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NCR Century 300

MANAGEMENT SUMMARY

The NCR Century 300, announced on September 22, 1970, is the long-promised upward extension of the Century Series product line that NCR has been marketing since March 1968. Judging from its initial specifications, the Century 300 should fulfill most of the promises. It provides impressive hardware and software facilities for multiprogrammed batch processing of business and scientific applications. It should also be an effective performer in real-time and data communications environments when NCR delivers the improved communications multiplexor and supporting software which are currently under development.

Thus, the Century 300 shapes up not only as the logical choice for current users of the NCR 315/RMC or Century 200 computers who need more processing power, but also as a system that merits careful consideration by most companies shopping for a new medium-scale computer.

Monthly rentals for Century 300 systems will begin at about $15,000, with most systems falling into the $20,000 to $25,000 range. Customer deliveries are scheduled to begin in February 1972.

The Century 300 has been designed to maintain full program and software compatibility with the smaller Century 200 Processor. Even the input/output commands have been left unchanged, so that it will be possible to run Century 200 object programs on a Century 300 without recompilation. ▷

A 650-nanosecond core memory with 4-way interleaving, together with overlapped instruction set-up and execution plus 18-way I/O simultaneity, make the NCR Century 300 a formidable new contender in the medium-scale computer market. Full upward compatibility is maintained with the smaller Century computers.

CHARACTERISTICS

MANUFACTURER: The National Cash Register Company, Dayton, Ohio 45409.
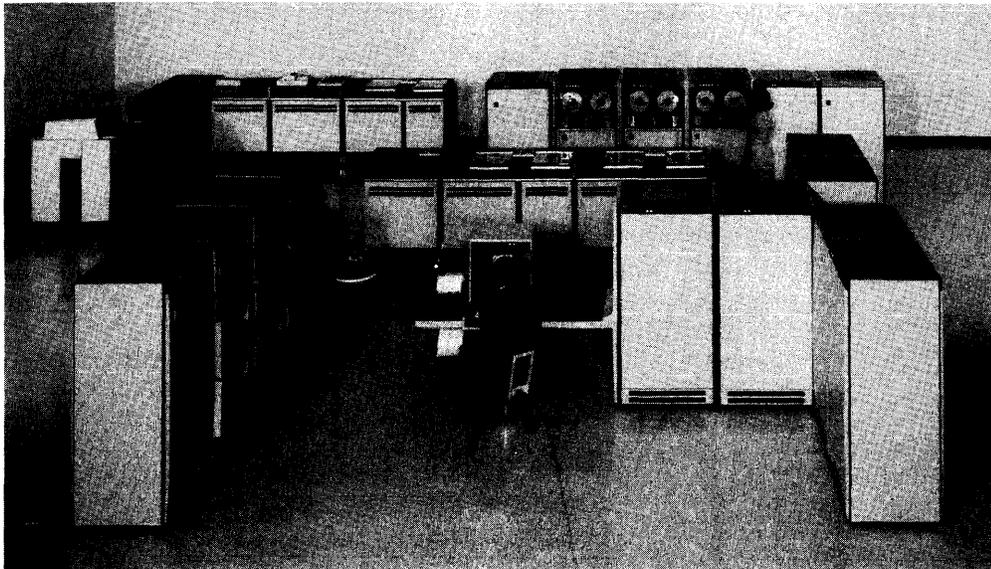
MODEL: NCR Century 300.

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."

FIXED-POINT OPERANDS: Can range from 1 to 256 bytes in length, in either decimal or binary mode. (In the "word binary" mode, which takes particular advantage of the Century 300'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. ▶

NCR's new 2314-style disc drives, which can store up to 47.7 million bytes per 11-disc pack, are shown at the left foreground of this large Century 300 configuration. The central processor is at right.

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▷ As compared with the smaller NCR Century computers, the Century 300 offers the following major improvements and innovations:

- Internal processing speeds which are four to five times as high as those of the Century 200.

- From 131K to 2097K bytes of core storage with a 650-nanosecond cycle time per 4-byte access.

- Four independently cycling core memory modules with 4-way interleaved addressing.

- Overlapped operation of two independent functional units—an Instruction Look-Ahead Unit and an Execution Unit—within the central processor.

- An Input/Output Control Unit capable of handling 18-way I/O simultaneity and a total data rate of up to 4.3 million bytes per second.

- An expanded repertoire of 67 standard instructions, including full arithmetic facilities (add, subtract, multiply, and divide) for four types of operands: variable-length packed decimal fields, 32-bit binary words, and both single- and double-precision floating point. Also included are add and subtract instructions for variable-length binary and unpacked decimal fields.

- A 16-level priority interrupt system.

- A standard Operator Communication Center that includes a CRT display, printer, keyboard, and control panel.

- A new high-speed drum, Model 650-101, that stores up to 4.2 million bytes with an average access time of 8.3 milliseconds and a data transfer rate of 1 million bytes per second.

- A new high-density disc controller that boosts the storage capacity of the recently announced Model 657 Disc Units from 29.8 million to 47.7 million bytes per 11-disc pack.

The Century 300 Processor uses monolithic integrated circuits of the same basic type used in the smaller Century 100 and 200 systems. "Hard-wired" logic is used in preference to the more flexible (but often slower) microprogramming control techniques employed in many other recently announced computers. The NCR 315 and IBM 1401 emulators which are optional features for the Century 200 Processor will not be available for the Century 300. ▷

▶ INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: 131,072 to 2,097,152 bytes. A system can include from 1 to 8 Memory Storage Units (MSU's) containing 131,072 or 262,144 bytes each. The 131K MSU consists of four 32,768-byte memory modules which cycle independently, while the 262K MSU consists of four independent 65,536-byte modules.

CYCLE TIME: 650 nanoseconds per 4-byte access. (Alternatively, one, two, or three bytes can be accessed during each cycle.) Word addresses are interleaved among the four memory modules within each MSU to permit overlapped accessing.

CHECKING: Parity bit with each byte 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.

CENTRAL PROCESSOR

INDEX REGISTERS: 63 for each active program, located in main storage.

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

INSTRUCTION REPERTOIRE: 67 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, multiply, 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: 10 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. ▶

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▷ NCR's choice of conventional magnetic core storage for the Century 300's main memory must be viewed as an indication that the "short-rod" thin-film memory used in the Century 100 and 200 Processors has left something to be desired in the way of production cost, performance, and/or reliability. (Core storage is now offered as an alternative to the short-rod memory for the Century 200 as well.)

In addition to the new drum and high-density disc pack drives, the Century 300 can use virtually all of the peripheral equipment now available for the Century 100 and 200 systems. Among these are magnetic tape units with speeds of up to 240,000 bytes per second, drum printers with alphanumeric printing speeds of up to 1500 lines per minute, optical and magnetic character readers, and a fairly broad selection of other input/output devices. Also available are NCR's smaller dual-spindle disc units, which store up to 4.2 million bytes in each removable 3-disc pack, and the venerable CRAM unit, which provides economical on-line storage for large files with comparatively low activities. The flexibility of the Century 300 hardware is somewhat limited, however, by the fact that no dual-channel peripheral controllers and no facilities for effective multiprocessing have been announced to date.

Software for the Century 300 will consist of all the facilities currently available for the Century 100 and 200 plus some significant additions and improvements. The existing software facilities, all disc-oriented, include three levels of operating systems, compilers for the COBOL and FORTRAN languages, an assembler for NCR's NEAT/3 language (which places strong emphasis upon the use of macro-instructions to facilitate coding), and an impressive assortment of utility routines and business-oriented application packages.

The current multiprogramming operating system will be upgraded to take advantage of the increased hardware capabilities of the Century 300. Newly announced software facilities include a conversational-mode compiler for the BASIC language and two program translators that should ease the conversion task for installations which are currently using NCR 315/RMC or IBM System/360 computers.

Customer support for the Century 300 will be supplied under the "partial unbundling" plan which NCR announced in September 1969. NCR supplies certain essential and predetermined systems support, educational assistance, and software without extra charge. Once the basic allotments have been exceeded, any additional NCR services that may be needed are separately priced.

Though the Century 300 blazes no new trails in either hardware or software technology, it shapes up as a ▷

The Century 300's Operator Communication Center, an integral part of the central processor, includes a CRT display, keyboard, printer, and control panel.

► ● **Special:** 12 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 TIMES: Internal speed of the Century 300 Processor is approximately four to five times as fast as the Century 200. Execution times for individual instructions will vary because of the overlapped operation of the Instruction Look-Ahead Unit and Execution Unit and their interaction with other system components. Some average execution times, assuming no indexing or indirect addressing, are as follows:

Move and add (c = a + b) for unpacked 5-digit decimal fields: 9 microseconds.

Move and multiply (c = a x b) for signed, packed 5-digit decimal fields: 20 microseconds.

Move and divide (c = a ÷ b) for signed, packed 5-digit decimal fields: 15.3 microseconds.

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 10 milliseconds.

CONSOLE: The Operator Communication Center, an integral part of the Century 300 Processor, includes a control console, I/O writer, and CRT display system. A typewriter-style keyboard is shared by the I/O writer and the display. The I/O writer is a character-at-a-time printer, rated at 66 words per minute, that produces a hard-copy log of each day's activities. The CRT display provides the operator with rapid access to status information and operating instructions. ►

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▷ well-designed, state-of-the-art system that should help to keep current NCR computer users happy and also win some significant new accounts for the company. □

► INPUT/OUTPUT CONTROL

I/O CHANNELS: Six High-Speed Trunks and one Multiplexor Trunk are standard. Four "Very High-Speed Trunks" are available as an optional feature.

CONFIGURATION RULES: Each of the six High-Speed Trunks provides four positions for free-standing peripheral units and/or controllers. The Multiplexor Trunk provides eight positions, three of which are reserved for the interval timer, I/O writer, and CRT display system; the other five positions are available for free-standing peripherals. Each of the four optional Very High-Speed Trunks provides eight positions for free-standing peripherals.

SIMULTANEOUS OPERATIONS: Concurrently with computing, one I/O operation can occur on each of the six High-Speed Trunks, on each of the eight subchannels of the Multiplexor Trunk, and on each of the four Very High-Speed Trunks (if installed). Also, the Input/Output Control Unit and the Instruction Look-Ahead and Execution Units of the Processor can all access main storage simultaneously.

I/O DATA RATES: For the High-Speed Trunks, the maximum transfer rate is 850,000 bytes/second for a single trunk or 240,000 bytes/second for each trunk when 18 I/O devices are operating simultaneously. The Multiplexor Trunk accommodates a maximum total data rate of 210,000 bytes/second and a maximum rate of 190,000 bytes/second on any one subchannel. For the optional Very High-Speed Trunks, the maximum transfer rate is 1,100,000 bytes/second for a single trunk or 650,000 bytes/second for each trunk when 18 I/O devices are operating simultaneously. The maximum total I/O data rate for a Century 300 system is 4.3 million bytes/second.

I/O INTERFERENCE: The maximum system I/O data rate of 4.3 million bytes/second can be maintained with a central processor degradation of less than 3 percent, according to NCR.

MASS STORAGE

650-101 DRUM: Provides fast access to frequently referenced information such as systems software, file directories, and high-activity files. Stores 4,194,304 bytes in 512 data tracks, each served by a fixed read/write head. Data is read and written in two tracks in parallel, and each 2-track group holds thirty-two 512-byte sectors. Average rotational delay is 8.3 milliseconds, and peak data transfer rate is 1,000,000 bytes/second. The 628-101 Drum Controller connects one or two 650-101 Drums to one of the optional Very High-Speed Trunks of the Century 300 Processor. The controller accepts and queues up to four I/O requests, and then executes them in the sequence in which the addressed sectors pass under the read/write heads.

657-101/102 DISC SUBSYSTEM: Provides large-capacity random-access storage in removable 11-disc packs. Available in either a one-spindle unit (Model 657-101) or a two-spindle unit (Model 657-102). Each spindle holds one disc pack and has a comb-like access mechanism with one head serving each of the 20 data recording surfaces. Average head movement time is 60 milliseconds, and average rotational delay is 12.5 milliseconds. The 11-disc packs are physically compatible with those used in the IBM 2314 Direct Access Storage Facility, though the recording formats differ. A Disc Controller connects up to four disc units (eight spindles) to one position of a Century 300 I/O trunk. Capacity and data transfer rate depend upon which of two controllers is used:

● The 625-201 Disc Controller records data at a density of 2200 bpi. Maximum data capacity is 7459 bytes per track, 149,180 bytes per cylinder, and 29.8 million bytes per 11-disc pack. Data transfer rate is 315,000 bytes/second.

● The 625-202 Dual-Density Disc Controller can record data at either 2200 or 3500 bpi, under programmed control. Maximum data capacity at the higher density is 11,944 bytes per track, 238,880 bytes per cylinder, and 47.7 million bytes per pack. Data transfer rate is 500,000 bytes/second.

655-201 DUAL-SPINDLE DISC UNIT: Has two independent spindles, each capable of driving a removable 3-disc pack. Each pack stores 4,194,304 bytes. Recording format is eight 512-byte sectors per track. Twelve read/write heads serve each of the six recording surfaces, and up to 262,144 bytes of data can be read without head movement. Average head movement time is 44.7 milliseconds, average rotational delay is 20.8 milliseconds, and data transfer rate is 108,000 bytes/second. Up to four disc units (eight spindles) can be connected to a 625-101 Disc Controller.

653-101 CRAM (Card Random Access Memory): Provides relatively low-cost random-access storage for large data files. Each unit stores 145 million bytes of data in a removable cartridge containing 384 oxide-coated Mylar cards. Each card has 144 tracks, and each track can hold 2623 bytes of data. A 36-head access mechanism moves to one of four positions to serve all the tracks. Card drop time is 90 to 125 milliseconds, head movement time is approximately 25 milliseconds, average rotational delay is 24 milliseconds, and data transfer rate is 83,000 bytes/second. Up to eight CRAM units can be connected to a 623-201 CRAM Controller.

INPUT/OUTPUT UNITS

All of the NCR century 100 and 200 input/output units (except the Integrated Card Reader and Integrated Punched Tape Reader) can also be used with the Century 300. Please refer to Report 70C-656-01 for descriptions of these units.

COMMUNICATION CONTROL

621-101 COMMUNICATIONS CONTROLLER: Controls up to 15 lines, at transmission speeds of 45 to 40,800 bits/second. Has a 16-position scanner and single-character buffer. Most I/O control functions must be performed by the Century 300 Processor.

NCR states that a larger communications controller, capable of handling up to 256 lines, is due to be released during the last quarter of 1970. ►

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▶ In addition, the 622-601 Processor Intercoupler permits high-speed direct interchange of information between two NCR Century computers at the same site.

SOFTWARE

The Century 300 will be able to utilize all of the software currently available for the Century 100 and 200 systems, as described in Report 70C-656-01. Century 300 users will naturally tend to use the highest available levels of the operating system and compilers.

In addition, NCR has announced some new and enhanced software facilities that will be of particular interest to Century 300 users, as described in the following paragraphs.

MULTIPROGRAMMING EXECUTIVE (B3): This multiple-partition operating system, already in use on the Century 200, will be upgraded to take advantage of the increased hardware capabilities of the Century 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 is scheduled for delivery with the first Century 300 systems in February 1972.

A still more powerful multiprogramming operating system, called B4, is currently under development and scheduled to become fully operational by August 1972. Among the promised extensions are: (1) spooling of card input 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 among active programs, (5) checkpoint and restart facilities to aid in recovery from system failures, and (6) dynamic reallocation of peripheral devices and main storage.

BASIC: A new compiler for BASIC, an algebraic language designed for time-sharing computers, can be used on both Century 200 and 300 systems. A pilot version is currently in operation on the Century 200. Programs are compiled as they are entered from remote teletypewriters, and can be executed immediately. Diagnostic messages permit on-the-spot correction of many errors. An accounting routine facilitates billing by recording the amount of computing time used by each programmer at each terminal.

NCR 315/RMC TRANSLATOR: Translates programs written in NEAT assembly language for the NCR 315/RMC computer into NEAT/3 source statements for the Century 300. The translator itself runs on the 315/RMC. Input is from punched cards, and output is on either cards or magnetic tape, together with a printed listing. Source statements that cannot be automatically translated are flagged on the listing for manual recoding.

360 BAL TRANSLATOR: This program, currently under development, is designed to translate IBM System/360 Basic Assembler Language (BAL) source programs into NEAT/3 source programs that can be compiled and executed on a Century 300. The translator will handle BAL programs that run under any of the standard IBM operating systems (OS, DOS, TOS, or BOS). Source statements that cannot be automatically translated are flagged on the printed listing for manual recoding. NCR states that the BAL Translator will be released only when and if a reasonable level of translation effectiveness is achieved.

PRICING

CENTURY 300 TAPE/DISC SYSTEM: Consists of 262K Processor, two 657-102 Disc Units (four spindles—up to 190 million bytes) and Dual-Density Disc Controller, three 633-221 Magnetic Tape Handlers (six drives—144KB), 640-200 Printer (1500 lpm), 686-201 Card Reader (750 cpm), 686-301 Card Punch (75-240 cpm), and all necessary control units. Monthly rental and purchase prices are approximately $21,700 and $1,005,000, respectively.

SOFTWARE: In the future, NCR software will either be priced separately or included in the price of the hardware, depending on the "value and uniqueness" of each offering. At present, only one package, the NCR Law Enforcement System, is separately priced; its three modules rent for $195/month each. Other separately priced software offerings may be announced with a 2-month minimum notice.

SYSTEMS SUPPORT: Users of Century 300 systems are entitled to $25,000 worth of NCR systems support services for the first $15,000 of monthly equipment rental, plus $200 worth of additional support for each $100 of rental between $15,000 and $25,000, plus $150 worth of additional support for each $100 of rental over $25,000. These allotments are based on a systems support charge of $25 per man-hour. Additional support beyond the allotted amount is separately priced at $25 per hour, with a half-day minimum charge.

EDUCATION: All educational services are separately priced. Every Century 300 installation receives a total educational allowance of $8,000 over the life of the system. This allowance provides basic training for four people. Prices of some specific NCR courses are as follows:

NEAT/3 I	$450
NEAT/3 II	275
COBOL	450
Operating Software	275
Century 300 Operating Systems	250
Century 300 Operator's Course	300

TESTING: A Century 300 user receives a "test and debug allotment" of 80 hours of machine time for the first $10,000 of monthly equipment rental, 5 hours for each $1,000 of rental from $10,000 to $20,000, and 3 hours for each $1,000 of rental over $20,000.

CONTRACT TERMS: The standard NCR rental contract for the Century 300 permits unlimited use of the equipment and includes prime-shift maintenance service. Additional maintenance coverage is available at extra cost. All Century 300 rental contracts are for a one-year minimum term; long-term leases are not available from NCR at this writing. A 50% purchase option credit applies to all rented NCR Century Series equipment. ■

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EQUIPMENT PRICES*

	Purchase Price	Monthly Maint.	Rental (1-year lease)**
PROCESSORS AND MAIN STORAGE			
Century 300 Basic System, including:	451,000	690	9,800
615-300 Processor			
618-100 131K-Byte Memory Storage Unit			
Century 300 Basic System, including:	589,000	800	12,800
615-300 Processor			
618-200 262K-Byte Memory Storage Unit			
Additional Main Storage:			
618-100 131K-Byte Memory Storage Unit	184,000	180	4,000
618-200 262K-Byte Memory Storage Unit	322,000	290	7,000
Processor Features:			
6301 Memory Extension (131K to 262K)	138,000	110	3,000
6302 Back-Up Memory Ports	6,200	0	135
6303 Time-of-Day Clock	2,200	0	50
6304 Very High-Speed Trunks (4)	11,500	22	250
MASS STORAGE			
650-101 Drum (4.2 million bytes)	124,200	520	2,700
628-101 Drum Controller (for up to 2 drums)	40,250	50	875
625-202 Dual-Density Disc Controller (for up to four 657-101 or 657-102 Disc Units)	49,450	70	1,075

* Please refer to the NCR Century 100 & 200 Equipment
Prices (Report 70C-656-01) for prices of the peripheral
equipment that can be used with a Century 300.

** Rental prices include equipment maintenance