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NCR Century 251

MANAGEMENT SUMMARY

The Century 251 was introduced in January 1973 as the sixth member of NCR's Century Series line of computers. Offering no new breakthroughs in either hardware or software, the Century 251—NCR's long-awaited response to the IBM System/370 Model 135—fits nicely between the current Century 200 and 300 models and is directed primarily toward NCR's traditional financial and retailing industry markets. The Century 251 has a little more than three times the processing power of the Century 200 and slightly more than one-half the power of the Century 300 processor.

Boldly rising above the price/performance curve of the existing medium-scale Century 200 models, the 251 offers users with requirements of 96K to 256K bytes of main memory a much more powerful processor with greater I/O configuration capability at a purchase price only about 10 to 25 percent higher or a rental price about 2 to 25 percent higher, depending upon memory size and length of contract term. Additional Century 251 main memory increments are 47 percent or 54 percent less costly than comparable Century 200 add-on memory for purchase or lease, respectively; as a result, the smallest differences in price between the Century 251 and 200 processors occur for the largest memory configurations.

On the other hand, the Century 251's competitive stance vis-a-vis the IBM System/370 Model 135 leaves little room for doubt that the new NCR system is far better suited for satisfying the upgrade requirements of current NCR Century 101 and 200 customers than for ▷

This latest processor in the Century Series is NCR's answer to the IBM System/370 Model 135. As such, its primary mission is to bridge the large gap between the Century 200 and 300, thereby providing a more reasonable migration path for installed Century users and protecting NCR's customer base from encroachment by competitive systems.

CHARACTERISTICS

MANUFACTURER: The National Cash Register Company, Dayton, Ohio 45409. Telephone (513) 449-2000.

MODEL: NCR Century 251 Computer System.

DATA FORMATS

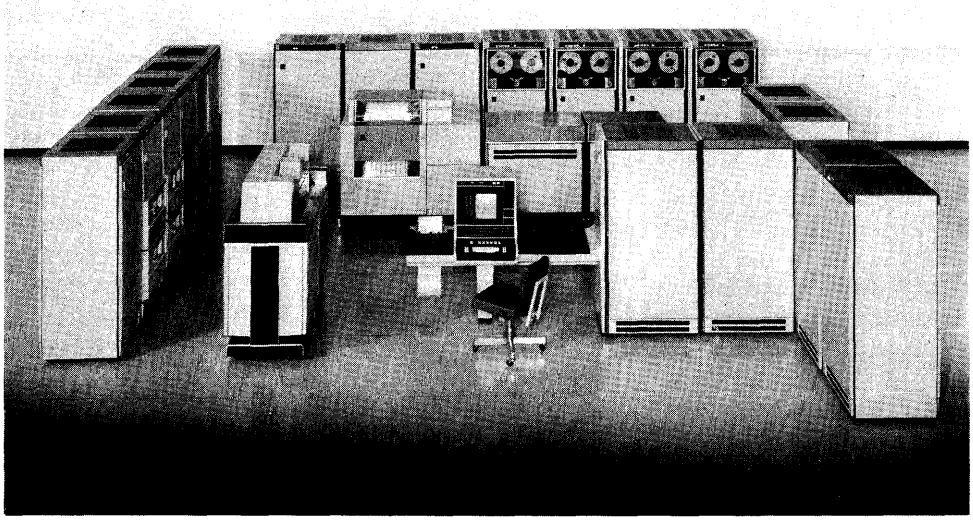
BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 1 or 2 BCD digits (in unpacked or packed format, respectively), or 8 binary bits. (Four consecutive bytes form a "word" in the Century 251, as in the Century 300 system.)

FIXED-POINT OPERANDS: Can range from 1 to 256 bytes in length, in either decimal or binary mode. (On the Century 251, a "word binary" mode is available that takes particular advantage of the Century 251's 4-byte adder; each 4-byte word is treated as a signed 31-bit integer.)

FLOATING-POINT OPERANDS: Consist of a 7-bit hexadecimal exponent and a 24-bit or 56-bit fraction (in "short" or "long" format, respectively).

INSTRUCTIONS: 4 or 8 bytes in length, specifying 1 or 2 memory addresses, respectively. The Century 251 instruction format is fully compatible with that of the Century 300.

INTERNAL CODE: ASCII. ►



With three times the internal performance of the Century 200, the 251 fits smartly athwart the sizeable gap between the 200 and the top-of-the-line Century 300. Shown here is a full-scale Century 251 installation with both disk and magnetic tape capability.

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usurping Model 135 systems destined to upgrade existing 360/30 installations. The Century 251 purchase price ranges about the same to no more than about 15 percent cheaper than the Model 135 for small or medium-sized systems, respectively; and the Century 251 lease prices range from about 11 percent lower, for medium-sized systems on long-term lease, to more than 5 percent higher for larger systems on a one-year lease term. (Note that because the Century 251 memory price is a disproportionately smaller part of the basic system price than memory on a comparable 370/135, the relative price-performance of the Century 251 increases with memory size up to medium-scale; at that point, as more peripherals are required, the lower-priced 370/135 integrated controllers tend to lessen the price/performance advantages of the 251.)

Thus, the Century 251 offers its stiffest competition to medium-sized 370/135's on lease. Its strongest potential, however, clearly lies in convincing current Century Series users to remain in the NCR fold. In that capacity, the Century 251 seems likely to provide firm resistance even to the lower-priced IBM 370/125, and should, at the least, serve to protect the installed Century Series customer base against undue losses to IBM or other vendors.

In essence, the Century 251 is a lower-cost, lower-performance version of the Century 300, with full field-upgrade potential to a complete Century 300 system. This upgrade is done with the installation of a Century 300 "Performance Package." The cost of this package is the difference in price between a comparably sized Century 300 and 251 mainframe. The design of the new processor and main memory is derived directly from that of the Century 300 processor. The 251 implements the full Century 300 instruction set, although its basic instruction execution times are generally about 10 to 15 percent slower than those of the 300. The core memory used in the 251, although fundamentally similar to that of the 300, has only 2-way interleaving instead of 4-way, and is slowed to a 1.2-microsecond cycle time from 0.68 microsecond in the 300. Due primarily to the 2-way interleaving, the Century 251's effective access time is about two-thirds that of the Century 300 and about twice as fast as that of the less powerful Century 200.

All peripherals, communications subsystems, and software operating systems available for the Century 300 can be used with the 251. The following distinguishing characteristics serve to further differentiate the Century 251 from the 300:

- The Century 251 has a considerably constricted (albeit realistic) range of memory sizes available, from a minimum of 96K bytes to a limit of 256K bytes.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: 98,304, 131,072, 196,608, or 262,144 bytes.

CYCLE TIME: 1.2 microseconds per two-byte access. Word addresses are interleaved among two memory modules within the MSU to permit overlapped accessing.

CHECKING: Parity bit with each word is generated during writing and checked during reading.

STORAGE PROTECTION: Provided by multiple base address and limit address registers. For each active program, one base address register (BAR) and one limit address register (LAR) define the lower and upper address limits of main storage that can be accessed.

RESERVED STORAGE: Byte locations 0 through 3072 are reserved for registers, control words, and specific portions of the resident Executive.

CENTRAL PROCESSORS

INDEX REGISTERS: A separate set of 63 registers is maintained in reserved storage for each active program.

INDIRECT ADDRESSING: Up to 5 levels; can be combined with indexing.

INSTRUCTION REPERTOIRE: The Century 251 has 71 instructions, all standard, including all of the Century 200 instructions except those associated with the optional NCR 315 and IBM 1401 Compatibility features. There are 7 classes of instructions:

Decimal Arithmetic: 9 instructions for adding, subtracting, multiplying, dividing, and comparing signed, packed BCD fields; for adding and subtracting unsigned unpacked BCD fields; and for packing and unpacking BCD fields.

Fixed-Point Binary: 11 instructions for adding, subtracting, multiplying, dividing, and shifting word-oriented (4-byte) binary operands; for adding, subtracting, and comparing variable-length binary fields; and for performing binary-to-decimal and decimal-to-binary conversions.

Floating-Point: 12 instructions for adding, subtracting, multiplying, dividing, and comparing floating-point operands in both short (1-word) and long (2-word) formats.

Data Movement: 3 instructions for internal data transfer operations.

Logical: 8 instructions for editing scanning, code translation, and Boolean operations.

Transfer: 13 instructions for testing, branching, and counting.

Special: 15 instructions for various hardware functions such as input/output, loading base and limit address registers, repeating an instruction setting up trace/monitor conditions, handling interrupts, etc.

INSTRUCTION EXECUTION TIMES: Timings are in microseconds, for fixed-point decimal operation.

Add, unsigned, unpacked (5 digits)	9.9
Add, signed, packed (5 digits)	9.0
Multiply, signed, packed (5 digits)	22.8
Divide, signed, packed (5 digits)	11.1

INTERRUPTS: 16 levels of prioritized I/O interrupts, plus a command code interrupt to handle common sub-

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- The Century 251 cannot have the Very High Speed Trunks provided as options for the Century 300; only two standard trunks and an integrated Multiplexor trunk are included in the "Basic" system, with four additional trunks optional. The overall maximum I/O data transfer rate and the individual trunk transmission rates are slowed somewhat, but not enough to preclude attachment of the fastest NCR peripherals available today, nor even the IBM 3330-type devices that are likely to be announced when NCR judges the time to be ripe.

Monthly rentals for the Century 251 begin at about $10,200, with typical systems falling into the $13,000 to $17,000 range. The "Basic" Century 251 package—like the Basic Century 300 package but unlike other basic Century systems—is not a complete configuration; it consists of the processor and main memory only.

By fitting into the excessively large price/performance gap that existed between the Century 200 and 300 since release of the large system in September 1970, the Century 251 helps to provide a practical growth path to the top-of-the-line Century 300 for smaller Century users. Formerly the Century Series user migration generally stopped short at the 200; fewer than 30 Century 300 Systems have been installed worldwide to date, although more than 825 Century 200 Systems have been delivered.

The Century 251, together with the reconfigured Basic Century 101 system announced in December 1972, can be regarded as critical moves by NCR in an ongoing campaign to inject new vigor into an existing line of computers that has come under increasing fire from recent competitive offerings by other vendors. Both new NCR systems offer significant improvements in price/performance over the previous Century Series members, while maintaining the Century Series' promise of considerable potential for first-time computer users, current users of second-generation systems such as the IBM 1400 series, and "low-end" users of other third-generation systems. □

routines such as time-of-day access, etc., and 2 processor interrupts to handle programming errors and memory errors.

TIME-OF-DAY CLOCK: An optional clock register, located in main memory, provides a binary indication of the time of day for use in controlling real-time programs, schedulers, and job accounting routines. The clock is incremented every 25 microseconds.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Two High-Speed Trunks, with 4 positions each for free-standing peripherals and/or controllers, and one 8-position Multiplexor Trunk are standard. Three of the Century 251 multiplexor positions are reserved for the interval timer, I/O writer, and CRT display system; the other five positions can be used for free-standing peripherals and/or controllers. Four more optional High-Speed Trunks are also available.

SIMULTANEOUS OPERATIONS: One I/O operation can occur on each of the 8 subchannels of the Multiplexor Trunk and on one position on each of the High-Speed Trunks concurrently with computing, resulting in 14-way I/O simultaneity. Also, with the two-way memory interleave, the I/O Control Unit and the Arithmetic Logic Unit of the Century 251 Processor can access main storage simultaneously.

I/O DATA RATES: Each of the six High-Speed Trunks can transfer data at a maximum rate of 826,000 bytes/second. The integrated 8-position Multiplexor Trunk can accommodate a data transfer rate up to 173,000 bytes/second on any one position, subject to an overall multiplexor data rate of 210,000 bytes/second. The maximum aggregate I/O data rate for the Century 251 (with 6 channels attached) is 2.74 million bytes/second.

I/O INTERFERENCE: On the Century 251, due largely to the 2-way memory interleaving, the maximum system I/O data rate of 2.74 million bytes/second can be maintained with a minimal central processor I/O degradation (due to the "cycle-stealing" technique used in the Century Series).

PERIPHERAL EQUIPMENT

See the NCR Century Series Report, 70C-656-01, for descriptions of the mass storage, I/O units, and communications devices that are available for the Century 251. All such units available for the Century 300 can also be used with the Century 251.

SOFTWARE

The Century 251 can use all of the four different levels of integrated, disc-resident operating systems available for the Century Series computers. Each consists of a Monitor, an Executive, and several other routines. The Monitor controls the sequencing, loading, and linking of programs. The Executive is a run-time supervisor that handles all I/O operations, error conditions, and program overlays. The four levels can be summarized as follows:

BASIC EXECUTIVE (B1): All Century systems can use the basic B1 operating system. This disc-resident operating system handles the batch-mode processing of one program at a time. It was initially delivered in November 1968 with the first Century 100 installations. The B1 system consists of a Monitor, an I/O Executive, and Disc Management, Log, and Display routines.

DUAL OPERATING EXECUTIVE (B2): Usable on Century 200 and larger systems with at least 32K bytes of main storage, this operating system divides main memory into two distinct areas. One is dedicated to a single real-time or batch program. The other area is used for sequential processing of batch programs. The B2 system was delivered late in 1969. Its resident portion occupies about 6000 bytes of main storage.

MULTIPROGRAMMING EXECUTIVE (B3): This operating system divides main memory into two or more partitions of at least 16K bytes each. Each partition has its own set of 63 index registers, its own disc unit, and its own job stream, so its operations are largely independent of those in other partitions. The B3 system was delivered late in 1969.

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The multiple-partition B3 system is also available in an upgraded version designed to take advantage of the increased hardware capabilities of the Century 251 or 300. The principal extensions are: (1) support of operator communications via the CRT display system, and (2) use of a single system disc unit, shared by all active programs, rather than a separate disc unit for each partition. Up to nine jobs can be executed concurrently, each in a separate partition with an independent job stream. Printer output can be spooled (i.e., written on a disc unit for later printing). The upgraded B3 Multiprogramming Executive was delivered with the first Century 300 system in February 1972.

MULTIPROGRAMMING EXECUTIVE (B4): A still more powerful multiprogramming operating system, called B4, can support any number of concurrent jobs, limited only by system resources; for most Century 251 installations, that number will not exceed 10. B4 has been operational on the Century 300 since March 1972. Among the B4 extensions over earlier Century operating systems are: (1) spooling of both input and output data, (2) expanded operator communication facilities, with system status displays organized in a hierarchical structure, (3) comprehensive job scheduling and job accounting routines, (4) facilities for inter-job communication amoung active programs, (5) remote job entry facilities, (6) checkpoint and restart facilities to aid in recovery from system failures, and (7) dynamic reallocation of peripheral devices and main storage. B4 makes extensive use of overlays and has a minimum practical resident main memory requirement of 64K bytes; additional memory up to a total of about 100K bytes is utilized if available. B4 is the primary Century 251 operating system.

All of the Century Series compilers, assemblers, utility routines, and applications programs described in Report 70C-656-01 can be used by NCR 251 systems.

PRICING

EQUIPMENT: The following systems illustrate typical Century 251 configurations. All necessary control units and adapters are included in the indicated prices, and the quoted 1-year lease prices include equipment maintenance.

SMALL CENTURY 251 DISC SYSTEM: Consists of 96K-byte Century 251 Processing Unit and main memory, 657-102 Dual-Spindle Disc Unit (2 drives, 96 million bytes total), 686-102 Card Read/Punch (800/83-294 cpm), and 640-102 Printer (450/900 lpm). Monthly rental and purchase prices are approximately $10,150 and $475,950, respectively.

CENTURY 251 TAPE/DISC SYSTEM: Consists of 256K-byte Century 251 Processing Unit and main memory, two 657-102 Dual-Spindle Disc Units (4 drives, 120 million bytes total), eight 633-211 Magnetic Tape Units (144KB), 680-201 Card Reader (1200 cpm), 686-302 Card Punch (83-294 cpm), and 640-300 Printer (1200 lpm). Monthly rental and purchase prices are approximately $17,675 and $838,150, respectively.

SUPPORT: NCR systems support is billed to Century 251 users at the rate of $25 per hour or $150 per day. Each user is entitled to a maximum amount of "free" NCR support equal to twice the monthly rental of the system. Additional support is billed separately.

EDUCATION: All educational services are separately priced. Every Century 251 installation receives a total educational allowance of $6,000 over the life of the system, which provides basic training for four people.

CONTRACT TERMS: The standard NCR Century rental contract permits 200 hours of use per month. Occasional extra-shift operation beyond 200 hours per month is billed at the rate of 20% of the hourly rate for the Basic System and 10% of the hourly rate for all additional components. An unlimited-use contract is available at an additional charge of 10% over the basic rental. A 50% purchase option credit applies to all NCR Century Series equipment. A test and compile allowance of 80 hours is provided at no additional charge. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*
BASIC SYSTEM				
Century 251 Basic System, including:				
615-251/618-053	Processor with 96K-byte core memory	$319,600	$1,050	$6,800
Substitutions for Century 300 Basic System:**				
615-251/618-103	Processor with 128K-byte core memory	9,400	30	200
615-251/618-153	Processor with 192K-byte core memory	51,700	155	1,100
615-251/618-203	Processor with 256K-byte core memory	94,000	280	2,000
PROCESSOR FEATURES				
6360	Additional High-Speed Trunk Group (First set of two additional trunks)	14,000	20	300
6361	Additional High-Speed Trunk Group (Second set of two additional trunks)	14,000	20	300
6362	Time-of-Day Clock	2,200	0	50

* Rental prices include equipment maintenance.

** Substitution prices are added to Basic System price.