the user pays an additional charge which is a fixed percentage of the monthly maintenance charge. Alternatively, the user can obtain on-call maintenance service at standard hourly rates.

SOFTWARE: Generally, the basic operating system, basic job management and file systems, programming tools such as linking and debugging aids, the job control language, and conversion aids are provided at no additional cost. A basic kit of documentation is also provided with the system. Monthly license fees are charged for language processors, utilities, application packages, communications software, and advanced job management and file systems. Extra charges also are levied for customer services, such as education, program development, system design, implementation and conversion, and network design.■

EQUIPMENT PRICES

DPS 7/60 or DPS 7/65

Configuration

CPU with 2 megabytes memory, two 100-megabyte and two 1,270-megabyte disk drives, two 780K-byte and four 200K-byte tape units, a 500 card per minute reader, a 1,000 line per minute printer, and 16 data communication lines via an DN 7102.

Monthly Rental FF 115,000

Software

GCOS 64-E, COBOL, Utilities, IOF, TDS, IDS II, Software DN.

Monthly Rental FF 15,000

DPS 7/70

Configuration

CPU with 4 megabytes memory, two 100-megabyte and four 1,270-megabyte disk drives, two 780K-byte and six 200K-byte tape units, a 500 card per minute reader, two 1,000 line per minute printers, and 32 data communication lines.

Monthly Rental FF 180,000

Software

GCOS 64-E, Multi Backing Store, GAC, Dynamic Status Display, SBR, COBOL, Utilities, IOF, TDS, IDS II, Software DN.

Monthly Rental FF 26,000

DPS 7/80

Configuration

4 megabytes of memory, two 100-megabyte and four 1,270-megabyte disk drives, two 780K-byte and six 200K-bytes tape units, one 500 card per minute reader, two 1,000 line per minute printers, and 32 data communication lines.

Monthly Rental FF 207,000

Software

Software DN, GCOS 64-E, Multi Backing Store, GAC, Dynamic Status Display, SBR, COBOL, Utilities, IOF, TDS, IDS II, QUERY.

Monthly Rental FF 26,000■

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PRODUCT ENHANCEMENT

On October 14, 1981, CII-HB added two low-end models to the DPS 7 family and also announced several system software enhancements. The new DPS 7/35 and DPS 7/45 extend the series downward to the power level of the 64/DPS-4, superseding both the 64/DPS-4 and 64/DPS-6. Deliveries of the new models are scheduled to begin before the end of this year.

A DPS 7/35 can have from 1 to 3 megabytes of memory, 3 to 5 I/O channels, 1 integrated mass storage processor supporting up to 10.5 gigabytes of disk storage, and 1 data communications controller supporting up to 12 lines. When equipped with a Datanet front-end processor, the 7/35 can support up to 48 communications lines. A medium configuration with 1 megabyte of memory, 1 diskette unit, 1,500 megabytes of disk storage, a 600-line-per-minute printer, and 5 synchronous communications lines will rent for 48,000 FF per month or may be purchased for 1.4 million FF. The monthly license fee for the GCOS 64-E operating system, the TDS transaction system, and interactive application development and maintenance facilities will be 9,600 FF per month, including support.

A DPS 7/45 can have from 1 to 4 megabytes of memory, 3 to 6 I/O channels, 1 integrated mass storage processor supporting up to 10.5 gigabytes of disk storage, and 1 data communications processor supporting up to 15 lines. With a Datanet front-end processor, the 7/45 can support up to 48 lines. A medium 7/45 configuration with 2 megabytes of memory, 1 diskette drive, 1,600 megabytes of disk storage, a 1,100-line-per-minute printer, 2 tape drives (6,250 bpi), and 8 synchronous communications lines will rent for 82,500 FF per month or may be purchased for 2.22 million FF. The monthly license fee for the same software as the 7/35 plus the IDS II database management system will be 12,550 FF per month, including support.

Software enhancements include new DSA (Distributed Systems Architecture) products that allow Level 64, 64/DPS and DPS 7 systems to be networked under GCOS 64-E for production work and applications development. A new Menu Driven Facility (MDF) provides simplified dialog, user guidance via menus, and an integrated mode of operation for both computer specialists and non-technical users. Other new software includes TDS-LS, a transaction system for upper-range models that supports up to 1,000 active terminals; TILS, a system load simulator; and TCRF, a package that provides immediate transaction system restart on a reserve computer.□