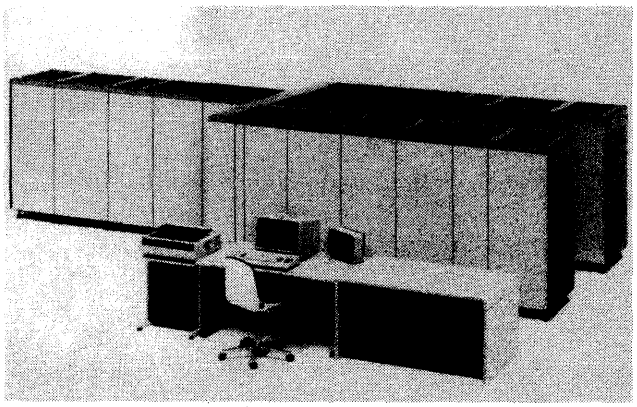
Siemens 7.800 Series



Pictured is the Siemens 7.890. The 7.800 Series compete with the IBM 4300 and 30XX Series. Main memory ranges from 12 to 32 megabytes.

The Siemens 7.800 series systems, now comprising 13 models, are IBM plug compatible machines designed to compete with the IBM range stretching from the larger 4300 models to the 30XX mainframes. They are all based on Fujitsu products.

MODELS: Siemens 7.865–2, 7.865–3, 7.870–2, 7.872–2, 7.875–2, 7.880–2, 7.881–2, 7.882–2, 7.890D, 7.890E, 7.890F, 7.890L and 7.890S.
CONFIGURATIONS: Single and dual processor systems with main memories ranging from 4 to 128M bytes and from 6 to 64 input/output channels.
COMPETITION: IBM 4300 and 30XX series; BASF 7/7X and 7/8X systems; Amdahl 5800 series; NAS 6000, 8000 and 9000 systems; ICL Atlas 10 models.
PRICE: The entry level model, namely the 7.865–2, costs approximately DM 880,000; the top model of the series, the 7.890S, is priced from DM 13,000,000.

MANAGEMENT SUMMARY

Since its introduction in October 1978, the Siemens 7.800 series, based on Fujitsu models, has undergone rapid expansion both to keep pace with IBM models, with which its machines are plug-compatible, and to keep abreast of other PCMs (Plug-Compatible Manufacturers) who offer similar Fujitsu based systems (ICL with the Atlas 10, Amdahl with various models) or Hitachi based machines (BASF, Olivetti and NAS).

The Siemens range was introduced in three phases. The first coincided with the announcement in 1978 of the 7.870, 7.872, 7.880 and 7.882 designed to match the then existing IBM 303X models. A less powerful entry level model, the 7.865 was announced in February 1980.

The second date of note was January 1981, when Siemens, anticipating the arrival of the IBM 4341–2, the 3033S, 3033N and 3081, launched the 7.875–2 and 7.881–2 and restructured coincidentally the entire product line. This resulted in the current designators, namely, 7.865–2, 7.870–2, 7.872–2, 7.880–2, 7.881–2 and 7.882–2, with the suffix 2 implying larger memories. All these models use 64K-bit chips. The 7.865–3 is an upgraded version of the 7.865–2, offering a 25% increase in processor performance.

The third phase was announced in mid-August 1982, when Siemens introduced its models in the renamed 7.890 family, designated D, E, F, L and S. The entry level to this part of the 7.800 series is the 7.890D and the top model is the 7.890S. These machines replace the previously introduced 7.890 series with the old 7.890 becoming the 7.890F.

The 7.890 family is extremely powerful with the 7.890E being just below the IBM 3081K in performance, and the top model, the 7.890S, comparable to the recently launched IBM quadriprocessor, the 3084Q.

CHARACTERISTICS

SUPPLIER: Siemens Aktiengellschaft, Bereich Datenverarbeitung. Otto-Hahn-Ring 6, Postfach 83 29 40. 8000 Munich 83, West Germany. Telephone (089) 636–1. Telex 528 801.

MANUFACTURER: Fujitsu Ltd., 6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan 100. Telephone (03) 216–3211.

MODELS: Systems 7.865–2, 7.865–3, 7.870–2, 7.872–2, 7.875–2, 7.880–2, 7.881–2, 7.882–2, 7.890D, 7.890E, 7.890F, 7.890L, 7.890S.

DATA FORMATS

BASIC UNIT: The 8-bit byte. Each byte can represent 1 alphanumeric character or 2 BCD digits. Two bytes represent a half-word, 4 bytes a word, and 8 bytes of double-word.

FIXED POINT OPERANDS: A half-word can represent a 15-bit signed integer, a word can represent a 31-bit signed integer.

FLOATING POINT OPERANDS: A word is used to represent a signed, short floating point number with a 7-bit characteristic and a 24-bit mantissa. A signed, long floating point number can be represented in a double-word with a 7-bit characteristic and a 56-bit mantissa. For extended floating point representation, two 64-bit double-words are used to provide a 7-bit characteristic and a 112-bit mantissa.

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TABLE 1. CHARACTERISTICS OF SIEMENS 7.800 SERIES

MODEL	7.865-2	7.865-3	7.870-2	7.872-2
SYSTEM CHARACTERISTICS				
Date of introduction	Jan. 1981	July 1982	Jan. 1981	Jan. 1981
Date of first delivery	May 1981	Oct. 1982	May 1981	May 1981
Number of central processors	1	1	1	2
Principal operating systems	BS3000/OS/VS1/MVS/VM/370			
Purchase price, entry system (CPU)	DM 880,000	DM 1,139,000	DM 1,380,000	DM 2,354,000
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Read cycle time, nanoseconds	—	—	—	—
Write cycle time, nanoseconds	—	—	—	—
Bytes fetched per cycle	8	8	8	8
Storage interleaving	4-way	4-way	4-way	4-way
Minimum capacity, megabytes	4	8	4	8
Maximum capacity, megabytes	12	16	12	16
Increment size, megabytes	4	4	4	4
Error correcting memory	Standard	Standard	Standard	Standard
BUFFER STORAGE				
Cycle time, nanoseconds	70	59	59	59
Bytes fetched per cycle	32	32	32	32
Capacity, bytes	8,192	8,192	32,768	2 x 32,768
Time to fetch 8 bytes, nanoseconds	—	—	—	—
RELOADABLE CONTROL STORAGE				
Capacity	8,192 96-bit words per CPU	8,192 96-bit words per CPU	8,192 96-bit words per CPU	8,192 96-bit words per CPU
PROCESSING UNIT				
Machine cycle time, nanoseconds	70	59	59	59
Relative performance level (est)	1.0	1.25	1.5	2.5
Instruction prefetching	Standard	Standard	Standard	Standard
Processing unit features				
Clock Comparator and CPU Timer	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard
Floating-Point	Standard	Standard	Standard	Standard
Direct Control	Standard	Standard	Standard	Standard
Instruction Retry Hardware	Standard	Standard	Standard	Standard
Multiprocessor systems				
Tightly coupled	—	—	—	Yes
Loosely coupled	—	—	—	Yes
Attached processor system	No	No	No	No
Integrated storage control	Optional	Optional	Optional	Optional
I/O CONTROL				
Integrated channels, standard	6	6	6	12
Integrated channels, optional	4	4	6	12
Selector channels	None	None	None	None
Data rates, bytes per second				
Byte multiplexer	40K/200K	40K/200K	40K/200K	40K/200K
Block multiplexer	2000K/3000K	2000K/3000K	2000K/3000K	2000K/3000K
Maximum I/O data rate, bytes/second	14,000K	14,000K	14,000K	28,000K

One of the most significant aspects of all the models in this Siemens 7.800 range is the software. Siemens has not set out to track IBM's offerings in this area exactly, but to enable users to transfer from IBM to Siemens with relatively little overhead in software changes. Thus, transfers to Siemens will find that they can apply MVS/OS/VM operating systems and Siemens BS3000 operating system which provide a functional equivalent of IBM's OS/VS2 (MVS). All 7.800 models can be operated under BS3000, MVS/SP1 and VM, but the 7.890 models, in due course, will be able to use MVS/SP2.

INSTRUCTIONS: System 7.800 processors have a superset of the IBM System/370 instruction set. The additional instructions are hardware-implemented machine instructions that combine the functions of a number of instructions to reduce overhead. Models 7.865-2 and 7.865-3 have 189 instructions; models 7.870-2 and 7.872-2 have 193 instructions; and models 7.875-2, 7.880-2, 7.881-2 and 7.882-2 have 195 instructions, as do the 7.890 models.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

STORAGE TYPE: N-MOS semiconductor memory composed of 64K-bit chips is used for all models.

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TABLE 2. CHARACTERISTICS OF SIEMENS 7.800 SERIES

MODEL	7.875-2	7.880-2	7.881-2	7.882-2
SYSTEM CHARACTERISTICS				
Date of introduction	Jan. 1981	Jan. 1981	Jan. 1981	Jan. 1981
Date of first delivery	June 1981	June 1981	June 1981	June 1981
Number of central processors	1	1	2	2
Principal operating systems		BS3000/OS/VS1/MVS/VM/370		
Production status	New	New	New	New
Purchase price, entry system (CPU)	DM 3,193,060	DM 4,124,660	DM 5,969,760	DM 8,054,320
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Read cycle time, nanoseconds	—	—	—	—
Write cycle time, nanoseconds	—	—	—	—
Bytes fetched per cycle	8	8	8	8
Storage interleaving	3 x 16 max.	4 x 16 max.	4 x 16 max.	8 x 16 max.
Minimum capacity, megabytes	8	8	8	8
Maximum capacity, megabytes	24	32	32	64
Increment size, megabytes	4/8	4/8	4/8	4/8/16
Error correcting memory	Standard	Standard	Standard	Standard
BUFFER STORAGE				
Cycle time, nanoseconds	26	26	26	26
Bytes fetched per cycle	32	32	32	32
Capacity, bytes	32,768	64	2 x 64	2 x 64
Time to fetch 8 bytes, nanoseconds	—	—	—	—
PROCESSING UNIT				
Machine cycle time, nanoseconds	26	26	26	26
Relative performance level (est)	2.3	3.3	5.4	5.4
Instruction prefetching	Standard	Standard	Standard	Standard
Processing unit features				
Clock Comparator and CPU Timer	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard
Floating-Point	Standard	Standard	Standard	Standard
Direct Control	Standard	Standard	Standard	Standard
Instruction Retry Hardware	Standard	Standard	Standard	Standard
Multiprocessor systems				
Tightly coupled	No	No	Yes	Yes
Loosely coupled	No	No	Yes	Yes
Attached processor system	No	No	No	No
Integrated storage control	No	No	No	No
I/O CONTROL				
Integrated channels, standard	8	12	24	24
Integrated channels, optional	8	4	8	8
Selector channels	None	None	None	None
Data rates, bytes per second				
Byte multiplexer	110K/1600K	110K/1600K	110K/1600K	110K/1600K
Block multiplexer	2000K/3000K	2000K/3000K	2000K/3000K	2000K/3000K
Maximum I/O data rate, bytes/second	20,000K	20,000K	20,000K	20,000K

There are effectively three sub-ranges within the 7.800 series. Within a sub-range one machine can be field upgraded to another, but this is not the case from one sub-range to another. The first sub-range comprises models 7.865-2, 7.865-3, 7.870-2 and 7.872-2. The second sub-range consists of models 7.875-2, 7.880-2, 7.881-2 and 7.882-2. The architecture of the 7.865-2 sub-series is different from that of the 7.875-2 models. The 7.875-2 architecture is similar to that of the third sub-range, the 7.890 systems, which comprise models D, E, F, L and S. These are the most recently introduced models of the 7.800 and by far the most powerful.

CAPACITY: See Characteristics Table.

CYCLE TIME: See Characteristics Table.

CHECKING: Error detection and single-bit-error correction are standard on all models. If an error is detected and corrected during a data transfer from main memory to the buffer memory, the corrected data is then automatically written back to main memory to eliminate the error.

STORAGE PROTECTION: Each 2K block of memory has a 7-bit key that includes a 4-bit access code, a reference bit, an alteration bit, and a write-protection bit.

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TABLE 3. CHARACTERISTICS OF SIEMENS 7.800 SERIES

MODEL	7.890D	7.890E	7.890F	7.890L	7.890S
SYSTEM CHARACTERISTICS					
Date of introduction	Aug. 1982	Aug. 1982	Aug. 1982	Aug. 1982	Aug. 1982
Date of first delivery	—	—	—	—	—
Number of central processors	1	1	1	2	2
Principal operating systems	BS3000/OS/VS1/MVS/VM/370/MVS/SP VERSION 2				
Purchase price, entry system (CPU)	—	—	—	—	—
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Read cycle time, nanoseconds	—	—	—	—	—
Write cycle time, nanoseconds	—	—	—	—	—
Bytes fetched per cycle	8	8	8	8	8
Storage interleaving	4-way	4-way	4-way	4-way	4-way
Minimum capacity, megabytes	8	16	16	16	32
Maximum capacity, megabytes	32	32	64	64	128
Increment size, megabytes	8	8	8	8	16
Error correcting memory	Standard	Standard	Standard	Standard	Standard
BUFFER STORAGE					
Cycle time, nanoseconds	—	—	—	—	—
Bytes fetched per cycle	64	64	64	64	64
Capacity local buffer/CPU KB	16	32	64	32	64
Capacity global buffer/MCU KB	128	128	256	128	256
RELOADABLE CONTROL STORAGE					
Capacity	—	—	—	—	—
PROCESSING UNIT					
Machine cycle time, nanoseconds	—	—	—	—	—
Relative performance level (est)	1.0	1.4	1.8	2.4	3.4
Instruction prefetch	Standard	Standard	Standard	Standard	Standard
Processing unit features					
Clock Comparator and CPU Timer	Standard	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	Standard
Floating-Point	Standard	Standard	Standard	Standard	Standard
Direct Control	Standard	Standard	Standard	Standard	Standard
Instruction Retry Hardware	Standard	Standard	Standard	Standard	Standard
Multiprocessor systems					
Tightly coupled	—	—	—	Yes	Yes
Loosely coupled	—	—	—	Yes	No
Attached processor system	No	No	No	No	No
Integrated storage control	Yes	Yes	Yes	Yes	Yes
I/O CONTROL (BS3000)					
Channel Proc. Element 89044	1-2 optional	1-2 optional	1-2 optional	2-4 optional	2-4 optional
Channel Proc. Element 89045	1-2 optional	1-2 optional	1-2 optional	2-4 optional	2-4 optional
I/O CONTROL (MVS, VM, VS1)					
Channel Proc. Element 89044	1 optional	1 optional	1 optional	2 optional	2 optional
Channel Proc. Element 89045	2 optional	2 optional	2 optional	2-4 optional	2-4 optional

NOTES: The 89044 has 16 channels, max. 6 as block multiplexer channels in data streaming (DS) mode: four of remaining 12 channels usable as byte multiplexer channels: 8 remaining used as block multiplexer channels. Maximum transfer rate on 89044 is 24 MB/second.

The 89045 has 8 block multiplexer channels, 6 of which can function simultaneously in DS mode. Two of these can also be configured as byte multiplexer channels. Maximum transfer rate on 89045 is 24 MB/second.

Across the entire 7.800 family of 13 systems, considerable attention has been paid to optimize functional efficiency. This is done by the usual mixture of high-speed buffers used as a cache memory, separate input/output processors, pipe-lining techniques on some models, virtual addressing and the use of a microprogrammed instruction execution unit. Functional efficiency and reliability are helped by the use of 64K-bit chips and LSI (Large Scale Integration) which have become a characteristic of Japanese computers,

CENTRAL PROCESSORS

There are currently three CPU models in the 7.800 series, each of which can be ordered in a single or dual processor configuration. All models have a separate channel processor and a separate service processor. In addition, the smallest model has 8K 96-bit words of reloadable control storage and, optionally, an integrated disk controller. The larger models cycle more than four times as fast, have eight times as much cache memory, and twice as many standard channels.

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such as the Fujitsu range on which the 7.800 series is based. Dual systems with multiprocessing and shared memory are standard on some members of the 7.800 range.

The first sub-range comprises the 7.865-2, the 7.865-3, the 7.870-2 and the 7.872-2. The 7.865-2, the current entry level model to the entire 7.800 series, is designed to compete against the IBM 4341-2 and performs at 1.9 million instructions per second (mips), according to Siemens, offering a 1.35 advantage factor over its rival. Mips, as a comparison factor, is reasonable when comparing machines of similar architecture, such as the Siemens and IBM ranges, but can be misleading when used as a criterion for dissimilar machines. It also gives no indication of throughput. The Siemens (nee Fujitsu) machines are very similar to the IBM 4341-2 in input/output architecture, except that the Siemens/Fujitsu systems have separate input/output processors, whereas the channels are integrated on the IBM systems. The resultant difference is not significant, but provides the Siemens range with a slight advantage.

The next machine in this lowest sub-range is the 7.865-3, an upgraded 7.865-2 with a 25% increase in power over its lower numbered counterpart.

It seems likely that the 7.865-2 will continue nominally as an entry level system, but may be dropped from the actively marketed list by Siemens soon. Memory capacities and other relevant data can be seen from the tables.

The next machine in the lower sub-range is the 7.870-2 which provides a 50% increase in power over the 7.865-2 and a 20% increase over the 7.865-3. For this particular range of machines, it seems that the relatively new 7.865-3 has strong claims for being the best.

The last in this lower sub-range of the 7.800 series is a dual processor version of the 7.870-2. This machine offers a very considerable increase in power, since there are now dual processors each with their own complement of input/output processors. Main memory on this and other dual processors in the series is shared and is not double the capacity of the single processor counterpart. Thus, on the 7.870-2, that is the single processor system, main memory ranges from 4-16 megabytes, while capacity on the dual 7.872-2 is from 8-16 megabytes. Each of the dual central processors has its own individual service processor, but, as a significant bonus, each central system can access either of the two available input/output processors. These are called channel processors by Siemens.

The main function of the channel processors is to conduct data to the peripherals which are attached directly to them. Each channel processor (CHP) services both block and byte multiplexer channels. Each of the processors has six channels as standard and can be expanded to a maximum of ten or twelve channels. The various permutations of byte and block multiplexer channels which may be attached to these channel processors can be seen from the Characteristics section of this report under Input/Output Control. An optimizing feature of CHPs is the availability of an address

REGISTERS: All models have 16 general purpose, 32-bit registers; 16 32-bit control registers; and 4 64-bit floating point registers.

INSTRUCTION REPERTOIRE: The System 7.800 instruction set includes the System/370 Universal Instruction Set plus "macro-instructions" used by the operating system to reduce overhead.

CACHE MEMORY: All System 7.800 models have a buffer memory of 8K, 16K, 32K or 64K bytes. The 7.890 models also have a global cache of 128K or 256K bytes. Data is transferred from main memory to the buffer 32 bytes at a time (four blocks of 8 bytes each), and from the buffer to the CPU 4 or 8 bytes at a time.

CONTROL STORAGE: The smaller processors (7.865-2, 7.870-2, and 7.872-2) have 8K 96-bit words of reloadable control storage. The medium-sized processors are hardwired, while the 7.890 models are microcoded.

DYNAMIC ADDRESS TRANSLATION: The smaller processors can support 15 virtual memory spaces of 16 megabytes each, and the larger models can support up to 128 virtual memory spaces of 16 megabytes each. Virtual addresses, composed of an 8-bit segment number, a 4-bit page number, and a 12-bit displacement number, are translated by hardware in the Storage Control Unit. To reduce the need to fetch tables from memory, a translation lookaside buffer holds information on the most recently used (up to) 512 pages. A segment table origin stack is used to keep track of which virtual space each page belongs.

COMPATIBILITY FEATURES: The 7.800 series are software compatible with the IBM System/370 and 30XX processors running under MVS, VM/370 and OS/VS1.

SIMULTANEITY: The smaller processors execute one instruction and preprocess the next instruction at the same time. The 7.875-2 and larger models have a six-stage pipeline and can execute one instruction while preprocessing up to five more instructions at the same time. When a branch instruction is identified, both the next instruction and the instruction located at the branch address are preprocessed.

Memory on the 7.865-2, 7.870-2, and 7.872-2 is four-way interleaved, and the Storage Control Unit fetches 8 bytes at a time from each memory block, transferring 32 bytes at a time to the cache memory. Interleaving on the larger models depends on installed capacity and can be up to 8 x 16-way interleaving.

INPUT/OUTPUT CONTROL

CONSOLE I/O: Each processor is equipped with a console that includes a color display, a keyboard, and disk drives. The service processor, which is integrated in either the processor or the console, handles operator communications with the system and also runs diagnostic programs. To simplify communications,the operator can use a light pen to select operations from lists displayed by the system.

3806-2 CONSOLE: This desk-sized unit contains a single color display, single operator keyboard, and two floppy disks for loading microcode and diagnostic software. A hardcopy printer is included. One 3806-2 is required for the 7.865-2.

3807-2 CONSOLE: This console has the same characteristics as the 3806-2. One 3807-2 is required for the 7.870-2 and two for the dual-processor 7.872-2.

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translation facility which reduces the workload on the operating system when virtual addresses are used in programs destined to be used by a CHP. This facility is available only on BS3000 controlled 7.800 systems.

The middle sub-series of the 7.800 range comprises the 7.875-2, 7.880-2, 7.881-2 and 7.882-2. The philosophy of design is the same as that in the remainder of the 7.800 series but bears a closer resemblance to the 7.890 sub-range than to the machines in the 7.865-2 category. The main increase in performance over the lower sub-series of machines comes about, not only from increased processor power, but also from the use of pipelining techniques. These are implemented through the Pipeline Unit (PLU). Pipelining is a method of overlapping the execution of one instruction with another. This functions through the division of each instruction into phases. In a non-pipeline machine one instruction is completed before going on to the next, but in the pipeline machine the number of instructions which are overlapped depends on the number of phases in the pipeline. In the Siemens middle sub-range, a six-phase pipeline is used, so that as soon as one instruction has completed its passage through phase one, the next instruction goes into phase one, while the preceding order is in phase two. This continues through the six phases enabling six instructions to be in various stages of execution at the same time.

Another increase in power over the lower sub-range takes place through an increased channel capacity in the input/output processors. On the machines numbered 7.865-2 to 7.872-2, the maximum number of channels is either 10 or 12. On the machines numbered from 7.875-2 to 7.882-2, the maximum number of channels is 16. There are other more technical differences described in the Characteristics Section of this report.

The 7.875-2 and 7.880-2 are single processor machines. The 7.881-2 and 7.882-2 are dual processor machines sharing a common memory. As with other sub-series, all members of this middle sub-range can be upgraded to the next higher numbered one in the field.

The most powerful members of the 7.800 range are gathered into the 7.890 sub-series and comprise the 7.890D, 7.890E, 7.890F, 7.890L and 7.890S. There is not a great difference between the D and the E models, both having a maximum main memory of 32M bytes, for example, but the E models start with a minimum of 16M bytes while the D commences with 8M bytes. The model F is also, in essence, an upgraded E, but has a maximum 64M bytes of memory. Both models L and S are dual processor systems.

All the 7.890 level machines are based on the Fujitsu model M380 and are basically the same machine as that used by ICL in its Atlas 10 series. They not only have the pipelining used on the middle 7.800 sub-range, but also have 31-bit real addressing which is needed for MVS/XA implementation, in addition to cache memory common throughout the 7.800 range.

3808-2 CONSOLE: This desk-sized unit contains two displays, two keyboards, and two floppy disk drives for loading diagnostic software. Normally, one station is used for operation and the other for maintenance activities. One 3808-2 is required for a 7.875-2, 7.880-2, or 7.881-2, and two for the dual-processor 7.882-2. On the 7.882-2 systems, either console can access any part of the system.

3809 CONSOLE: A desk-sized unit containing one display with keyboard and three floppy disk drives. These are used for loading microcode, loading diagnostic software and for storing maintenance information. A hard-copy printer is also a standard fitting.

I/O CONTROL: Peripherals are attached to 7.800 systems via independent Input/Output Processors (IOPs) which support both byte multiplexer and block multiplexer channels and which include their own dynamic address translation hardware for channel commands. The channel interface is designed according to IBM channel interface specifications. A 7.865-2 or 7.870-2 system has one IOP with one byte multiplexer and five block multiplexer channels. Up to six channels and three integrated disk controllers can be added to the 7.870-2. Byte multiplexers have a transfer rate of 40 kilobytes/second (200 kilobytes per second total in burst mode), block multiplexers 2.0 megabytes/second, and the file controller 1198 kilobytes/second. The total transfer rate of the IOP is 14 megabytes/second.

A 7.872-2 system has two IOPs, each accessible to either processor.

A 7.875-2 or 7.880-2 system has one IOP with two byte multiplexer channels and 6 or 10 block multiplexer channels, respectively. More channels can be added up to a total of 16, and the IOP can support 2.048 sub-channels. Byte multiplexers have a transfer rate of 110 kilobytes/second, and block multiplexers 2.0 megabytes/second. The total transfer rate of the IOP is 20 megabytes/second.

A 7.881-2 or 7.882-2 system has two IOPs each accessible to either processor. All IOPs can be equipped with data streaming channels.

The 7.890 models have two Channel Processor (CHP) elements numbered 89044 and 89045. The number of these which are fitted depends on whether the system is intended to run under the Siemens operating system BS 3000, or under IBM operating systems, such as MVS. The permutations of these elements and details of channels can be seen from the table of "Characteristics of the Siemens 7.800 Series" which describes the 7.890 models.

MASS STORAGE

FIXED DISKS—MODEL 3843: There can be one or two drives of this unit, which can be considered as two drives of 317.5MB each or two drives of 100MB each. The average access time is 48.4ms, including positioning time and the transfer rate is 1198 KB/second.

FIXED DISKS—MODEL 3846: This is virtually identical to the model 3843, except that it has double the capacity. The space required for it is also not much greater. The 3843 can be regarded as either comprising two drives of 200MB each or two drives with a capacity of 635MB each. The other characteristics are identical to the model 3843, that is, an average access time of 48.4ms, including positioning and a transfer rate of 1198 KB/second.

REMOVABLE DISKS—MODEL 3842: This comprises one or two drives, each with a capacity of 200MB. The average access time, including positioning, is 58.4ms and the transfer rate is 806 KB/second.

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Some idea of the relative power of these systems can be gained by looking at the figures supplied by Siemens: the 7.890D can be field upgraded to the 7.890E with a performance increase of around 1.3; the model E upgrades to the model F with a similar factor for performance increase; model F upgrades to model L with a 1.2 factor and model L to the top model, the 7.890S with an improvement factor of about 1.4

These 7.890 models can have one or two channel processors on the single processor models and two or four on the dual processor models (7.890L, 7.890S).

A very wide spectrum of peripherals can be used with the 7.800 systems. The details are contained in the Characteristics section of this report.

SOFTWARE

The main software on the 7.800 systems is dominated by the Siemens BS3000 operating system. In addition to this, there is the Siemens teleprocessing system, called FNA, (Free Network Architecture), AIM (Advanced Information Manager) which is a database allied with communications system, and other aids which handle networking (NJP—Network Job Processing), manage resources (RMF—Resource Management Facility), deal with telecommunications (TCAM—Telecommunication Access Method), facilitate emulations (PEP—Partitioned Emulation Program) and use IBM optical character equipment via IBM-OCR support. Compiler and Assemblers offered for the 7.800 range include Cobol, Pascal, PL/1 (PL/1 Optimizer), Basic Algol, Fortran 77 and Assembler (Assembler-H). A great deal of IBM software will also function. Detail is under IBM Compatibility.

The components of the BS3000 operating system include the Supervisor, Language Processors, Subsystems TSS (Time Sharing System), JES (Job Entry Subsystem), utility programs and additional products. BS3000 allows and manages 16MB per user of virtual storage space, will support up to 128M bytes of physical main memory, will handle both single and dual processors and will perform not only all the functions of IBM's MVS, but has additional facilities, which will allow unattended operation. Full information on this and other software is contained in the Characteristics section under Software.

COMPATIBILITY

The 7.800 range has interface compatibility with comparable IBM System/370 and 30XX. The 7.800 can be integrated into a hardware and software network with IBM systems.

IBM operating systems OS/VS1, MVS or VM can be used on the System 7.800 without change together with the corresponding SP products and licensed programs. All peripheral devices with interfaces compatible with the "IBM Interface Specification" may be connected to a central processor of the 7.800.

MAGNETIC TAPE UNITS

Siemens currently offers IBM-compatible tape drives with recording densities of 800, 1600, or 6250 bpi.

3854 MAGNETIC TAPE DEVICE: This is a 9-track unit that has a recording density of 320 (NRZ) or 640 (PE) bytes per cm (800 or 1600 bpi, respectively), a read/write speed of 160 (NRZ) or 320 (PE) kilobytes per second, a rewind speed of 14.5 meters per second, and a forward tape speed of 5.1 meters per second. The 3854 connects to all models via a 3850–1, –2, –3, or –4 controller.

3857 HIGH DENSITY MAGNETIC TAPE DEVICE: This 9-track unit has a recording density of 640 (PE) or 2460 (GCR) bytes per cm (1600 or 6250 bpi, respectively), a read/write speed of 200 (PE) or 781 (GCR) kilobytes per second, a rewind speed of 12.2 meters per second, and a forward tape speed of 3.18 meters per second. Up to eight magnetic tape devices can be connected to all models via a 3850–1, –2, –3, or –4 controller.

3859 HIGH DENSITY MAGNETIC TAPE DEVICE: This 9-track unit has a recording density of 640 (PE) or 2460 (GCR) bytes per cm (1600 or 6250 bpi, respectively), a read/write speed of 320 (PE) or 1250 (GCR) kilobytes per second, a rewind speed of 16.2 meters per second, and a forward speed of 5.1 meters per second. Up to eight magnetic tape devices can be connected to all models via a 3850–1, –2, –3, or –4 controller.

HIGH-SPEED TERMINALS

3833 PRINTER: A chain printer, the 3833 can print at rates up to 3,500 lines/minute when equipped with a 16-character set and 2,000 lines/minute with a 48-character set. Other sets available have 60, 63, and 120 characters, respectively, resulting in maximum printing rates of 1,477 and 1,060 lines/minute, respectively. Lines can be 132 or 136 characters long, or optionally, 150 characters long. Printing is 10 characters/inch at 6 or 8 lines/inch. An optional two-channel adapter allows the printer to be switched between two 7.800 systems. Character chains are packaged in interchangeable cassettes.

PUNCHED CARD UNITS

3815 CARD READER: This unit reads 80-column cards at up to 1,250 cards/minute. The hopper holds 2,000 cards and each of the two stackers holds 1,800 cards. The unit can be optionally equipped to read mark sense cards and cards containing both punches and marks. A two-channel option also is available.

3816 CARD PUNCH: This unit punches 80-column cards at up to 250 cards/minute and has a 2,000-card hopper, two 1,000-card stackers, and a 200-card reject pocket. The unit can be optionally equipped to print up to 25 lines of up to 64 characters each on cards as it punches them. A two-channel option also is available.

TERMINAL SUBSYSTEMS

3880 TERMINAL SYSTEM: This subsystem is composed of a 3884 cluster controller, 3886/7 display terminals, and optionally, 3888 printer terminals.

3884–1 CLUSTER CONTROLLER: Connectable to either a byte or block multiplexer channel at a maximum line length of 100 meters, the 3884–1 cluster controller permits the 3886 data display terminals as well as the 3888 (matrix printers) and 3889 (line printer) printer terminals to be connected to host 7.800 systems. Maximum data throughput

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IBM's VM/370 and MVS/370 and the associated Systems Extensions (SE) and Systems Products (VM/SP and MVS/SP version 1) will also run on the 7.800 range. All 7.890 models will run MVS/SP version 2 (MVS/XA).

COMPETITIVE POSITION

The competitive position has to be assessed against the 7.800's arch rival, namely IBM, and against other PCMs. The main attraction of the 7.800 is that it an execute a high percentage of IBM systems, without change and at lower cost. Just what this means in practice varies from one Siemens or IBM product to another. The 7.800 is certainly at least as reliable as its IBM counterparts and less expensive.

Siemens PCM rivals fall into two categories, those with identical or closely related machines, that is Amdahl and ICL who market Fujitsu based products similar to those of Siemens and Hitachi based systems, namely those from BASF and NAS. ICL is having a difficult time with its Fujitsu-based products (only three sold at the time of writing). The Hitachi users mainly down-market from the Fujitsu based machines, seems to be doing well from all reports, certainly in the case of BASF.

ADVANTAGES AND RESTRICTIONS

There are very definite advantages in Siemens, ICL, BASF and other PCM's products over those of IBM. The PCM system requires less power, lower outlay, less space, and uses better technology. The PCM products have also achieved an excellent reputation for reliability.

The general disadvantages of the Fujitsu based products, such as those from ICL, Siemens and Amdahl can be divided into two areas—software and markets, neither of which, it should be emphasized, detract from the intrinsic attractions of the systems. The software uncertainty is whether the PCMs will continue to maintain compatibility with IBM, how much so, and whether it is important in the long run. The query about the market is whether there exists a viable sales sphere for such products. The recession has doubtless affected some potential sales at the time of writing and the answer to this question may not appear until 1984–5 as a result.□

is 350 kilobytes per second. When using the 38804–3 Extension Feature for coaxial cables, up to 12 terminals can be connected in increments of four terminals.

3884–3 CLUSTER CONTROLLER: The 3884–3 cluster controller permits the 3886 data display terminal and the 3888, 3893 and 3889 printer terminals to be connected to the Communications Control Processor. Up to 12 terminals can be hooked up in increments of four terminals into a star-type configuration. The data transfer rates to the communications control processor are 1200 to 7200 bits per second for the BSC and 9600 bits per second for HDLC or SDLC via dedicated lines. In the public dial network, the 3884–3 Cluster Controller can be operated under HDLC.

3886 DISPLAY TERMINAL SYSTEM: This consists of a controller (3884), four choices of display and separate keyboard (3886–2, 3886–4, 3886–3 and 3886–5) together with options such as a light pen attachment (38802), pass reader (38803), needle printer (3888) and line printer (3889). The actual displays are divided into two groups; the 3886–2 and 3886–4 which each have 24 lines of 80 characters and a 25th line for functions and operating communication; and the 3886–3 and 3886–5 which are identical with the other two models, except that the 3886–3 and 3886–5 are color units with green, white and red, which are useful for display curves, tables and statistical data. There are various keyboard options.

3888 PRINTER TERMINAL: The 3888–3 Printer Terminal is connected as an independent terminal to the 3884 Controller. Equipped with a 1,920-character buffer, to match the characteristics of the display terminals, the 3888 prints at up to 180 lines/minute. The unit prints at 10 characters/inch, 136 characters to the line, and 6 or 8 lines/inch using a 63-character set.

3884–4 PRINTER TERMINAL: Same specifications as the 3888–3, but possesses a forms attachment for the printing of single documents.

3889–1/–3 PRINTER TERMINAL: The 3889–1 printer terminal is connected as an independent terminal to the 3884 Cluster Controller. Printing speed is 230 lines per minute. Character spacing is 10 characters per inch with 136 characters per line and 6 or 8 lines to the inch. The 3889–1 uses a 96-characters set, and has a data buffer of 4,096 bytes.

DATA COMMUNICATIONS

3893–1 COMMUNICATIONS CONTROL PROCESSOR: A programmable subsystem with 128K to 512K bytes of memory, the 3891–2 can support up to 352 asynchronous or synchronous half-duplex lines at speeds up to 9,600 bits/second. The processor uses the IBM 3705–II instruction set and supports IBM BSC communications protocol. Data is transferred to and from the host 7.800 system in burst mode via a channel adapter and either a byte or block multiplexer channel. The 3893–1 has one to four communications scanners, each of which can support up to 32 line sets. Each line set can support up to four lines.

The 3893–1 runs under a Network Control Program (NCP) generated on the 7.800 by selecting macros from a range of functions. The NCP is downline loaded to the 3893–1.

3893–2 COMMUNICATION CONTROL PROCESSOR: This programmable subsystem has from 128K to 512K bytes of memory and can support up to 320 asynchronous or synchronous half-duplex lines. The 3893–2 is upgradable to a 3893–1. All other characteristics are the same as the 3893–1.

3893–3 COMMUNICATIONS CONTROL PROCESSOR: A programmable subsystem with between 128KB and 256KB of memory which can support up to 64 lines. All its other characteristics are the same as the 3893–1. The 3893–3 is upgradable to the 3893–2 or 3893–1.

SOFTWARE

BS3000 OPERATING SYSTEM: The functional equivalent of and compatible with IBM's OS/VS2 (MVS), BS3000 is a virtual memory control system that supports batch, interactive, and multi-user jobs in a multiprogrammed environment composed of multiple virtual storage spaces. Each job can have up to 16 megabytes of virtual memory, provided that the system has sufficient disk storage space.

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Under BS3000, real memory is divided into pages of 2048 bytes each. Virtual memory is divided into consecutive segments of 65,536 bytes, each containing 32 pages. BS3000 combines two pages to form a 4096-byte page. Page tables define the relationship between real and virtual memory at any moment in time. These tables are continuously updated and monitored for pages which are not being used frequently. Based on this, the page management system then allocates real memory to new pages.

There are two main types of programs under BS3000: privileged and non-privileged routines. The Control System is privileged and consists of the Executive, the Data Management System, the Teleprocessing System, and System Services. Non-privileged routines consist of language processors, utility routines, and user programs.

The Executive performs the following functions:

- Handling console I/O
- Processing user command language
- System accounting, spooling
- Interrupt handling

The Data Management System handles I/O operations except for data terminals and the console(s), including file management and the sharing of files. Access methods supported by the Data Management System include sequential access (QSAM, BSAM), Partitioned access (BPAM), direct access (BDAM), Indexed Sequential Access (ISAM), and Virtual Storage Access (VSAM). Access to the data terminals is by the VTAM (Virtual Telecommunications Access Method) for all application programs and subsystems of the host processor. VTAM interacts with a communications control processor (CCP) to which all remote terminals are connected. VTAM also supports locally connected terminals. The communication control processor is controlled by the NCP (Network Control Program) and performs network-oriented communications control.

System Services include an Interactive Debugging Aid, SMART (Siemens Maintenance via Remote Telecommunications), OLTEC (Online Test Control Program for performing diagnostic tests of any I/O control unit), and hardware status reports printed by the SVP (Service Processor) console.

For execution, tasks are classified as either interactive or background (batch). Interactive tasks are initiated via the keyboard of a data terminal. Batch tasks can be assigned any of 9 priorities.

Operating system components (except the Executive), user programs, and application programs are stored in virtual memory and relocated into real memory during execution. Virtual memory space is reallocated to the programs during loading.

Real memory under BS3000 is divided into two sections: one is reserved for the Executive and the real-memory resident programs, and the other is divided into 4K page frames. All paging is done on demand only.

Virtual memory is subdivided into 6 classes. Classes 1-4 are reserved for the system, while Classes 5 and 6 are available to the user. Class 6 memory is available for user-written programs and begins at the low-order end of the available memory area. Class 5 memory comprises the high-order 64K and is used for tables and buffer areas that have to be set up for user tasks.

Dynamic Address Translation is handled via a special Address Translation Memory (ATM) that holds 128 entries. Each ATM entry contains a Segment and Page reference that is combined with a virtual address displacement to result in a real address. A hit will result in 90-95% of all address references using this multi-level address translation scheme. When an address cannot be determined on the first pass through the ATM, a fall back to Segment/Page tables with an additional 256 entries is required. A maximum of 2-levels are required for 2K-page addressing, and 3-levels are required for 4K-page addressing schemes.

BS3000 includes the Advanced Information Management system (AIM) which supports data management and data communications. AIM comprises a large number of different software functions: data base management, program management, message management, administrator support, service programs, and programming languages. Service Programs include a Linkage Editor and Loader, and a SORT/MERGE program.

In December 1982 Siemens announced a development of the BS3000 operating system called BS3000 MSP (Multiple System Product), whose main market is the large system user. However, it can be applied on all 7.800 models. It supports 31-bit real and virtual addressing and permits bimodal operation.

The virtual address space is extended to two gigabytes with BS3000 MSP and Siemens will be introducing new functions to take advantage of this enormous space. The first version of BS3000 MSP is called BS3000 MSP10.

The general development of BS3000 MSP will be along the following lines. BS3000 MSP will have interface and functional compatibility with MVS/SP1.3 and following versions. The control of a loosely coupled system will be made as simple as possible by "products that balance the loading of a system," enable a single console to control all systems and enable magnetic tape drives to be assigned to different CPUs. New products will be brought out from time to time, for instance, Relational Database (AIM/RDB), for design and control of private databases; INTERACT for interaction and communication with applications programs and ADAMS for program development and maintenance.

BS3000 MSP10, the initial version of BS3000 MSP, in conjunction with its associated job entry subsystems JES and JES/E, provides extensions to BS3000 in the field of coupling and extends developments towards compatibility with MVS/SP.

The Advanced Functions/Job Entry Subsystem and its extensions (AF-JES and AF-JES/E) offer new functions and facilities which include the following:

- support for IBM 3380 Direct Access Storage when installed with Data Management/Device Support Extension (DM/DSE) and Data Management/Integrated Data Services (DM/IDS) program products
- Cross Memory Services (CMS) allows data transfer, data access and program calls between two address spaces
- Virtual I/O Extended (VIO/E) allows direct or partitioned data to be held in main memory: such data sets can be temporary or permanent

BS3000 MSP 10 also includes Standard System Program Products (SSPP) which consists of logical extensions to certain products to meet the needs of large users. These extensions usually involve the preprogramming of the available exits, the coding of various standard routines and the modification of some system codes. SSPPs will be made available for the Resource Access Control Facility (RACF), System Management Facility (SMF) and Operation Procedure Facility (OPF).

In addition to the above, BS3000 MSP Version 10 offers Extended Console Support (ECS) which manages the full screen, split screen with a menu technique and other operator friendly facilities. An extension to ECS allows users to

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operate all machines of a Job Entry Subsystem/Multi-Access Spool (JES/MAS) from a single operator console.

Among the remaining parts of BS3000 MSP 10 are included the Relational Database (AIM/RDB), Advanced Query Language (AQL), AIM Database/Data Communications system (AIM DB/DC) and AIM/VSAM.

AIM/RDB is an extension of the Advanced Information Manager (AIM) DB/DC system. It offers database processing for interactive, on-line and batch environments.

AQL, Advanced Query Language, enables end-users to access relational databases from terminals or from programs. Relationships between data are not fixed.

AIM Database, Data Communications system, AIM, DB/DC, enables the user to define Codasyl-like data structures. The goal of AIM DB/DC is flexibility, insofar as the user need install only that which he requires: for example, it can be used either as a pure database system or as a data communications monitor, through user-selection of those functions meeting his needs. Security and logging functions are provided for all users with large numbers of data sets, whether these be conventional sets or of the VSAM type.

AIM, Virtual Storage Access Method, AIM/VSAM enables monitoring and recovery of VSAM data sets to be effected. All types of VSAM data sets (KSDS, ESDS and RRDS) can be used with the same instructions as those used in general batch programs.

LANGUAGES: Ten languages are available on the System 7.800: RPG 2, Algol 60, ANS Cobol, Fortran IV, PL/1, Basic, APL, Pascal, LISP and an Assembler. All language compilers are IBM-compatible.

UTILITIES: Siemens offers a full complement of IBM-compatible utilities.

DATA BASE MANAGEMENT SYSTEM: The 7.800 systems use the Advanced Information Management system (AIM) which satisfies the same requirements as IBM's IMS but which follows the Codasyl standard.

DATA COMMUNICATIONS SOFTWARE: The 7.800 systems support Future Network Architecture (FNA), the functional equivalent of IBM's SNA.

PRICING

System 7.800 systems are available for purchase and on one-year rental and three and four-year lease plans. Listed below are examples of basic prices for each model. One should expect an immediate reaction by Siemens to any significant price changes by IBM.

EQUIPMENT PRICES

PROCESSOR AND MEMORY 7.800 SYSTEM	PURCHASE PRICE DM	ONE-YEAR RENTAL (1) DM	THREE-YEAR RENTAL (1) DM	MONTHLY MAINT. DM
7.865–2 : 4MB	853,130	34,300	28,800	2,093
7.865–3 : 8MB	1,112,130	47,940	40,270	2,835
7.870–2 : 4MB	1,353,130	95,920	80,570	9,570
7.872–2 : 8MB	2,300,330	163,100	137,000	15,185
7.875–2 : 8MB	2,948,800	166,375	139,755	16,545
7.880–2 : 8MB	3,930,400	196,375	164,955	17,585
7.881–2 : 8MB	5,775,500	217,875	183,015	18,685
7.882–2 : 8MB	7,665,800	292,500	245,700	20,370
7.890–D : 8MB	3,925,000	203,150	170,620	14,350
7.890–E : 16MB	5,427,000	251,250	211,050	17,300
7.890–F : 16MB	6,504,000	280,000	235,200	19,300
7.890–L : 16MB	8,750,000	372,500	312,900	24,500
7.890–S : 32MB	11,900,000	512,500	430,500	35,600 ■

(1) Price includes maintenance

Note: a 4-year rental agreement is possible on all machines from the 7.875–2 upwards