

Bull DPS 8000 Series

MANAGEMENT SUMMARY

UPDATE: *Within the DPS 8000 large system line, Bull has extended the power range to an entry-level Model 41 processor and a high-end quad processor Model 84. The overall growth path for Bull systems using the GCOS 8 operating system has also been expanded, by the addition of the high-end DPS 9000 Series. Continuing its emphasis on distributed processing, Bull now supports the Oracle relational database system for multiplatform distributed applications.*

Bull's 1989 corporate reorganization formalized the declining interest of Honeywell in the computer systems business per se. Groupe Bull of France now is firmly in charge of its international alliance with Honeywell and NEC of Japan.

Primary U.S. vertical markets for the DPS 8000 and other GCOS 8-based systems are manufacturing, public sector segments, telecommunications, insurance, and retail. The leading use of these systems is in large-scale, on-line transaction processing, although both the GCOS 8 and CP-6 operating systems support multipurpose processing.

In 1987 Bull HN Information Systems—Honeywell Bull at the time—addressed the growing power needs of its DPS 8 users with the DPS 8000 Series of large-scale mainframes. (As high-end systems keep getting bigger, the smaller models of the DPS 8000 could now be considered medium-scale mainframes.) Although the upgrade path for GCOS 8-based systems has further benefited from the DPS 90 and then DPS 9000 Series, Bull has continued to fill in the power increments within the DPS 8000 range. The DPS 88, which spanned the current power range of the DPS 8000 and DPS 90, is no longer marketed.

The three new DPS 8000 models announced in May 1988 include an entry-level Model 41, architecturally a Model 81 clone but with two thirds (0.64 times) the Model 81's performance. At the high end, with three and four processors, ➤

The Bull DPS 8000 Series of medium-scale mainframes, first offered as an upgrade path for DPS 8 Series users, now includes five models with a 5-to-1 performance range. DPS 8000 systems are optimized for interactive on-line and distributed processing. **MODELS:** DPS 8000 Models 41, 81, 82, 83, 84.

CONFIGURATION: DPS 8000 Series models include one to four CPUs, 16 to 256 megabytes of main memory, and 16 to 64 channels.

COMPETITION: Amdahl 5890 Series, CDC 960 Series, IBM 4381, IBM 3090 low-end models, NAS AS/EX Series low-end models, Unisys A10 and A12.

PRICE: From \$450,000 to \$2,370,000.

CHARACTERISTICS

MANUFACTURER: Groupe Bull. In the U.S., contact Bull HN, 300 Concord Road, Billerica, Massachusetts 01821. Telephone (508) 671-6000. In Canada, contact Bull HN Ltd., 155 Gordon Baker Road, North York, Ontario M2H 3P9. Telephone (416) 499-2855.

MODELS: DPS 8000 Models 41 and 81 each have one processor. Models 82, 83, and 84 have two, three, and four processors, respectively. Models and pricing may vary by national market; contact the local Bull office.

DATA FORMATS

BASIC UNIT: Nine-bit bytes organized functionally to process 36-bit words. Special features ease manipulation of 4-, 6-, 9-, and 18-bit groups, plus 72-bit double-precision groups. ➤



The Bull DPS 8000 Series, with one to four processors, spans the performance range between the DPS 8 Series and the DPS 90 Series. The maximum configuration contains four CPUs and 64 physical channels.

Bull DPS 8000 Series

TABLE 1. SYSTEM COMPARISON

MODEL	DPS 8000/41	DPS 8000/81	DPS 8000/82	DPS 8000/83	DPS 8000/84
SYSTEM CHARACTERISTICS					
Date announced	May 1988	June 1987	June 1987	May 1988	May 1988
Date first delivered	June 1988	Dec. 1987	Dec. 1987	June 1988	June 1988
Field upgradable to	DPS 8000/81	DPS 8000/82	DPS 8000/83	DPS 8000/84	(Max. size)
Relative performance	0.64	1.00	1.79	2.54	3.21
Number of processors	1	1	2	3	4
Cycle time, nanoseconds	85	85	85	85	85
Word size, bits	36	36	36	36	36
Operating systems	GCOS 8, CP-6	GCOS 8, CP-6	GCOS 8, CP-6	GCOS 8, CP-6	GCOS 8, CP-6
MAIN MEMORY					
Type	1M-bit MOS-DRAM	1M-bit MOS-DRAM	1M-bit MOS-DRAM	1M-bit MOS-DRAM	1M-bit MOS-DRAM
Minimum capacity, bytes	16M	16M	32M	32M	32M
Maximum capacity, bytes	128M	128M	256M	256M	256M
Increment size, bytes	16M	16M	16M	16M	16M
Cycle time, nanoseconds	NS	NS	NS	NS	NS
BUFFER STORAGE					
Minimum capacity	256KB	256KB	256KB	256KB	256KB
Maximum capacity	256KB	256KB	256KB	256KB	256KB
Increment size	0	0	0	0	0
INPUT/OUTPUT CONTROL					
Number of channels:					
Byte multiplexer	NA	NA	NA	NA	NA
Block multiplexer	NA	NA	NA	NA	NA
Word	NA	NA	NA	NA	NA
Other	Up to 16	Up to 16	Up to 32	Up to 48	Up to 64

NA—Not applicable.
NS—Not supplied by vendor.

➤ respectively, the Model 83 and 84 provide an upgrade path to customers who started with the original single-processor Model 81 or dual processor Model 82. Compared to the Model 81, the dual, triple, and quad processors have a relative performance of 1.79, 2.54, and 3.21, respectively.

These performance figures are based on vendor-performed standard "debit-credit" benchmark testing under the GCOS 8 operating system. The debit-credit benchmark measures transactions processed per second in a standardized realistic scenario. In absolute terms, the tests showed that Models 41, 81, 82, 83, and 84 could process 18, 28, 50, 75, and 100 transactions per second, respectively.

Note that jobs using long floating-point operands would have substantially slower performance. Jobs using Binary Coded Decimal (BCD) encoding also exact a performance penalty.

The overall range of the currently marketed GCOS 8 machines, from the entry-level DPS 8000/41 to the DPS 9000/94, allows a 56-fold increase in processing power (from 18 to 1,010 transactions per second, measured by the debit/credit benchmark).

Bull has not published debit/credit benchmark figures on the older DPS 8 machines. According to older proprietary benchmarks, the baseline DPS 8000 Model 81 was said to have 1.6 times the performance of the DPS 8/70 in commercial/scientific batch environments and 1.8 times in Data Management IV Transaction Processor (DM-IV/TP) environments. Compared to the DPS 8/49, the Model 81 was said to have a relative performance range of 2.6 to 3.0.

The entire DPS 8000 line makes use of very-large-scale integration (VLSI), current mode logic (CML) gate arrays and one-megabit dynamic random access memory (DRAM) ➤

➤ **FIXED-POINT OPERANDS:** Binary fixed-point numbers are represented with 18-bit half-word, 36-bit single-word, and 72-bit double precision operands.

FLOATING-POINT OPERANDS: In GCOS 8, operands may be represented as binary floating point (single-precision, double-precision, or mixed) with a range of 10 ± 38 , and as hexadecimal floating point (single- or double-precision) with a maximum range of 10 ± 153 . The CP-6 operating system handles floating point operands differently.

INSTRUCTIONS: All basic instructions use one 36-bit word. The processor performs operations using 6-, 9-, 18-, 36-, and 72-bit operands. All single-word instructions use bits 0 through 17 for the address field, bits 18 through 27 for the op code, bit 28 as the interrupt inhibit bit, bit 29 as the address register bit, and bits 30 through 35 as the instruction address modifier. Multiword instructions use bits 0 through 17 for various functions as required, bits 18 through 27 as the op code, bit 28 as the interrupt inhibit bit, and bits 29 through 36 as the operand descriptor or modification field. Words two, three, and four contain the operand descriptor or indirect pointer for operands one, two, and three, respectively.

INTERNAL CODE: Nine-bit ASCII code is standard.

MAIN MEMORY

Main memory ranges from 16 megabytes to 256 megabytes. Memory interlacing improves performance by allowing simultaneous access to data. Memory uses automatic error detection and correction procedures. Memory can be expanded by adding 16-megabyte boards. Memory for each System Control Unit can be expanded independently (asymmetrically) to 32, 64, or 128 megabytes.

STORAGE TYPE: Main memory uses one-megabit dynamic random access memory (DRAM) circuits.

CAPACITY: See Table 1.

CYCLE TIME: Vendor does not release cycle times. ➤

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TABLE 2. MASS STORAGE

MODEL	MSU0500	MSU0501	MSU3380/82	MSU3381/83	MSU3391/93	MSS8080
Cabinets per subsystem	8-15	8-15	8	8	8	8
Disk packs/HDAs per cabinet	2	2	2	2	2	8
Capacity	626MB	1.1GB	2.52GB	5.04GB	7.56GB	1.03GB
Tracks/segments per drive unit	1630 per surface	1686 per surface	13,275	26,550	39,825	16,872
Average seek time, msec.	25	25	15	17	16	18
Average access time, msec.	33.3	33.3	23.3	25.3	24.3	26.3
Average rotational delay, msec.	8.3	8.3	8.3	8.3	8.3	8.3
Data transfer rate	1065K bps	1065K bps	3M bps	3M bps	3M bps	1.875M bps
Controller model	MSP0611/0612	MSP0611/0612	MSP3880/3884	MSP3882/3886	MSP3991/3992	Integrated (2)
Comments	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

► chips. Single-processor models feature 16 megabytes of main memory, expandable to 128 megabytes, and one Input/Output Processor (IOP) which supports up to 16 physical channels. Models are upgradable throughout the series up to the Model 84 quad processor.

Almost from the start, the new DPS 8000 Series has run under Software Release 3000, the latest version of the standard Bull GCOS 8 operating system used for all of the company's large-scale mainframe products.

The venerable Multics operating system was not carried into the new larger environment. Bull does continue to support the DPS 8's alternative CP-6 operating system. CP-6 supports less application software than GCOS 8, but offers well-liked ease-of-use features for program development.

In the mass storage area, Bull's 1988 introductions featured the FIPS-compliant MSP3990 storage subsystem, a product obtained through IBM Corporation. The MSP3990 consists of single- and triple-capacity storage units and their controllers. The MSU3390 and MSU3392 storage units each hold more than 2.5 gigabytes of data, while the MSU3391 and MSU3393 each hold up to 7.5 gigabytes. Each storage unit includes four actuators. Storage unit purchase prices range from \$59,000 to \$113,000.

Controllers for these disk units are the MSP3991 mass storage processor, with two channels supporting two paths (simultaneous data transfers to/from the central processor), and the MSP3992 with four channels and four paths. Purchase prices for the controllers are \$70,000 and \$130,000, respectively.

For customers implementing high-performance transaction processing applications, Bull also announced its MSS8080 mass storage subsystem, calling it "the most economical choice"; the basic system sells for \$78,900 and a secondary system for \$49,300. Specific applications areas include airline reservation systems, order entry, and catalog sales. The MSS8080 can be configured in multiple modules, each of which features two actuators and holds up to 760 megabytes of data. A single MSS8080 cabinet can contain more than 3 gigabytes of storage. Additional cabinets can expand the capacity to a maximum of 24 gigabytes. The storage device can transfer data at up to 10 megabytes per second using a new, high-capacity data channel interface. Multiple data transfers are multiplexed in the interface to achieve this transfer rate. ►

► **CHECKING:** Eight-bit code for single-error correction and double-error detection.

RESERVE STORAGE: Not applicable. Associative memory and cache memory are included in the CPU.

CENTRAL PROCESSORS

DPS 8000 complexes use Very-Large-Scale Integration (VLSI) gate arrays and one-megabit DRAM main-memory chips. A gate-array chip consists of 1,500 bipolar gates and 399 internal logic cells using Current Mode Logic (CML). Gate-array circuit chips are contained in multilayered, ceramic Single-Chip Packages (SCPs), which greatly reduce the required number of circuit boards—one circuit board can contain up to 30 SCPs. Apart from reducing space, power, and cooling requirements, these modern circuit technologies improve performance and reliability.

A central complex includes one to four central processing units (CPUs), plus a model-dependent number of System Control Units (SCUs), main memory components, Input/Output Processors (IOPs), Service Processors (SPs), and modems (for remote maintenance). The use of compact SCPs makes it possible to house each CPU and its associated logic components in a single logic cabinet. Thus each model has one logic cabinet and one power cabinet per processor; multiprocessor configurations have one central cable cabinet as well.

Model 81 is the original DPS 8000 single-processor model, against which other models are measured. The newer entry-level Model 41 has the same architecture as the Model 81, but is limited to two thirds the Model 81's performance.

The Model 82 dual-redundant system features two of every major central system component in a tightly coupled configuration, with CPUs and other components sharing central processing load, I/O processing, communications processing, and all memory. In dual redundant configurations, a duplicate module will take over the functions of a failed module while continuing to maintain its own work load or functions. Models 83 and 84 expand the Model 82's concept to three and four processors, respectively. (For performance rating comparisons, see the Management Summary section.)

Each CPU makes use of instruction pipeline processing to speed up instruction execution. Pipeline processing resembles an assembly line: Several instructions at different stages of execution can be processed concurrently.

CPUs also employ virtual memory addressing and contain an associative memory holding the most recently referenced page table words. Descriptor-controlled access provides system security. Extended segment capability supports segment sizes up to four billion bytes. An execution control store holds up to 64K bytes of command information. ►

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
MTU0630	9	800/ 1600/ 6250	NRZI/ PE/ GCR	75 or 125	60-100K/120-200K/ 468.7-781.2K
MTU8205	9	800/ 1600/	NRZI/ PE	125	100-200K
MTU8206	9	1600/ 6250	PE/ GCR	125	200-780K
MTU8208	9	1600/ 6250	PE/ GCR	200	320-1250K
CTS8500	18	37,871 bytes	AXP	79	3M
Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
PRU0903	900 lpm	136	10	6 or 8	4-to-19 width x 3-to-11 length
PRU1203	1,200 lpm	136	10	6 or 8	4-to-19 width x 3-to-11 length
PRU1600	1,375 lpm	136 or 160	10	6 or 8	4-to-22 width x 3-to-22 length

➤ With the DPS 8000, Bull unveiled Interel, a new relational data management system, and its companion product Infoedge, a family of end user-oriented facilities which also contain tools for program development. Interel includes a Structured Query Language (SQL) and its own data dictionary system. Interel's implementation of SQL is compatible with IBM's SQL/DS and DB2, Oracle from Oracle Corporation, Ingres from Relational Technology Inc., and the Teradata DBC/1012 database computer.

Bull has even repackaged a Teradata database machine under its own label as the Relational Data Base Computer (DBC), which may be implemented with DPS 8000 and larger GCOS 8 machines. The DBC package includes associated disk storage, channel exchanges, interfaces, and addressing expansions. A single DBC can serve multiple hosts.

Bull proposes that the Relational DBC is necessary for databases greater than 25 gigabytes in size, "compelling" for databases between 10 and 25 gigabytes and worth considering for databases between 2 and 10 gigabytes. Software relational database management systems—Interel or Oracle—should suffice for databases smaller than two gigabytes.

In addition to Interel and Infoedge, other major software additions include Pacbase, an applications generator from CGI Systems Inc., and Pathvu and Retrofit, program analysis and structuring tools obtained from Catalyst. Pacbase uses a methodology based on computer-aided software engineering (CASE) to improve productivity in all phases of application development. Bull claims the product should reduce system maintenance costs and the time required for software maintenance and development. The product ➤

➤ In addition to main memory, the DPS 8000 Series comes with 256 kilobytes of cache memory to provide high-speed access to the most recently used instructions and data.

The SCU component is the interface between the CPU and main memory and the input/output processor and connected peripherals. The SCU regulates data transfer traffic and controls system interrupts and demands for central memory. The SCU features eight connection ports and supports concurrent data requests from multiple ports. The SCU can process requests concurrently from up to five ports. Memory commands conform to either a high or low priority. Generally, read commands get a high priority while write commands get a low priority. Additionally, high-priority requests are given precedence during SCU port selection, and low-priority requests are considered when there are no high-priority requests.

The Maintenance Subsystem handles DPS 8000 maintenance and service chores, incorporating both local and remote maintenance. Users can obtain remote testing and diagnosis from the Technical Assistance Center, via the included modem(s).

The Service Processor (SP), a microcomputer with its own operating system and storage units, handles all diagnostic testing for the CPU and SCU, while the Maintenance Console Adapter, under the control of the SP, provides similar functions for the IOP. The SP is required for hardware initialization, loading firmware, and initialization of the boot-load process. Additional SP functions include direct error diagnosis to capture intermittent errors; background CPU test, called Patrol, to handle areas not addressed by direct diagnosis; comprehensive native fault tests to diagnose steady-state failures; and on-line/off-line testing which includes functional and stress tests.

Each central system also has at least one interactive control console with a 14-inch (optionally 23-inch) display, command keyboard, and IOP channel connection. An IOP can support up to four consoles. A 100-characters-per-second console printer is optional. ➤

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TABLE 4. TERMINALS

MODEL	BDS 5 Asynchronous	BDS 7 Synchronous
DISPLAY PARAMETERS		
Max. chars./screen	2000, 3300	2000, 3300
Screen size (lines x chars.)	25 x 80/132	25 x 80/132
Symbol formation	7 x 10	7 x 10
Character phosphor	Green or amber	Green or amber
Total colors/no. simult. displayed	NA	NA
KEYBOARD PARAMETERS		
Style	Low profile	Low profile
Character/code set	ASCII	ASCII
Detachable	Standard	Standard
Program function keys	16 standard	16 standard
OTHER FEATURES		
Buffer capacity	3 pages	3 pages
Tilt/swivel	25°/90°	25°/90°
Graphics capability	NA	NA
TERMINAL INTERFACE	RS-232-C; RS-422-A	RS-232-C; RS-422-A

NA—Not applicable.

NS—Not supplied by vendor.

➤ should also help companies reduce development backlogs and increase control of corporate data.

Pathvu and Retrofit analyze and restructure existing Cobol programs, helping users to better maintain and enhance their existing Cobol software. Pathvu does the analysis and generates reports tailored to the needs of a software management team. It follows the logic patterns in a program code, identifies "dead" code and logic flaws, and creates and maintains 43 separate statistics used to generate management, technical, and individual program reports.

Retrofit converts unstructured Cobol programs into structured Cobol. It unscrambles convoluted logic, corrects structural flaws, assures consistency, and produces PERFORM-based programs that are functionally equivalent to the original program.

Additionally, the company augmented Magna 8, its fourth-generation language offering, with transaction processing capabilities.

Most recently, Bull has introduced the System Security Manager (SSM) for GCOS 8 systems. (Contact vendor on availability of SSM for specific GCOS 8 releases.) Applicable to both local and remote users, SSM offers a GCOS 8 installation flexible degrees of security, but with pervasive and tough enforcement. For example, the security manager can determine how many defective logon attempts constitute a security breach, and how reports of security breaches for each user should be routed. Once a security breach occurs, SSM directs printed and audible alarms to the system console, and a log record to the security terminal and a control file. It also terminates the work unit causing the breach, locks the offender's user profile, and prevents establishment of any new work units for that user until the user profile has been unlocked.

In SSM, security levels can be applied to personal IDs, user IDs, processes, and files. Hierarchical security levels can be defined, along with nonhierarchical access categories and sets of categories. Thus a user or process can be restricted both to a set of substantive categories and by security clear- ➤

➤ **SPECIAL FEATURES:** To speed relational database processing, DPS 8000 systems can interface with Bull's *Relational DBC (Data Base Computer)* system. Manufactured by Teradata Corp., this fault-tolerant, fully redundant database machine can support databases ranging from 2 gigabytes to 1,000 gigabytes on up to 32 disk storage units. The DBC can serve up to 16 large Bull systems at one time. It attaches to a central system via two or more FIPS I/O channels. Oracle and Bull's own Interrel relational database software can be used with the DBC.

To address user access and security requirements, the CPU is designed to operate in three modes: slave, master, and privileged master modes. For general user applications, slave mode limits user access to memory and furnishes a restricted instruction set. Privileged master mode lets users access certain memory domains, but protects them against alteration while also protecting the GCOS 8 operating system from corruption.

PHYSICAL SPECIFICATIONS: The dimensions and weights for Bull mainframes are listed in the following chart:

	Width (in.)	Ht. (in.)	Depth (in.)	Wt. (lb.)
Honeywell Bull Mainframes				
DPS 8000 Model 41, one processor	72	72	32	2,300
DPS 8000 Model 81, one processor	72	72	32	2,300
DPS 8000 Model 82, two processors	176	72	32	4,700
DPS 8000 Model 83, three processors	176	72	104	7,000
DPS 8000 Model 84, four processors	176	72	176	9,300

The operating environment for DPS 8000 systems should be between 68 degrees and 78 degrees Fahrenheit at a relative humidity of 40 percent to 60 percent, noncondensing. The systems can operate on 200, 208, 220, 380, 415 V AC, three-phase power at a frequency of 60 Hz. Models operating at 50 Hz are also available. A DPS 8000 processor consumes 10.7 ➤

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▷ **ance level.** User profiles are encrypted and can be managed centrally. The security manager can immediately lock a user out of the system if necessary.

COMPETITIVE POSITION

In the vendor's marketing formulation, what makes the GCOS 8 system family distinctive is a combination of advanced data management (including Bull's relational strategy), price/performance and efficiency (per benchmark testing), low five-year cost of ownership, multivendor compatibility/coexistence, and ease of growth.

The new System Security Manager is without direct competition on GCOS 8 platforms.

Bull originally positioned the DPS 8000 Series against the high end of the IBM 4381 Series and the low end of the IBM 3090 Series. For example, Bull ranked the performance of the DPS 8000 Model 41 with the IBM 4381 Model Group 23, and that of Models 82 to 84 with several models of the IBM 3090 Series. The high-/low-end distinction has since been blurred, however, by the range expansion of the DPS 8000 Series and both IBM lines.

Competitive IBM plug compatibles are the Amdahl 5890 Series and low-end models of the NAS AS/EX Series. DPS 8000 systems also compete against the Unisys A Series (Models A10 and A12) and the CDC 960 Series.

Bull markets the 8000 processors as general-purpose mainframes, but with particular emphasis on transaction processing—a longstanding interest of Bull from the days when on-line transaction processing was something of a niche specialty. This historically has influenced Bull's comparison of its machines with those of other vendors that were geared primarily to batch processing. As it has in the past, Bull still claims to have a two-to-one advantage over IBM in on-line transaction processing; but now Bull claims that debit/credit benchmark testing confirms this advantage.

The debit/credit benchmark provides double-entry bookkeeping for a customer account in a banking-like application. Each test transaction realistically involves both in-memory processing and several I/O functions: reading a 100-byte message from a terminal, rewriting the account, writing history, rewriting the teller, rewriting the branch, and sending a 200-byte message to the terminal. This benchmark is nonproprietary and accepted by several vendors, although there is still room for debate about how a particular test was implemented.

Bull does not publish MIPS (millions of instructions per second) ratings. A company spokesperson compared use of MIPS ratings to ranking race cars by the maximum RPM of their engines—at a spotlight.

Like IBM, Unisys, and most other vendors, Bull has been addressing hardware/software connectivity concerns. Bull announced its Integrated Information Architecture (IIA), a

▶ **kVA, operating on 208 V AC, 60 Hz.** The systems have a heat output of 31.4K Btus per hour operating on 208 V AC, 60 Hz.

CONFIGURATION RULES

DPS 8000 Models 41 and 81 are each a single-processor complex comprising one CPU; one System Control Unit (SCU); 16 megabytes of main memory, expandable to 32, 64, or 128 megabytes; one System Console and console printer; one Service Processor (SP); one modem and communications phone line for remote maintenance; and one Input/Output Processor (IOP) with up to 16 physical channel connections, supporting up to 128 logical channels.

DPS 8000 Model 82 is a fully redundant processor complex comprising two CPUs; two SCUs; a total of 32 to 256 megabytes of main memory (16, 32, 64, or 128 megabytes per SCU); two System Consoles and console printers; two SPs; two modems and communications phone lines for remote maintenance; and two IOPs, each supporting up to 16 physical channels, for a total of up to 32 physical and 256 logical channels.

DPS 8000 Model 83 is a fully redundant processor complex comprising three CPUs; two SCUs; a total of 32 to 256 megabytes of main memory (16, 32, 64, or 128 megabytes per SCU); two System Consoles and console printers; two SPs; two modems for remote maintenance; and three IOPs, each supporting up to 16 physical channels, for a total of up to 48 physical and 384 logical channels.

DPS 8000 Model 84 is a fully redundant processor complex comprising four CPUs; two SCUs; a total of 32 to 256 megabytes of main memory (16, 32, 64, or 128 megabytes per SCU); two System Consoles and console printers; two SPs; two modems and communications phone lines for remote maintenance; and four IOPs, each supporting up to 16 physical channels, for a total of up to 64 physical and 512 logical channels.

Optional in all models are 23-inch console monitor screens and additional control consoles (up to four per IOP).

All models support up to eight network processors.

INPUT/OUTPUT CONTROL

The DPS 8000 IOP handles data transfers between connected peripheral subsystems or network processors and the SCU. Each IOP supports up to 16 physical channels; as seen by software, this equates to 128 logical channels. Concurrent input and output operations are possible through channel pipelining. Maximum transfer speed is three megabytes per second per channel. Each IOP has an aggregate throughput rate of up to 17.8 megabytes per second.

MASS STORAGE

Refer to Table 2 for information about mass storage devices.

INPUT/OUTPUT UNITS

Refer to Table 3 for information about magnetic tape and printer products.

TERMINALS

Refer to Table 4 for information about terminals.

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▷ framework that lets users working within mainframe, mini, or micro environments access data at different computing levels within an organization. This is similar in concept to IBM's evolving three-level Systems Application Architecture (SAA).

In conjunction with this concept, the Interrel relational data management system is designed to make it easier for end users to access databases and find the information they need. Interrel, using an SQL interface, can access both relational and nonrelational data structures.

The GCOS 8 operating system runs on all Bull large-scale mainframes, making it possible for applications written for one large machine to work with minimal or no modification on other Bull large-scale hardware running GCOS 8.

The Personal Computer Interconnect product lets PC users access mainframe data and download the data to the PC for incorporation into popular PC-based application packages, such as Lotus 1-2-3, dBASE III, MultiMate Advantage, and WordStar Professional. For even greater freedom to mix processing platforms, Bull now supports the Oracle relational database product family, which supports more than 80 platforms from a wide variety of vendors.

Bull's cross-platform (OS/2, UNIX, GCOS 6/HVS 6, GCOS 7, GCOS 8) activities focus on improved compatibility and integration both among its own product lines and with other vendors' lines—via Open Systems industry-standard products and by various interfaces. Since mid-1988 Bull has called its network OSI/DSA to stress its full implementation of the Open Systems Interconnection model, including inherent peer-to-peer communications. This avoids the need for customers to migrate users or applications to OSI software, or to operate separate proprietary and OSI networks. (Note, however, that the "OSF" in Bull's network products predates and does *not* stand for Open Systems Foundation.)

As always, system price comparisons are complex. Certain basic IBM systems may cost less, for example, but IBM prices additional required system components separately. On the other hand, Bull retails main memory increments at a flat rate of \$120,000 per 16 megabytes, whereas IBM list prices for successive increments decrease on a per-megabyte basis.

Recently IBM 3090 architecture has been modified to permit asymmetric memory increments for multiple processors—a capacity the DPS 8000 already has. While each SCU follows a fixed powers-of-two growth path (16, 32, 64, and 128), the two SCUs on a multiprocessor configuration can have different amounts of memory; thus totals of 48, 96, and 192 are permitted.

Corporate organizational changes at this vendor have been an internal preoccupation for several years. Since 1962, Honeywell and NEC have had a long-term technology agreement; Honeywell's relationship with Groupe Bull began in 1970. A 1987 buy-in by Groupe Bull made it an equal

▷ COMMUNICATIONS

Datanet 8 Series front-end network processors handle communications functions for the DPS 8000 mainframes. The Datanet 8 Series includes the 8/10, 8/20, and 8/30, which operate within Bull's Distributed Systems Architecture (DSA), an open communications architecture. Up to eight Datanet processors can be configured per system.

The DPS 8000 Series is designed to accommodate distributed processing. To support connection of the system to other vendors' equipment, the DPS 8000 conforms to all levels of the Open Systems Interconnection (OSI) standard.

Bull also has an OSF/SNA gateway product that enables DSA network users to communicate with IBM host computers employing IBM's Systems Network Architecture. (IBM 3270 terminal emulation is required.)

Datanet 8 Series network processors operate under the control of the Distributed Network Supervisor (DNS) software executive, which in turn operates under the GCOS 8 operating system. DNS also supports other Bull mainframe systems under GCOS 8 (and midrange systems under GCOS 7).

Features common to all network processors in the Datanet 8 Series include:

- Capability to interconnect systems using private networks that use High-level Data Link Control (HDLC) data communications links
- Capability to connect to PDNs, to VANs, using the CCITT X.25 interface, and to most types of standard digital or analog, leased or switched data communications lines
- Capability to attach terminal devices
- System Control Facility for remote maintenance
- Console access for network management functions
- Integrated 5¼-inch diskette drive for executive software maintenance functions

Datanet 8 Series processors require a visual display console. Physical connections between Datanet 8 Series network processors and DPS 8000 central systems are made through Direct Interface Adapter (DIA) channels. Each network processor provides support for one to four connections to the DPS 8000.

Datanet 8/10 is a single processor system which provides support for a maximum of 31 data communications lines. The basic system includes one megabyte of central memory expandable to a maximum of two megabytes. A 5¼-inch diskette drive for executive software support is included with the basic system. A console visual display terminal is required, along with a receive-only console printer for each supporting site.

Three RS-232-C asynchronous data communications ports are included with each 8/10. Line interface module options accommodate line characteristics such as data transmission speed, asynchronous/synchronous operation, and physical interfaces such as RS-232-C, V.35, and X.21.

The basic Datanet 8/20 configuration has a single processor with cache memory and one megabyte of central memory, all of which may be doubled for increased performance. Auxiliary hardware is similar to that for Datanet 8/10. Three RS-232-C asynchronous data communications ports are included with each DATANET 8/20. The basic system's 31

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▷ (42.5 percent) but dominant partner with Honeywell in a globe-encircling French-U.S.-Japanese partnership. At the end of 1988, marked by a \$435 million net loss for the year, a series of layoffs, and successive reorganizations, Honeywell reduced its role in the company by selling off a 22.6 percent stake to Groupe Bull. Honeywell Bull Information Systems was then renamed to reflect its now majority (65.1 percent) owner, Groupe Bull; the new U.S. organization is called Bull HN Information Systems, Inc., with HN briefly alluding to Honeywell and NEC's minority stakes in the partnership—19.9 percent and 15 percent, respectively. The new arrangement also increases NEC's control of the company.

Amid all the corporate turmoil, Groupe Bull reemphasized the global synergy of its technology partnership, bringing forth a new high-end mainframe series, the DPS 9000, whose CPU, peripherals, and networking were each contributed by a different partner. By contrast, the DPS 8000 was considered a U.S. product, the DPS 7000 primarily a French product, and the DPS 90 primarily a Japanese product. The DPS 9000 promotion has been followed by a \$20 million corporate identity advertising campaign.

The U.S.-based Bull HN remains a sizable company, with over 18,000 employees worldwide and operations in more than 28 countries. Bull HN's annual revenues—from the U.K., Italy, Asia, Australia, Mexico, and Canada, as well as the U.S.—exceed \$2 billion.

Groupe Bull overall has more than 45,000 employees and operations in more than 90 countries. Combined R&D resources of the partnership exceed \$600 million. Honeywell continues to contribute advanced work in artificial intelligence, secure computing, and semiconductor technology.

Company products range from CP8 Smart Cards to mainframes to large networks. Bull HN claims the largest OSI network in the world, integrating more than 900 minicomputers and 12,000 distributed terminals for Britain's Department of Social Security.

ADVANTAGES AND RESTRICTIONS

At the time of introduction, the DPS 8000 Series models were much needed intermediate upgrades for the approximately 80 percent of the company's worldwide user base who was then using DPS 8 systems: Fully one third of those DPS 8 users had already reached the top of that line, the Model 8/70, and the price jump to the larger DPS 90 was major.

Apart from throughput capacity, the technology upgrade—from LSI to VLSI circuitry, and from 16K-/64K-bit to one-megabit memory chips—was also welcomed for its reliability, space, and power advantages.

Even large Model 84 quad processor systems generally find 32 to 64 megabytes of main memory adequate for their

▶ data communications ports can be expanded to 127 ports with power and line expansion module options.

The basic Datanet 8/30 is similar to the 8/20 but with two megabytes of central memory; again, the basic configuration can be doubled for increased performance. The basic system provides support for 159 data communications ports, expandable to 255 ports with a line expansion module option.

Datanet 8/10, 8/20, and 8/30 processors are fully upward compatible. These network processors can also coexist with pre-DSA products to facilitate migration from earlier systems.

Line options common to all three DATANET models include:

- Multiline Communications Controller-16 (DCF8052). It accommodates up to four Communications Interface Adapters.
- RS-232-C Asynchronous/Character Synchronous Integrated Communications Interface Adapter (DCF8073). The adapter has four RS-232-C communications ports, includes four 50-foot cables (DCE to DTE) for device attachment, and has a maximum data transfer rate per port of 19.2K bps.
- RS-232-C Bit Synchronous HDLC Integrated Communications Interface Adapter (DCF8049). The adapter has two RS-232-C communications ports, includes two 50-foot cables (DCE to DTE) for device attachment, and has a maximum data transfer rate per port of 19.2K bps.
- Low/Medium Speed Asynchronous/Character Synchronous Communications Interface Adapter (DCF8053). This nonintegrated adapter requires a minimum of one line interface module. It will accommodate up to four line interface modules. Maximum data transmission rate per line interface module is 19.2K bps.

The following line interface modules are allowed with DCF8053:

- RS-232-C/V.24 Asynchronous/Character Synchronous Line Interface Module (DCF8055). This module has one RS-232-C/V.24 data communications port, includes one 50-foot cable (DCE to DTE) for device attachment, and has a maximum data transmission speed of 19.2K bps.
- MIL-188-C Asynchronous/Character Synchronous Line Interface Module (DCF8059). This module has one MIL-188-C data communications port, includes one 50-foot cable (DCE to DTE) for device attachment, and has a maximum transmission speed of 19.2K bps.
- Medium/High Speed Character Synchronous/Bit Synchronous Communications Interface Adapter (DCF8061). This nonintegrated adapter is capable of supporting one medium speed (to 19.2K bps) or one high speed (to 64K bps) data communications.

The following line interface modules are allowed with DCF8061. Each includes a 50-foot cable (DCE to DTE).

- RS-232-C/V.24 Bit Synchronous HDLC Line Interface Module (DCF8062). This module has one RS-232-C/V.24 data communications port, and has a maximum data transmission rate of 19.2K bps.
- X.21 Bit Synchronous HDLC Line Interface Module (DCF8064). This module has one X.21 data communications port and has a maximum data transmission rate of 64K bps.

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▷ needs; this is fortunate, given Bull's current price structure for main memory increments.

Having previously offered its users IBM-supplied double-capacity disk drives, Bull has now taken the next step and made available IBM's triple-capacity drives, along with economical alternatives for appropriate environments.

DPS 8 users migrating to a DPS 8000 can move most of their existing disk, tape, printer, and card unit peripherals over to the DPS 8000 Series, although they must purchase channel connection exchange features to connect peripherals to the DPS 8000 IOP.

Bull's comprehensive database strategy ensures that users can preserve their database investment. I-D-S/II can still be used for CODASYL-type databases, including for on-line transaction processing. Users wanting to experiment with or migrate gradually to relational databases can use Bull's Interel software to perform SQL relational queries on existing databases—without duplicating or transforming those databases—while developing new databases that are actually relational. Bull expects Interel to provide long-term service to many installations that will indefinitely maintain both CODASYL and relational databases. The Oracle database manager is provided for users needing distributed processing across multiple platforms, or who already have Oracle on their PCs and want to extend that relational capability upward. Finally, for users with maximum performance requirements, Bull offers a fully integrated, Teradata-supplied database computer. □

▶ **MIL-188-C Bit Synchronous HDLC/Character Synchronous Line Interface Module (DCF8067).** This module has one X.21 data communications port and has a maximum data transmission rate of 64K bps.

- **V.35 Bit Synchronous HDLC/Character Synchronous Line Interface Module (DCF8069).** This module has one V.35 data communications port and has a maximum data transmission rate of 64K bps.
- **Bell 301/303 Bit Synchronous/Character Synchronous Line Interface Module (DCF8071).** This module has one Bell 301/303 data communications port and has a maximum data transmission rate of 64K bps.

SOFTWARE

OPERATING SYSTEM: GCOS 8 Software Release 3000 is the latest version of the company's primary operating system for large-scale mainframes. Introduced in 1979 with the DPS 8 systems as the *General Comprehensive Operating Supervisor*, GCOS is a product with roots dating back to the early 1960s. Bull's objective has been to keep the GCOS 8 operating system current through releases that capitalize on new technology while preserving the user's investment in software. GCOS 8 is a multiprocessing, multiprogramming, communications-oriented operating system that supports distributed systems requirements.

Bull's overall goal for distributed systems is the eventual linking of an organization's entire complex of physically separate data processing systems into a single logical network system regardless of physical boundaries. Bull's Integrated Information Architecture concept divides Bull systems into

three different operating levels: the enterprise level at the top of a computing organization, the departmental level at the middle, and the workstation level at the bottom. Users can access information pertinent to an entire organization at the enterprise level. Departmental level data serves the specialized needs of separate groups within an organization. Workstation-level processing meets the informational needs of individuals. Each level can be interconnected in two or three tiers to meet specific user requirements.

Included in the new release is support for relational data management software, improved transaction processing, and high-capacity disk drives. Software Release 3000 also includes the Rapid Access Data System (RADS), a software disk cache feature for improving system response time, particularly within interactive environments.

In addition to GCOS 8, DPS 8000 mainframes can also operate under the Control Program (CP) 6 operating system without modification to hardware.

GCOS 8 Software Release 3000 is offered for all large-scale processor lines from the DPS 8, DPS 8000, and DPS 88 to the DPS 90 and DPS 9000. Generally, applications written for GCOS 8 can run on any Bull large system running GCOS 8 without modification. Migration from Release 2500, the former GCOS 8 version, can be accomplished without recompiling application software.

GCOS 8 is a user-defined and user-oriented virtual operating system, with multidimensional capabilities. GCOS 8 balances the use of system resources, and provides multiple options for customizing the system for each user's needs. GCOS 8 can concurrently support a wide range of processing modes: batch processing, remote job entry (RJE), interactive remote job entry (IRJE), timesharing, transaction processing, direct program access, on-line test and diagnostics, on-line program test and development, and decision support for end users.

GCOS 8 also has file protection and file sharing, testing and diagnostics, communications, data management facilities, language processors, diagnostic and system protection facilities, and various system utilities. Batch, timesharing, transaction processing, and other activities can be individually tailored and dynamically varied throughout the day.

GCOS 8 is a flexible operating system that features hardware transparency; the user has no need to know the particular architecture of the system, its hardware, I/O devices, or processor types. All processors can access all of memory and can execute any program. GCOS 8 can address up to 256 megabytes of real memory and can use the entire real memory for all dimensions. Up to 477 user programs can be executed concurrently. It provides high throughput by efficient and rapid scheduling of all activities, which reduces operator intervention; peripherals are allocated before memory so that processing is not delayed by operator or mechanical delays.

GCOS 8 memory management is flexible. The system architecture with GCOS 8 provides dynamic memory management, descriptor-controlled access, and shared access to both data and procedures. Each of these functions is based on a hardware-protected memory segment. The memory segment is defined by a segment descriptor that contains the logical address of the beginning of the segment, the size of the segment, and the permissions that control its use.

Dynamic memory management permits programmers to develop software as if there were an unlimited logical memory. The available physical memory depends on the system configuration and the work load. ▶

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► GCOS 8 controls the physical organization of up to 512 work spaces of up to four million pages of virtual storage each, with each page consisting of 4,096 bytes. Up to 477 separate working spaces (out of 512) are available for user processes.

Any available page of main memory can be used for any page-sized block of logical memory. Although pages may be located anywhere in memory, they can be accessed as if they were physically contiguous. Segment descriptors and page table words translate the virtual address to a main memory address.

Programs, including the GCOS operating system itself, are protected by a domain structure. A domain is a set of non-contiguous segments in one or more working spaces. Domains put boundaries around certain parts of the operating system, protecting them from unauthorized access. The programmer and site administrator decide which segments will be available to a subprogram.

Other security features built into the operating system include log-on controls, file access controls, control of on-line user transaction access to applications, and control of database access down to the field (data item) level. The operating system will abort an activity if an illegal operation is attempted.

System access to a GCOS host begins with the GCOS 8 network interface module (DNET/ROUT), which routes terminal access to the requested subsystem. Logon procedures vary greatly among subsystems, but all require user identification and password. Each subsystem has a master user defined for administrative purposes. The master user console is typically a terminal connected via the front-end network processor.

PROGRAMMING LANGUAGES: Language processors available for use under GCOS 8 are Ada, APL, Basic, C, Cobol-68, Cobol-74, Cobol-85, Compiler "B," Fortran-66, Fortran-77, GMAP, GPSS, Lisp, Pascal, PL/I, RPG II, and Simscript.

DATABASE MANAGEMENT: Bull's Interel (integrated relational) data management system accesses relational files, of course, but also provide relational access (in query mode only) to nonrelational UFAS files and DM-IV databases. Interel accomplishes this without restructuring data files or programs. Included with Interel is an integrated and extensible data dictionary system called the Information Resource Dictionary System (IRDS).

All Bull systems also support the Oracle relational database management system. While Interel has high-performance characteristics, Oracle excels in support of distributed processing across multiple hosts and across hosts from multiple vendors.

Bull continues to offer Data Management-IV (DM-IV), a CODASYL network-model database management and transaction processing system. DM-IV's database management component, the Integrated Data Store/II (I-D-S/II), administers the creation of the physical and logical structures of the database and controls the creation of the application-specific views of that database used in processing. It then serves as the interface between the database and the various DM-IV processors. I-D-S/II is fully integrated with Bull's Cobol-74 compiler, and user interfaces are also implemented for Fortran.

DATA MANAGEMENT: As described briefly above, data management on Bull large systems is handled through Interel with IRDS and through DM-IV with I-D-S/II.

Interel includes Bull's version of the Structured Query Language (SQL) and Bull's Information Resource Dictionary System (IRDS), both of which conform to ANSI standards. Interel's SQL is compatible with IBM's SQL/DS and DB2, Oracle from Oracle Corporation, Ingres from Relational Technology Inc., and the Teradata DBC/1012 database computer.

The Interel SQL uses English-like commands to create, update, or delete tables, and to authorize access for system users. Interel automatically creates table definition and database table space, establishes the necessary controlling information, and deposits this information in the IRDS central dictionary.

Interel accesses stored data through its Data Manager. Using this component, full relational files can be added to existing nonrelational models, and information can be merged through SQL. This provides users with a seamless interface from third-generation database technologies to newer fourth-generation technologies and allows users to migrate to relational database functions without the need to duplicate information through copy management.

DM-IV contains a collection of facilities to handle database management, transaction processing, querying, and report processing, in addition to providing batch and interactive database capabilities.

Data Dictionary/Directory System (DD/DS) is a comprehensive set of software modules that can implement a centralized data dictionary/directory. Data is entered into the dictionary database via batch or interactive operations. The DD/DS supports up to 19 entity-types including fields, records, files, programs, procedures, jobs, schemas, and reports. Also supported are multiple versions and status of each entity-type, alias names, narrative, and attributes unique to the entity type.

Several report generation facilities are available to the DD/DS user. The reporting system extracts information from the data dictionary and presents it to the user in various formats. Included is an extensive cross-reference reporting capability for all entity-type occurrences and an Impact Analysis Report which analyzes and reports the effect of change to an entity-type occurrence. A complete set of utilities assist in maintenance of the data dictionary system and its database.

DM-IV's File Management Supervisor (FMS) provides powerful file management capabilities, including multilevel user catalogs, file sharing, and access control. The system employs a hierarchical (tree-structured) design. A System Master Catalog lists the various user Master Catalogs, and each user may, in turn, define one or more levels of subcatalogs. Users may permit general sharing of their files or specify individual users who may have access to them on either a read/write or read-only basis. Password access control can be imposed at any or all levels of the file structure. Security is also provided by the optional logging of file access attempts and by a timesharing command allowing a user to encrypt his or her file using a predefined algorithm.

DM-IV's Unified File Access System (UFAS) provides automatic management for file processing, including record location and automatic blocking and unblocking. File organizations supported include sequential, relative, indexed, and integrated files. UFAS also includes facilities for error checking and initiation of error processing as defined by ANSI Cobol-74 and file integrity protection for normal and abort processing.

DM-IV's Common Files Facility (CFF) controls the sharing of user program and data files between GCOS III and GCOS 8 as well as between GCOS 8 hosts without requiring

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► manual partitioning of data or mass storage devices. The CFF allows different large systems using GCOS 8 to share disk files on a single common group of disk drives.

CFF allows up to four computer systems to share common disk drives. Concurrent access to files is controlled by lock bytes in the mass storage processor that supervises disk drive operation. Locking occurs at the single file level, which ensures that only one computer system in the cluster can update a file at one time. CFF clusters can also exist within communications networks based on Bull's DSA.

DATA COMMUNICATIONS: *Distributed Network Supervisor (DNS)* has been designed specifically for use in the Datanet 8 Processor, and is part of a set of communication software products based on Bull's Distributed Systems Architecture (DSA). DNS supports up to four host connections, enabling one Datanet 8 to serve multiple hosts.

DNS operates in the Datanet 8 in conjunction with a GCOS 8-based host to provide support for transaction processing, distributed transaction processing, distributed terminal concentration, timesharing, remote job entry, direct program access, and networks made up of DPS 90, DPS 9000, DPS 88, DPS 8000, DPS 8, DPS 7, DPS 7000, and DPS 6 (or Level 6) hosts in any combination. DNS supports private networks, Public Data Networks (PDNs) and Value Added Networks (VANs), including X.25 packet switched and X.21 circuit switched networks. DNS supports a variety of Bull terminals.

Functions that can be distributed throughout the systems that make up a DSA network include network monitoring, cross-network software loading, dumping, data logging for statistics, billing and maintenance, in-line tests, and software generation.

The *Network Processing Supervisor* and the DPS 8000 support five types of remote processing in any combination: remote job entry (RJE), transaction processing, timesharing, message switching, and direct program access. RJE is supported by four standard interfaces for remote computers: remote computer interface, remote network processor multimessage interface, BSC interface, and HDLC interface.

The information network is controlled by a combination of the Datanet Front-end Network Processor and the NPS software, and can range in size from several terminals to a comprehensive, distributed information network with multiple host processing facilities.

NPS supports a variety of remote terminals, computers, and communications facilities from Bull and other vendors. NPS can also be customized to support integration of additional terminal types and network protocols into the system, journalization of message traffic on mass storage, restart/recovery capability, supervisory control through one or more Network Control Supervisory Stations, statistical recording and reporting, and control of line/terminal parameters.

The *Remote Terminal Supervisor II (GRTS-II)* provides controls for five types of remote processing: remote job entry, transaction processing, timesharing, message concentration, and direct program access. RJE supports the same standard interfaces as NPS. Programming subsystems supported under timesharing are the same as for NPS. GRTS-II does not support the direct program access communications-queued (DAC-queued) mode provided in NPS, nor does it support any host interface which makes use of the DAC-queued method.

GRTS-II includes a *Communication On-Line Test System (COLTS)* and support for remote terminals and devices with speeds from 75 to 56,000 bps. GRTS-II may coexist with

NPS or DNS, each residing and executing in a different network processor. Host-to-host file transmission is supported through the Data Link System.

Transaction Processor 8 (TP8) is Bull's newest transaction processing product. TP8 is particularly suited to heavy transaction processing work loads and contains features that make it compatible with all earlier GCOS transaction processing products, including DM-IV/TP, TPE II, TDS, and TPE. This compatibility helps preserve a user's information investment while offering a natural growth path for increased performance and functionality.

TP8 provides an on-line, realtime system and, through DSA session control, interfaces with a logical network that is independent of the physical topology of the communications network. TP8 is a native-mode transaction processor designed to take advantage of the features of both GCOS 8 and DSA. TP8 supports both DSA and pre-DSA networks. System resources can be partitioned to a logical application level.

Several major services traditionally associated with transaction processing executives, such as integrity control, memory management, buffer management, and journalization, have been integrated into the GCOS 8 operating system software layer known as shared software. These services are used by the various environments of GCOS8/TP8 as well as batch and other transaction processors. As a part of shared systems service software, TP8 can help reduce memory requirements because only one copy of the executive software is necessary for all native users.

TP8 can also take better advantage of multiple central processors, allowing parallel execution of application routines. Applications can be implemented through routines and programs written in several languages including Cobol 74 or Fortran. While in execution, each routine or program is processed independently and can access the range of facilities available in GCOS 8.

The DM-IV Transaction Processor (TP) is the older Bull product currently in wide use with GCOS 8 systems. DM-IV/TP provides the facility for rapid, efficient, on-line database processing. It is especially effective in applications where the end user has little or no knowledge of the operating system or storage structure, or data processing in general. Its internal design is optimized for high-volume transaction processing where extremely fast response and fast, automatic restart/recovery are required. The TP system includes both on-line software components for processing the actual transaction and a variety of support software products for program testing, library updating, and TP system generation. Within DM-IV/TP, there are five major functional components: Transaction Manager, Database Manager, Integrity Manager, Message Manager, and Executive Manager.

Supporting tools for both TP8 and DM-IV/TP include the Transaction Application Test System (TATS) and Transaction Screen Management System (TSM). TATS is a software tool that provides an interactive timesharing environment for writing, compiling, testing, and debugging Transaction Processing Routines (TPRs) using a DM-IV (I-D-S/II) database. TATS also provides a TPR program skeleton generator, and forms mode support is currently provided for the TP8 or DM-IV/TP Forms Option (TPFO). The TATS package can also be used to interactively verify database updates and to integrate completed TPRs into the production system.

TSM is a set of tools designed to enhance the development of application programs in a TP8 or DM-IV/TP environment. This system enables the developer to design, develop, test, and implement screen formats for application systems. Lit- ►

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► file or no knowledge of the communications network or the TP8 or DM-IV/TP operating environment is required.

Personal Computer Interconnect (PCI) is a personal computer program for host access. PCI executes as an application layer on MS-DOS-based personal computers. The product supports Bull MicroSystem PC (AP and XP), IBM PC/AT/XT, and true IBM compatibles. PCI allows PC users to access host-based data and to transfer data to a PC, and provides a state-of-the-art person/machine interface. Users can operate a pointing device (mouse or trackball) to point at pop-up menus and icons representing file drawers, folders, and applications. All operations can also be controlled from the keyboard. Windows allow the user to manage several operations at once. These can include spreadsheets, host query, and data conversion.

Features supported under PCI include auto logon, window manager, graphics controller, VIP terminal emulation, file transfer, script processing, and optional encryption and decryption of files. PCI can work with Lotus 1-2-3, dBASE III Plus, Multimate Advantage, WordStar Professional, ChartMaster, Spreadsheet Auditor, GEM, Bridge, and One Shot.

The *TimeSharing System (TSS)*, in connection with a DATANET front-end processor, provides timesharing computing services to multiple users at remote terminals. System resources allocated to timesharing can be dynamically varied under operator control. The timesharing executive, operating as a subexecutive under GCOS 8, suballocates storage and dispatches the processor to the programs of individual timesharing users. Timesharing on GCOS 8 utilizes the GCOS 8 memory architecture to permit any desired amount of system memory to be allocated to timesharing. A single copy of TSS can support up to 600 users, assuming sufficient memory, I/O, and communications facilities are provided. In multiple-processor systems, the timesharing users' programs can simultaneously use as many processors as necessary. A separately priced Multicopy Support Option allows from two to four copies of the timesharing executive to run on one GCOS 8 system, thereby increasing the number of users that can be supported.

GCOS timesharing users have a choice of six major programming languages: Cobol-74, Extended Basic, Pascal, TimeSharing Fortran-66, Fortran-77, and APL. Timesharing users can communicate directly with batch-mode facilities, permitting the development and testing of programs, data entry, control of batch program execution, and manipulation of results from remote terminals.

I-D-S/II provides the ability to interactively update and retrieve information from an I-D-S/II database. Access is a conversational file management system for creating, deleting, and maintaining catalogs and files and for assigning passwords and accessing criteria. The FDUMP facility can be used for inspection and maintenance of permanent files. The LODT routine permits execution of experimental user subsystems, including trace analysis and debugging of user programs from remote terminals. The TimeSharing Activity Report monitors the accumulated use of the timesharing system resources.

PROGRAM DEVELOPMENT: Bull offers a number of products for program development. Among the newest are Pacbase, an applications generator from CGI Systems Inc., and Pathvu and Retrofit, two program analysis and structuring tools from Catalist.

Pacbase uses a methodology based on computer-aided software engineering (CASE) to improve productivity in all phases of application development. The company claims the product should reduce system maintenance costs and the time required for software maintenance and development.

The product should also help reduce development backlogs and help companies better control corporate data.

Pathvu and *Retrofit* analyze and restructure existing Cobol programs, helping programmers maintain and enhance existing Cobol software. Pathvu does the analysis and generates reports tailored to the needs of a software management team. It follows the logic patterns in a program code, identifies "dead" code and logic flaws, and creates and maintains 43 separate statistics which are used to generate management, technical, and individual program reports.

Retrofit converts unstructured Cobol into PERFORM-based structured Cobol. It unscrambles convoluted logic, corrects structural flaws, assures consistency, and produces restructured programs that are functionally equivalent to the original program.

Other program development tools include the *Text Executive Processor (TEX)*, DM-IV Procedural Language Processor (PLP), the Transaction Application Test System (TATS), the Transaction Screen Management System (TSM), the DM-IV Query and Reporting Processor (QRP), and the Personal Computing Facility (PCF).

With the *Text Editor* users can create, format, maintain, and print text. *TEX* is an interpretive language that integrates the capabilities of the Text Editor with text processing, providing additional verbs and subroutine calls. The optional DM-IV Procedural Language Processor (PLP) is an extension of QRP which provides a high-level, procedure-oriented language for use by application and system programmers. When using the QRP end-user facilities, the user need not be concerned with the database structure or access methods.

Syntax Directed Editor (SDE) is a productivity tool designed to support the creation or modification of Cobol-74 programs. SDE reduces the amount of code that a programmer must enter and immediately checks for format and syntax errors.

System-80 is designed to reduce the time and effort of coding, maintenance, and documentation normally associated with Cobol program development. It interacts with the programmer to acquire needed information about files, fields, screen formats, and validations and edits.

Softool is a set of software tools designed for cost-effective management, development, and maintenance of application software. The Softool Development Environment Product Set offered by Bull consists of the Cobol Programming Environment (Cobol-74) and the Change and Configuration Control.

Simsript provides the user with a simulation-oriented language that permits the translation of complex mathematical and logical models into meaningful simulation sequences. It is an event-oriented language with a timing routine that allows the analysis of activities in a controlled sequence in simulated time.

The *General-Purpose Simulator System (GPSS)* is a simplified, simulation-oriented language that establishes mathematical models in order to provide results for further analysis.

The *General Macro Assembler Program (GMAP)* enables the programmer to code either in an open-ended macro language or directly in machine-oriented symbolic instructions.

The *Debug Support System (DSS)* supports batch or on-line debugging of user programs, and can trace programs, display memory contents, and modify memory locations. ►

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- Object-level debug can be performed with any language. Symbolic debug is supported by Cobol-85, Cobol-74, Fortran-77, and PL/1.

UTILITIES: System utilities include a Sort/Merge Facility, the File Generation Facility, FMS Utilities, Visual Information Display for Efficient Operation, Comprehensive System Utilities Facility, System Utility 8, General Loader, Bulk Media Conversion, and Source and Object Library Editor.

OTHER SOFTWARE: Bull groups its application programs into several overlapping "environments": end-user computing, (software) production, information management, communications and networking, administrative tools, and support applications.

A key software family in the end-user computing category is *Infoedge*, introduced with GCOS 8 SR3000. Serving experienced data processing professionals, technical end users, and non-data processing professionals, Infoedge includes a spreadsheet, a forms generator, and access to the relational database (Interel) data dictionary.

The *Infoedge-Personal Computing* facility, which interfaces with Interel, lets users create and maintain forms with variable text and results fields; it also supports data storage and retrieval functions, math and logic functions, editing and graphics, and an on-line HELP facility.

Infoedge decision-support facilities include Infoedge-Graph for interactive facilities and Infoedge-Financial Planner for financial modeling and business planning. Infoedge query facilities include Example Query, an end-user request facility; also Reporter, a facility for formatting data obtained from Example Query and SQL into report form. Workstation facilities include Infoedge-Mail, a distributed electronic message facility, and Infoedge-Meetings, a facility that permits authorized users to attend "meetings" through a terminal device.

Bull offers application programs that address Finance, Management Sciences, Manufacturing, Health Care, and Banking.

Magna 8 is Bull's fourth-generation language; it also provides transaction processing capabilities.

PRICING AND SUPPORT

POLICY: DPS 8000 equipment is available for purchase or for rental under a one-year or four-year lease.

SUPPORT: Bull offers several maintenance plans falling under basic hardware maintenance, extended maintenance coverage, and premium services. Basic monthly hardware maintenance provides contracted on-call remedial maintenance service during the Principal Period of Maintenance (PPM). PPM covers a period between 8 a.m. and 6 p.m., Monday through Friday, excluding holidays. Basic service includes toll-free access to the National Response Center, 24 hours a day, seven days a week, and remote mainframe maintenance access. Other features include the services of specialist personnel from the Technical Assistance Center, Customer Service Engineer visits when necessary, and remedial and preventive maintenance services.

Extended Maintenance service provides coverage for hours outside the PPM. Under this coverage plan, the user pays an additional charge which is a fixed percentage of the base maintenance charge. The percentage varies by day and number of extended hours beyond the regular maintenance period. Customers requesting service outside the PPM will be billed at published contract-customer hourly rates. The cur-

rent rate is \$159 per hour for all times Monday through Sunday. Customers who do not have a maintenance contract will be billed at a time and materials rate of \$185 per hour for a minimum of four hours.

Premium service provides maintenance coverage on a 24-hour, seven-day-per-week basis. Coverage includes guaranteed response time credits, preventive maintenance, equipment installation, field change order installation, and equipment malfunction protection credits.

System engineering falls into one of five billable support categories, as described in the following table. Field engineering managers are responsible for the degree of skill required to perform the job.

	Hourly Rates* (\$)	Monthly Rates (\$)
Principal or senior technical consultant	138	19,174
Project supervisor or technical consultant	112	15,653
Technical specialist	100	14,088
Systems analyst/senior programmer	85	11,739
Programmer	59	8,218

*Minimum four-hour charge, plus local/state taxes.

Hourly charges are for a four-hour minimum. The monthly rates do not include supplies.

GCOS 8 is delivered as two separate products. The Basic System is licensed at no separate charge to customers who acquired their central systems from Bull and for a separate license fee to customers who acquired their central systems from sources other than Bull. The GCOS Executive is separately licensed for the same tiered fee to all customers regardless of how they acquired their central system. All other facilities, such as job management, file systems, conversion aids, language processors, utilities, applications packages, communications software, system maintenance, and system performance analysis are separately priced.

The Bull TotalCare Software Services program provides users with a variety of standard and customized software support services ranging from onetime installation of operating system software to ongoing site management. Ongoing support is part of Basic and Expanded Services. Basic Support gives users access to Bull's National Response Center through a toll-free number 24 hours per day, seven days per week. A software specialist at a Bull Technical Assistance Center then tries to solve the problem. Expanded Service features on-site support in addition to on-line diagnostic facilities. Customized programs include start-up services, system techniques for on-site management, supplemental services, and system services. TotalCare charges include some fixed pricing based on the amount of software a company uses. Other charges are quoted individually, depending on the site and specific needs.

EDUCATION: Education services include standard courses, advanced professional training, multimedia self-instruction courses permitting customers to self-train as often as needed, site surveys to determine educational requirements, on-site classes, and clustered on-site classes to accommodate a group of users from an area.

TYPICAL CONFIGURATIONS: Sample configurations for the DPS 8000 Series are shown below. Detailed equipment and selected software prices follow these configurations. ►

Bull DPS 8000 Series

► **SMALL CONFIGURATION:**

DPS 8000/41:	\$ 450,000
Central System Complex includes CPU, 16 megabytes of main memory, one system control unit, one input/output processor with 16 channels, one system console, one maintenance unit, and one modem	
60 BDS 5 Terminals	59,700
One MSP3880 Mass Storage Processor	62,850
One MSU3380 Head of String Mass Storage Unit	82,800
Three MSU3382 Mass Storage Slave Units	177,000
One MTS8206 Magnetic Tape Subsystem	45,000
Seven MTU8206 tape units; 125 ips, 1600/6250 bpi	129,500
One MTF8200 1 x 8 switch	No charge
One URP8602 Embedded Unit Record Processor	4,500
Two 1203 high-speed belt printers	76,550
TOTAL PURCHASE PRICE:	\$1,087,900

LARGE CONFIGURATION:

DPS 8000/84:	\$2,370,000
Central System Complex includes four CPUs, 32 megabytes of main memory, two system control units, four input/output processors with 64 channels, two system consoles, two maintenance units, and two modems	
Additional 32M of Main Memory	240,000
200 BDS 5 Terminals	199,000
Two MSP3992 Mass Storage Processors, four-path	260,000
Four MSU3391 Head of String Mass Storage Units	512,000
Twelve MSU3393 Mass Storage Slave Units	1,266,000
Two MTS8206 Magnetic Tape Subsystems	90,000
Fourteen MTU8206 tape units; 125 ips, 1600/6250 bpi	259,000
Two CTS8500 Cartridge Tape Subsystems	193,540
Six CTU8500 tape units; 79 ips, 38K bytes/in	239,040
One MTF8201 2 x 8 switch	6,130
One URP8602 Embedded Unit Record Processor	4,500
One 1203 high-speed belt printer	38,275
One 1600 high-speed belt printer	64,940
TOTAL PURCHASE PRICE:	\$5,742,425

EQUIPMENT PRICES

		Purch. Price (\$)	Monthly Maint. (\$)	1-Year Lease (\$)	4-Year Lease (\$)
PROCESSORS					
CPS8641	DPS 8000/41 Central System Complex includes one CPU, 16 megabytes of main memory, one Input/Output Processor (IOP) with 16 physical channels, one System Console with large screen monitor interface, 14-inch CRT, Keyboard, one Service Processor w/related storage devices, one Monitor, and one Modem	450,000	650	30,000	22,500
CPS8681	DPS 8000/81 Central System Complex includes one CPU, 16 megabytes of main memory, one Input/Output Processor (IOP) with 16 physical channels, one System Console with large screen monitor interface, 14-inch CRT, Keyboard, one Service Processor w/related storage devices, one Monitor, and one Modem	675,000	850	45,000	33,750
CPS8682	DPS 8000/82 fully redundant System Complex includes two CPUs; two System Control Units each with 16 megabytes of main memory; two IOPs each with 16 physical channels; two System Consoles with large-screen interfaces, 14-inch CRTs, keyboard, and IOP connections; two Service Processors, two Modems	1,300,000	1,600	87,850	65,000
CPS8683	DPS 8000/83 fully redundant System Complex features three CPUs; two System Control Units each with 16 megabytes of main memory; three IOPs each with 16 physical channels; two System Consoles with large-screen interfaces, 14-inch CRTs, keyboard, and IOP connections; two Service Processors, two Modems	1,835,000	2,150	122,300	91,750
CPS8684	DPS 8000/84 fully redundant System Complex features four CPUs; two System Control Units each with 16 megabytes of main memory; four IOPs each with 16 physical channels; two System Consoles with large-screen interfaces, 14-inch CRTs, keyboard, and IOP connections; two Service Processors, two Modems	2,370,000	2,700	158,700	118,500

NA—Not applicable.
NC—No separate charge.
NS—Information not supplied by vendor.

Bull DPS 8000 Series

		Purch. Price (\$)	Monthly Maint. (\$)	1-Year Lease (\$)	4-Year Lease (\$)
System Upgrades:					
CPK8641	DPS 8000/41 to DPS 8000/81	225,000	200	15,000	11,250
CPK8681	DPS 8000/81 to DPS 8000/82	675,000	750	45,000	33,750
CPK8682	DPS 8000/82 to DPS 8000/83	535,000	550	35,700	26,750
CPK8683	DPS 8000/83 to DPS 8000/84	535,000	550	35,700	26,750
CMM8601	Additional 16 megabytes of memory	120,000	210	8,000	6,000

		Purch. Price (\$)	Monthly Maint. (\$)	1-Year Lease (\$)	4-Year Lease (\$)
System Consoles and Console Options:					
CSU8600	Additional System Console	10,000	50	480	400
CSF8600	Optional printer for system console; 100 characters per second	1,225	50	121	103
CSF8603	Optional Printer Pedestal for CSF8600	395	NA	NA	NA
CSF8601	Optional 23-inch Large Screen Monitor for System Console	2,358	16	157	135
CSF8602	Optional Ceiling Mount for CSF8601	195	NA	NA	NA

RELATIONAL DATA BASE COMPUTERS

CPS8002	Relational DBC for DPS 8000	365,000	1,125	24,350	18,250
HE8016	Required service package for Relational DBC; onetime charge for 12 months, non-renewable	81,000	NA	NA	NA
HIP8002	Host Interface Processor	53,300	170	3,550	2,665
MXF8017	DPS 8000 Connection Exchange Feature	15,000	130	1,000	750

MASS STORAGE

MSP3882	3880 Mass Storage Subsystem includes mass storage processor; two-channel, FIPS-compliant system supports up to two MSU3380/81s and six MSU3382/83s	62,850	200	3,740	3,185
MSP3886	3880 Mass Storage Subsystem includes mass storage processor; four-channel, FIPS-compliant system supports up to two MSU3380/81s and six MSU3382/83s	74,700	224	4,435	3,785
MSP0611	Freestanding Single-Channel Mass Storage Processor	50,000	165	1,828	1,507
MSP0612	Freestanding Dual Channel Mass Storage Processor	64,375	227	2,133	1,761
MSK0612	Upgrade Kit, MSP0611 to an MSP0612	23,000	82	861	711
PSS8001	Capacitor Ridethrough Option for MSP0611, 0612	3,120	17	124	104
MSP3991	Mass Storage Processor, two-channel, two-path; includes two storage directors, each with one Primary General Disk Channel Connection to DPS 8000	70,000	210	4,667	3,500
MSF3991	Two additional Switched General Disk Channel Connections for MSP3991	15,000	24	1,000	750
MSP3992	Mass Storage Processor, four-channel, four-path; includes four storage directors, each with one Primary General Disk Channel Connection to DPS 8000	130,000	420	8,667	6,500
MSK3390	Upgrade kit from MSU3390 to MSU3391	59,900	NC	3,993	2,995
MSK3392	Upgrade kit from MSU3392 to MSU3393	59,900	NC	3,993	2,995
MSK8082	Upgrade kit from MSF8080 to MSS8080	29,600	98	1,850	1,480
MSK3991	Upgrade from MSP3991 to MSP3992	60,000	210	4,000	3,000
MSF3992	Four additional Switched General Disk Channel Connections for MSP3992	30,000	48	2,000	1,500

Mass Storage Units:

MSU3380	Head of String Mass Storage Unit; includes four actuators	82,000	295	4,065	3,460
MSU3381	Mass Storage Unit; head-of-string double-capacity system provides 3.697 gigabytes of formatted capacity	113,000	295	6,035	5,525
MSU3382	Mass Storage Slave Unit; includes four actuators	59,000	215	2,950	2,515
MSU3383	Mass Storage Unit, secondary double-capacity system; up to three may be added to each MSU3380/3381	90,000	215	4,845	4,420
MSU3390	Head of String Mass Storage Unit; includes two string controllers, two HDAs, and four actuators; provides 1.848 gigabytes of formatted capacity at 512K words/sector	81,700	257	5,447	4,085
MSU3391	Head of String Mass Storage Unit; includes two string controllers, two HDAs, and four actuators; provides 5.369 gigabytes of formatted capacity at 512K words/sector	128,000	275	8,533	6,400
MSU3392	Mass Storage Slave Unit; includes two additional HDAs and four actuators; provides 1.848 gigabytes; up to three may be added to each MSU 3390	59,300	165	3,953	2,965
MSU3393	Mass Storage Slave Unit; includes two additional HDAs and four actuators; provides 5.369 gigabytes; up to three may be added to each MSU 3390	105,500	165	7,033	5,275
MSU0500	Dual Fixed Disk Mass Storage Unit, 626 megabytes of capacity	38,850	238	1,412	1,180
MSU0501	Dual Fixed Disk Mass Storage Unit; 1101 megabytes of capacity	43,850	273	1,777	1,482
MSK0501	Upgrade kit; MSU0500 to MSU0501	5,000	31	361	297
MSF0011	Dual Access Feature for MSU0501/0500	4,140	27	163	136
MSA 1141	Unit Addressing for up to two MSU05xx Units for MSP0611/0612	3,500	22	220	181
MSA 1143	Dual Addressing for up to two MSU05xx Units	4,500	24	216	178
MSF0500	Spare Head Disk Assembly for MSU0500	12,340	NA	NA	NA
MSF0501	Spare Head Disk Assembly for MSU0501	15,808	NA	NA	NA
MSF 1142	Unit expansion for configuring additional MSU05xx devices (max 7) to MSP0612	4,000	NA	125	NA
MSF 1143	Nonsimultaneous (Switched) Datanet Channel for MSP0611/0612	8,237	21	284	234

NA—Not applicable.

NC—No separate charge.

NS—Information not supplied by vendor.

Bull DPS 8000 Series

		<u>Purch. Price (\$)</u>	<u>Monthly Maint. (\$)</u>	<u>1-Year Lease (\$)</u>	<u>4-Year Lease (\$)</u>
Mass Storage Units (Continued)					
MSF1150	Second Nonsimultaneous (Switched) Datanet Channel for MSP0611/0612	8,237	19	283	233
MSF8030	Primary Disk Channel Connection Feature for MSP8021/22/23; each connection feature provides one IOP channel, cables, and associated interface logic in the mass storage processor	6,000	10	360	305
MSF8031	Switched Disk Channel Connection Feature for MSP8021/22/23; each connection feature provides one IOP channel, cables, and associated interface logic in the mass storage processor	4,850	8	290	245
MSF3882	Upgrade from MSP3882 to MSP3886; upgrade kit includes two switched general disk channel connections to the IOP	11,850	24	780	685

Mass Storage Exchange Features:

MXF8636	Channel Exchange Feature for MSP3880	18,350	NA	NA	NA
MXF8638	Channel Exchange Feature for MSP3884	36,700	NA	NA	NA

MAGNETIC TAPE SUBSYSTEMS

CTS8500	Cartridge Tape Subsystem including one single-channel tape processor and one two-drive CTU8500 cartridge tape unit (CTU); supports up to four CTUs	96,770	706	6,048	4,839
CTU8500	Cartridge Tape Unit with two drives, using standard 18-track cartridges with 200MB nominal capacity	39,840	271	2,490	1,992
CTF8501	Cartridge Loader for CTU8500 (supports both drives); supports automatic or programmable loading/unloading	8,225	41	514	411
CTF8500	Crossbar 2 x 16 option connects two Cartridge Tape Subsystems and allows each to access the other's cartridge tape units.	8,000	NA	NA	NA
CTF8502	Nonsimultaneous Channel Connection provides one extra channel connection	7,500	22	468	375
MTS8205	Magnetic Tape Subsystem; includes tape processor, one MTU8205 tape unit, and one IOP channel	48,000	410	2,913	2,516
MTS8225	Magnetic Tape Subsystem; FIPS-compliant, 125 inches per second (ips), 800/1600 bits per inch (bpi) supports up to eight tape devices and requires either MTF8200 or MTF8201	48,000	410	2,913	2,516
MTS8226	Magnetic Tape Subsystem; FIPS-compliant, 125 ips, 1600/6250 bpi supports up to eight tape devices and requires either MTF8200 or MTF8201	45,000	410	2,774	2,395
MTS8228	Magnetic Tape Subsystem; FIPS-compliant, 200 ips, 1600/6250 bpi supports up to eight tape devices and requires either MTF8200 or MTF8201	47,000	515	2,876	2,484
MTP0611	Magnetic Tape Processor for MTU0610/0630; supports up to eight tape units	29,400	239	1,093	918
MTF8030	Primary Tape Channel Connection Feature for MTP8021/8022/8023; each connection feature provides one IOP channel, cables, and associated interface logic in the magnetic tape processor	5,000	9	300	225
MTF8031	Switched General Tape Channel Connection Feature for MTP8021/8022/8023	4,850	8	290	245
MTF8209	Switched General Tape Channel Connection for MTS8225/26/28	8,000	12	421	364
MTF8201	Magnetic Tape Subsystem 2 x 8 Switch	6,130	14	323	279

Magnetic Tape Units:

MTU8205	Magnetic Tape Unit; 125 ips, 800/1600 bpi	19,050	240	1,038	897
MTU8206	Magnetic Tape Unit; 125 ips, 1600/6250 bpi	18,500	240	1,061	916
MTU8208	Magnetic Tape Unit; 200 ips, 1600/6250 bpi	21,000	342	1,163	1,005
MTU0630	Magnetic Tape Unit	14,815	202	604	516

Features for the MTU0630:

MTF0634	75 ips, PE/NRZI feature, 800/1600 bpi	4,725	189	297	268
MTF0635	75 ips, PE/GCR feature, 1600/6250 bpi	7,110	162	351	309
MTF0636	125 ips, PE/NRZI feature, 800/1600 bpi	9,805	213	472	410
MTF0637	125 ips, PE/GCR feature, 1600/6250 bpi	10,330	186	470	408
MTK0630	Performance upgrade MTF0634 to MTF0635	2,385	26	76	61
MTK0631	Performance upgrade MTF0636 to MTF0637	1,700	34	57	47
MTK0632	Performance upgrade MTF0634 to MTF0636	5,080	26	176	146
MTK0633	Performance upgrade MTF0635 to MTF0637	3,220	26	121	101
MTK0634	High Altitude Adapter	240	NA	8	6

Magnetic Tape Channel Exchange Features:

MXF8616	Channel Exchange Feature for MTP0610; each exchange feature provides one IOP channel connection to connect tape processor that was previously attached to a Level 66 or DPS 8 system to a DPS 8000 system	5,000	NA	NA	NA
MXF8618	Channel Exchange Feature for MTP0611 Magnetic Tape Processor; provides one IOP channel connection to connect existing processor previously attached to a Level 66 or DPS 8 to a DPS 8000 system	5,000	NA	NA	NA

NA—Not applicable.

NC—No separate charge.

NS—Information not supplied by vendor.

Bull DPS 8000 Series



		Purch. Price (\$)	Monthly Maint. (\$)	1-Year Lease (\$)	4-Year Lease (\$)
Features for the MTU0630 (Continued)					
MXF8620	Channel Exchange Feature for MTF8012/8013/8016/8017 channel connections; provides one IOP channel connection to attach existing systems previously connected to a Level 66 or DPS 8 to a DPS 8000 system	5,000	NA	NA	NA
MXF8634	Channel Exchange Feature for MTS8205/8206/8208 and MTF8202; provides one IOP channel connection to attach existing system previously attached to a DPS 8 to a DPS 8000 system	9,175	NA	NA	NA
LINE PRINTERS					
PRU0903	High-speed belt printer; 900 lpm	34,975	498	2,097	1,752
PRU1203	High-speed belt printer; 1200 lpm	38,275	553	2,375	1,955
PRU1600	High-speed belt printer; 1600 lpm, 136 print positions	64,940	639	2,953	2,515
PRK0903	Upgrade PRU903 to PRU1203	5,000	59	304	229
PRK0907	Exchange of PDSI to DAI interface for 0903.1203; includes control panel	3,000	NA	NA	NA
PRU1600 Options:					
PRB0500	63-character OCR-B Print Belt	2,460	122	186	171
PRB0524	63 character OCR A/B Print Belt	2,460	122	186	171
PRB0532	63-character Puerto Rico Print Belt	2,460	127	186	171
PRB0549	63-character OCR-A Alphanumeric Print Belt	2,460	122	186	171
PRB0600	94-character ASCII Belt; upper-/lowercase	2,567	122	191	173
PRF0022	24 additional print positions; 136 to 160	2,610	22	113	94
UNIT RECORD PROCESSORS					
URP8600	Embedded Unit Record Processor; supports up to two CRU0501/1050, PCU0120/0121, or CCU0401 card units	4,500	8	300	225
URP8601	Embedded Unit Record Processor; supports up to two PRU0903/0901/1201/1203 printers	4,500	8	300	225
URP8602	Embedded Unit Record Processor; supports up to two PRU1200/1600 printers	4,500	8	300	225
PUNCH CARD EQUIPMENT					
CRU0501	Card Reader (500 cpm); requires URA0056	19,500	148	694	578
TERMINALS					
BDS 5	Asynchronous display terminal	995	6	NS	NS
BDS 7	Synchronous display terminal	1,200	8	NS	NS
DATANET 8 SERIES NETWORK PROCESSORS AND OPTIONS					
DCU8110	DATANET 8/10 Network Processor system with 1MB of memory expandable to 2MB; supports a maximum of 31 data communications ports and includes 3 RS-232-C/V.24 asynchronous/character synchronous ports	23,900	130	1,195	795
DCU8120	DATANET 8/20 Network Processor system with cache memory, 1MB of memory expandable to 2MB. System is upgradable to dual-processor system with dual-cache memory; supports 31 data communications ports extendable to 127 ports, and includes 3 RS-232-C/V.24 asynchronous/char. synchronous ports	38,000	215	1,900	1,275
DCU8130	DATANET 8/30 Network Processor system with cache memory and 2MB of memory expandable to 4MB. System is upgradable to dual-processor system with dual-cache memory; supports 159 data comm. ports expandable to 255 ports, and includes 3 RS-232-C/V.24 asynchronous/char. synchronous ports	80,000	350	4,000	2,675
DATANET OPTIONS					
OPTIONS FOR THE DATANET 8/10 ONLY:					
DCM8110	One-megabyte Memory Expansion Module	7,000	50	350	230
OPTIONS FOR DATANET 8/20 ONLY:					
DCP8120	Extended Performance Option; includes second processor and associated cache memory	14,000	115	700	475
DCM8120	One-megabyte Memory Expansion Module	7,000	50	350	235
DCE8121	First Line Expansion Module; provides support for up to 32 additional data communications ports (max. 63 ports per DATANET 8/20)	2,500	5	125	85
DCE8122	Second Line Expansion Module; provides support for up to 64 additional data communications ports (max. 127 ports per DATANET 8/20); requires DCM8120 and DCE8121	5,000	10	250	170

NA—Not applicable.

NC—No separate charge.

NS—Information not supplied by vendor.



Bull DPS 8000 Series



<u>Purch. Price (\$)</u>	<u>Monthly Maint. (\$)</u>	<u>1-Year Lease (\$)</u>	<u>4-Year Lease (\$)</u>
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DATANET OPTIONS (Continued)

OPTIONS FOR DATANET 8/30 ONLY:

DCP8130	Extended Performance Option; includes second processor and associated cache memory	27,000	220	1,350	900
DCM8130	Two-megabyte Memory Expansion Module	14,000	100	700	470
DCE8131	Line Expansion Module; provides support for up to 96 additional data communications ports (max. 255 ports per DATANET 8/30); requires DCM8130	7,500	15	375	250

OPTIONS FOR DATANET 8/10, 8/20, AND 8/30:

DCF8002	Video Display Terminal Console, 24-by-80 character screen; one required for each DATANET 8/10, 8/20, or 8/30	795	20	40	30
DCF8003	Hard Copy Console Receive Only Printer (100 cps); one required for each system that uses DATANET 8, 8/10, 8/20, or 8/30 Network Processors	1,195	22	60	40
DCF8052	Multiline Communications Controller-16 (MLC-16) accommodates up to four Communications Interface Adapters; maximum of 16 data communications ports per MLC-16	2,700	15	135	90

LOW- AND MEDIUM-SPEED OPTIONS:

DCF8073	RS-232-C Asynchronous/Character Synchronous Integrated Communications Interface Adapter with four RS-232-C/V.24 data communications ports; includes four 50-ft. cables. Maximum port speed is 19.2K bps	2,000	16	100	70
DCF8049	RS-232-C Bit Synchronous HDLC Integrated Communications Interface Adapter with two RS-232-C/V.24 data communications ports; includes two 50-ft. cables. Maximum port speed is 19.2K bps	3,200	26	160	110
DCF8053	Low- and Medium-Speed Asynchronous/Character Synchronous Communications Interface Adapter; accommodates up to four Line Interface Module Connections; any combination of DCF8055, DCF8057, and DCF8059 is allowed	1,000	7	50	35

MEDIUM- AND HIGH-SPEED OPTIONS:

DCF8061	Medium- and High-Speed Character Synchronous or Bit Synchronous Communications Interface Adapter accommodates one Line Interface Module Connection (DCF8062, DCF8063, DCF8064, DCF8065, DCF8067, DCF8069, or DCF8071)	2,200	16	110	75
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NETWORK PROCESSOR CHANNEL CONNECTIONS

DCE8020	Datanet 8 Network Processor Channel Connection Feature; each connection feature provides one IOP channel, cables, and associated interface in Datanet 8/10	8,000	72	346	295
DCE8119	Datanet 8/10, 8/20, 8/30 Network Processor Channel Connection Feature; provides one IOP channel, cables, and associated interface in the Datanet systems	8,000	72	346	295

Network Processor Channel Exchange Features:

MXF8628	Channel Exchange Feature for Datanet 8 and PPS	3,500	NA	NA	NA
MXF8641	Channel Exchange Feature for Datanet 8/10, 8/20, and 8/30	3,500	NA	NA	NA

Hyperchannel Connections:

MXF8640	DPS 8000 Series Hyperchannel Connection Feature A161	14,000	111	1,111	745
MXF8632	DPS 8000 System Channel Exchange Feature for connecting existing A161 Hyperchannel Subsystem previously attached to a Level 66 or DPS 8 to an IOP	5,300	NA	NA	NA
MXF8639	Power Sequence for FIPS channel/subsystem	3,200	5	200	149

NA—Not applicable.

NC—No separate charge.

NS—Information not supplied by vendor.



Bull DPS 8000 Series



SOFTWARE PRICES

		Monthly License Fee (\$)	Ex- panded Support Charge (\$)	Initial License Fee (\$)	License Orig. Fee (\$)	Annual Basic Support (\$)
GCOS 8 SYSTEM RELEASE 3000						
Operating System Executive:						
SVS8053	GCOS 8 Operating System Executive; includes RADS (software disk cache), Console Manager, and Console Journal	2,800	NA	NA	8,000	NC
SVS8050	GCOS 8 Basic System	NS	NA	NA	NC	NC
SVS8073	Transaction Processor 8 (TP 8) for DPS 8000	1,800	270	NA	4,000	NC
Operating System Extensions:						
SVS8038	GCOS 8 System Security Manager	750	105	NA	2,500	NC
SVP8081T	Comprehensive System Maintenance Facility	473	58	NA	NA	NC
SVE8000	FMS Catalog Cache Facility	105	17	NA	NA	NC
SVE8001	FMS Test Access Facility	103	11	NA	NA	NC
SVE8002	Password Encryption Facility	71	6	NA	NA	NC
SVE8039	NP Operator Console	53	6	NA	NA	NC
SVE8050	Relational DBC Host Executive Facility	475	125	NA	NA	NC
SVE8059T	Report Distribution Facility (RDF)	1,032	NA	20,600	NA	3,000
SVE8060T	Online SYSOUT Collection and Retrieval (OSCAR)	576	NA	18,000	1,440	3,000
SVP8001	Software Management Facility	100	16	NA	NA	NC
SVS8014	Six Processor Support	115	15	NA	NA	NC
Operating Systems Utilities:						
SNU0471	PPS Utilities	53	6	NA	NA	NC
SVU8001	File Generation Facility	74	5	NA	NA	NC
SVJ8000	Parametric JCL	NA	NA	NA	NA	NC
SVU8018	VIDEO	32	5	NA	NA	NC
SVU8025	Comp System Utility Facility	222	30	NA	NA	NC
SVU8026	UTL8	221	28	NA	NA	NC
System Administration:						
SVE8043T	HAPS 8 Basic System	850	NS	20,000	NA	3,000
SVU8041T	Tape Management System	675	NA	22,000	NA	2,600
SVU8016	Mass Store I/O Analyzer	NA	NA	2,500	NA	105
SVU8022	FACTS	NA	NA	14,500	NA	2,284
SVU8023	SARA	NA	NA	14,800	NA	2,730
SVU8024	TRS	NA	NA	6,950	NA	1,097
Data Management Facilities:						
SVD8000	DM-IV Standard Facility	1,286	226	NA	NA	NC
SVD8001	DM-IV Fortran Subschema Trans.	148	13	NA	NA	NC
SVD8002	I-D-S/I Facility	2,233	152	NA	NA	NC
SVD8003	Index Sequential Processing Facility	60	9	NA	NA	NC
SVD8011	Multicopy DM-IV/TP Concurrency	488	41	NA	NA	NC
SVD8067	Interrel for DPS 8000	1,500	210	NA	9,800	NC
SVU8004T	Comprehensive Archival System	665	NA	16,000	NA	1,920
SVU8058	Performance Utilization System Monitor for DPS 8000	499	NA	NA	1,200	68
SNS8000T	Relational DBC Executive	2,175	NA	NA	8,700	NC
SVP8053	Relational DBC Administration Facility	600	150	NA	NA	NC

NA—Not applicable.

NC—No separate charge.

NS—Information not supplied by vendor. ■