NCR CENTURY

75/150 SYSTEMS TECHNICAL SUMMARY

NCR

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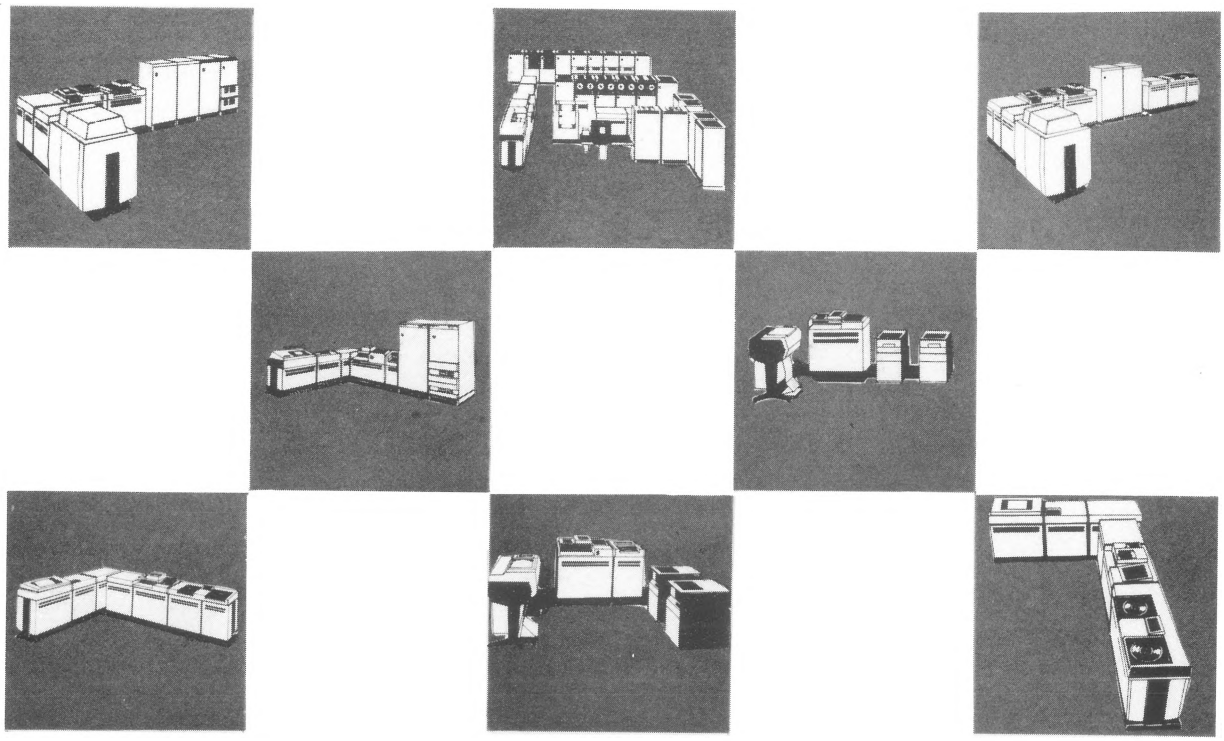
The information contained in this document was accurate at the time of publication; however, new product developments may have caused some specification changes since that time. For the latest information on any NCR product or system, contact your local NCR representative.



THE NCR CENTURY SERIES

The first NCR Century Series computer systems were released in March 1968. The result of hundreds of man years of research effort and practical experience in systems design, these computers represented a new departure in electronic data processing. For the first time, the advantages of random and sequential magnetic file processing were available for small-scale installations at a price the user could readily afford. For the first time, a major computer manufacturer had designed a complete family of systems around the concept of upward compatibility of hardware and software, covering the full spectrum of processing requirements. The basic member of the series is a low-cost, self-contained, disc file system. In the mid-range are system configurations that will meet any intermediate processing requirements with provision for online and multiprogramming. Large, sophisticated systems have been developed . . . and are continually being developed . . . to complete the family and extend its capabilities.

Upward compatibility is one of the hallmarks of the NCR Century Series. Concurrent hardware and software development, common input/output handling, standardization of the data base on an 8-bit ASCII-compatible character, and a modular approach to software design mean that the user of the smallest member of the Series can conceivably progress to the most sophisticated system without ever reprogramming existing applications.

THE NCR CENTURY 75 SYSTEM

The NCR Century 75 System is designed to cater for businesses entering high speed magnetic file processing for the first time.

In its basic form the NCR Century 75 System consists of :

- An NCR Century 101 processor with 16 K bytes of memory;
- Two 656 disc units, providing almost 10 million bytes of directly accessible magnetic storage;
- A 649 buffered printer, providing print speeds of up to 300 lines per minute;
- Either a punched card reader, that operates at 300 cards per minute, or, a paper tape reader that operates at 1000 characters per second;
- An I/O writer is a requirement of systems with paper tape reader, and can be taken as an option on any system. Two models of I/O writer are available, either a mechanical teletype unit operating at 6 characters per second, or a thermal printer operating at 30 characters per second.

THE NCR CENTURY 150 SYSTEM

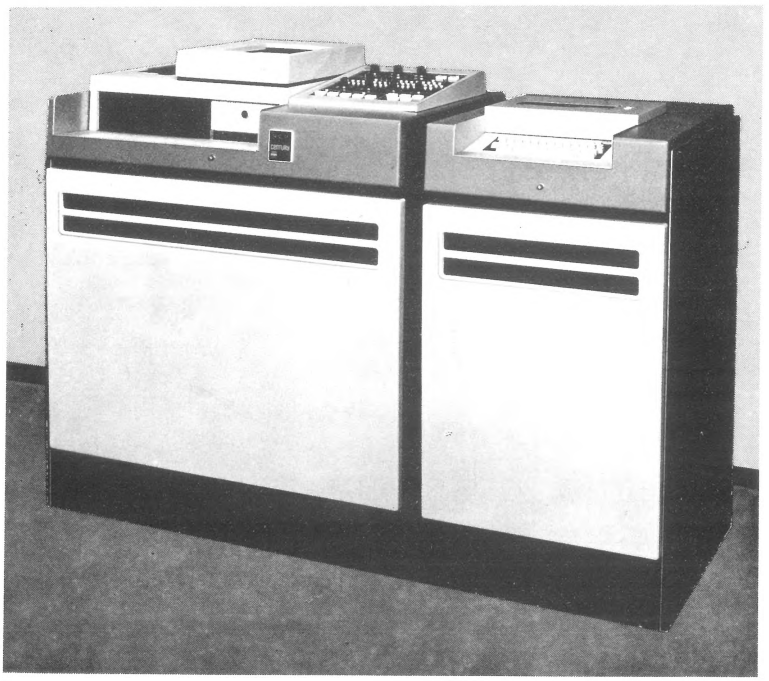
The NCR Century 150 System is designed to provide users of NCR Century 100 systems with a means of improving their throughput at a moderate cost.

In its basic form the NCR Century 150 System consists of :

- An NCR Century 101 processor with 24 K bytes of memory;
- A dual spindle 657 disc unit, providing over 50 million bytes of directly accessible magnetic storage;
- A 640-300 printer, with a 626 buffer-controller, which can print at speeds of up to 1200 lines per minute;
- Either a punched card reader, that operates at 300 cards per minute, or, a paper tape reader that operates at 1000 characters per second;
- Two models of I/O writer are available, either a mechanical teletype unit operating at 6 characters per second, or a thermal printer operating at 30 characters per second.

HARDWARE

THE NCR CENTURY 101 PROCESSOR



The newest member of the NCR Century series of processors is the NCR Century 101. Improvements reflecting the latest technological advances have been incorporated into the NCR Century 101, while still retaining the best features of earlier processors.

- **GREATER GROWTH POTENTIAL AND FLEXIBILITY**

  The memory of the NCR Century 101 processor can be expanded up to its maximum size of 64K bytes without changing its physical size. The central processor, as well as memory, logic circuity and power supplies are housed in a single, freestanding, 'low-boy' cabinet. The high speed disc and high speed printer, present in every system based on the 101 processor, combine to make a very powerful and flexible system, which can be augmented by the addition of such features as a communication package.

- **IMPROVED I/O SCHEME**

  Certain changes to basic NCR Century input/output design have been incorporated in the 101 processor to improve the efficiency of the system. These changes include a position priority scanner on the low speed common trunk and a bandwidth of 416KB on the high speed trunk. Two optional trunks provide an additional 16 peripheral positions, allowing a wide range of I/O facilities for batch, online, and real time applications.

- **COMMUNICATION CAPABILITIES**

  An optional communications interface permits up to 10 communication lines to be connected to the common trunk. A complete line of adapters extends the capabilities of the unit to a wide variety of applications. The NCR Century 101 is capable of functioning as a remote batch entry system collecting data for transmission to a larger system, or as the central system processing data from remote locations.

- **SOFTWARE COMPATIBILITY**

  The NCR Century 101 is completely compatible with existing NCR Century software. Upgrading to a larger member of the Series does not require the recompilation of programs. A variety of programming languages is available to meet a broad range of applications. All compilers - the NEAT/3, COBOL, and FORTRAN - generate object coding directly from source statements.

MEMORY

The NCR Century 101 processor uses core memory for data and program storage and is expandable in increments of 8,192 bytes up to 32K bytes and then in increments of 16,384 bytes up to 64K bytes.
Up to 16K (K = 1024 bytes) of memory can be contained on one 11" x 14" module in the processor. The addition of memory merely requires the insertion of additional modules. The maximum memory size of 64K requires only four modules and can be contained in one cabinet.

The NCR Century 101 memory has a cycle time of 1.2 microseconds. During each cycle, the system reads two bytes or writes one or two bytes of data. Memory also includes 63 index registers that are used to modify command operand addresses.

Memory Addressing

Memory locations are consecutively numbered starting with 0. Each number is considered the address of the corresponding byte and is addressable. Attempting to access a memory location greater than actual memory size results in an immediate program error (PE) condition.

Data Representation

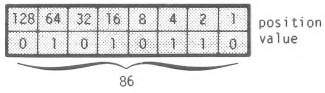
The basic storage unit is the byte, which is represented in the NCR Century 101 by eight information bits and one parity bit; the parity bit is not accessible to a user program. The eight bits in a byte may represent an 8-bit binary number, 4- or 8-bit binary-coded decimal numbers, or an 8-bit NCR Century character.

NCR CENTURY CODE CHART

B_8 B_7 B_6 B_5	B_4 B_3 B_2 B_1 →	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
↓		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	NL/LF	VT	FF	CR	SO	SI
0001	1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
0010	2	SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
0011	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
0100	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0101	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
0110	6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
0111	7	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	DEL

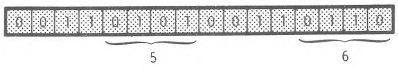
- Unsigned Binary

If the byte illustrated below is considered as an 8-bit binary number, its decimal equivalent is 86. An unsigned binary field is always assumed to be positive; a negative binary field is represented in 2's complement form.



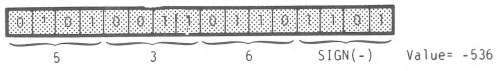
- Unsigned Binary-Coded Decimal

If the configuration below is considered as two unsigned BCD digits, decimal values are 5 and 6. Only the four least-significant bits in an unsigned BCD byte are significant; the remaining bits are non-functional in an arithmetic operation. A negative, unsigned BCD number is represented in 10's complement form.



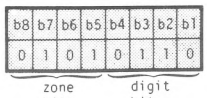
- Packed Binary-Coded Decimal

In this form, bits are blocked in groups of four, each group representing one BCD digit. A packed BCD field may be signed or unsigned.



- NCR Century Code

If the configuration below is treated as a character in NCR Century Code, it is equivalent to "V". Note that in the code chart, bit 8 is always 0. This configuration conforms to the American Standard Code for Information Interchange.



Object program commands are stored in memory in either 1-address (4-byte) or 2-address (8-byte) format. Even though many commands require two operand addresses, the two formats are functionally equivalent inasmuch as the 1-address format assumes the B operand address from the preceding command. All hardware command operation is memory-to-memory; in general, the results of an arithmetic operation replace the original contents of the B operand address.

INSTRUCTION FORMAT

The NCR Century 101 hardware command set offers maximum flexibility in 37 instructions. Thirty-four are standard; three are optional. The basic command format consists of eight bytes:

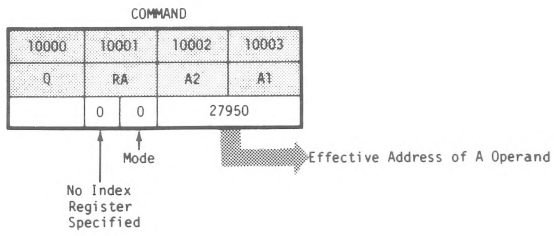
- Q – A 1-byte field specifying the command code (bits 1 through 7) and the command format (bit 8 indicates a 1- or 2-address command).
- RA/RB – One-byte fields that may be used to specify an index register whose contents modify the A or B operand address and to designate one of four modes of addressing.
- A2A1/B2B1 – Two-byte fields used in determining the memory locations of the A and B operands.
- T – A 1-byte field specifying the length of the A and B operands.

INDEXING AND ADDRESSING SCHEMES

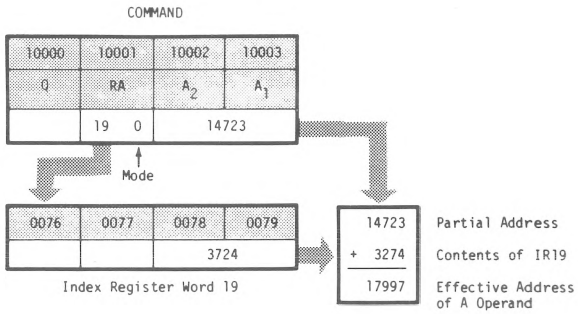
The NCR Century 101 permits four modes of addressing and the use of indexing with each mode. The RA/RB characters of the command specify whether indexing is to be performed, the index register to be used, and which mode of addressing is required. The two low-order bits of the character designate the mode; the six high-order bits designate the index register, if any. If the binary value of the six high-order bits is zero, no indexing is specified and the partial address (A2A1 or B2B1) becomes the effective operand address in modes 0 and 3; in modes 1 and 2, the partial address becomes the effective intermediate address.

Mode 0

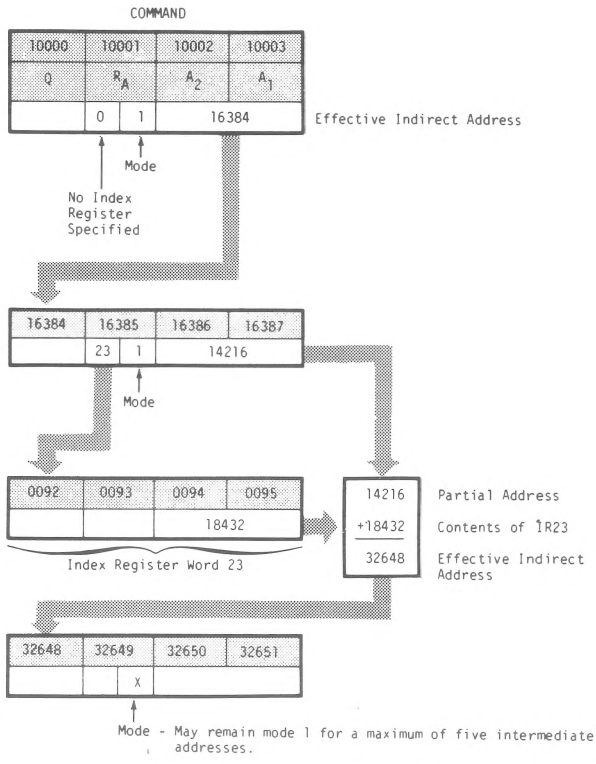
If b8 – b3 of the R character equal zero, no index register is specified, and the A2A1 or B2B1 characters form the effective address.



If b8 – b3 of the R character do not equal zero, the A2A1 or B2B1 characters are added to the contents of the specified index register to form the effective address; the contents of the index register are unchanged.

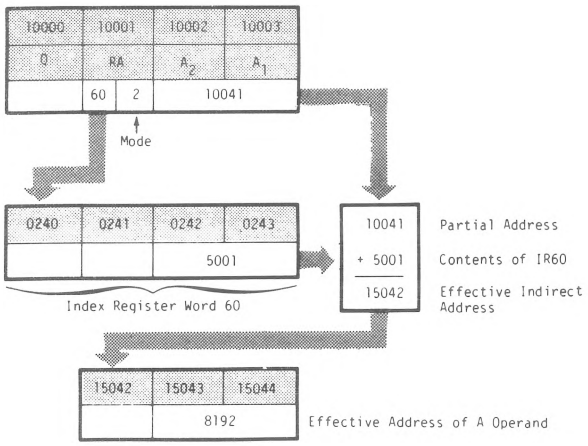


Mode 1



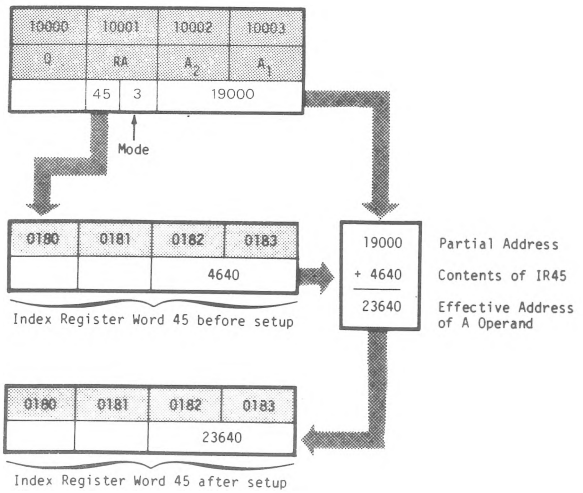
In mode 1 addressing, the A2A1 or B2B1 characters are added to the specified index register to form an intermediate address. (If no index register is specified, the A2A1 or B2B1 characters themselves are the intermediate address.) The contents of the 4-byte field specified by the intermediate address are read out of memory and used to form another intermediate address, provided there is no change in mode. Mode 1 can be repeated a maximum of five times. If no mode change has been initiated by the sixth repetition, an error occurs. A change to mode 0, 2, or 3 may be initiated at any of the intermediate fields referenced. Whichever mode is specified, the conventions governing that particular mode are followed until the addressing flow is complete.

Mode 2



In mode 2 addressing, the A2A1 or B2B1 characters are added to the contents of the specified index register to form an intermediate address. (If no index register is specified, the A2A1 or B2B1 characters are themselves the intermediate address.) This intermediate address locates a 3-byte field whose contents are the effective address for the operand.

Mode 3



Mode 3 functions in exactly the same way as mode 0, with one exception: during command setup, the specified index register is updated to contain the effective address of the A or B operand.

The number of indexing/addressing combinations possible gives the NCR Century 101 programmer considerable flexibility in data manipulation, table handling, and file processing.

IMPLIED T AND B OPERATION

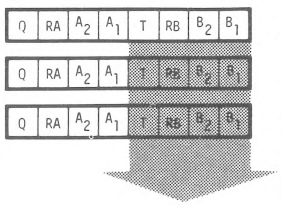
All commands that terminate normally have predictable length and B-operand values available for use by subsequent commands. Thus, any command may be coded in a 1-address format with the second operand and length implied (B2B1 and T characters derived from a previous 2-address command). The setup of the 1-address command does not disturb these values, and they are used as if the current command had set them up. Certain commands may not be followed by a 1-address command, but, in general, this characteristic can be used to eliminate unnecessary setup time by permitting many 1-address commands to be strung to a 2-address command. For example:
Given K, L, and M as memory locations, and the commands:

MOVE T characters from K→N
ADD L
ADD M

the total operation (K + L + M→N) could be executed as follows:

1. MOVE is a 2-address command that stores the contents of K in N, specifying the length and B operand address (N) for the commands that follow.

2. Using the length and B operand values derived from the MOVE command, the contents of L and M are added sequentially to the contents of N, and the result each time is stored in N. In this example, the chaining process results in a savings of 8 bytes.



MOVE K to N
ADD L *
ADD M *
* Address and length of N are implied

HARDWARE COMMANDS

FIXED POINT BINARY COMMANDS

ADD BINARY
SUBTRACT BINARY
COMPARE BINARY

Fixed point binary commands perform byte-level arithmetic functions in binary form.

DECIMAL ARITHMETIC COMMANDS

ADD SIGNED
SUBTRACT SIGNED
COMPARE SIGNED
ADD UNSIGNED
SUBTRACT UNSIGNED
PACK
UNPACK
MULTIPLY SIGNED (OPTIONAL)
DIVIDE SIGNED (OPTIONAL)

Decimal commands execute arithmetic functions in binary-coded decimal format and pack and unpack data for binary-coded decimal operations.

MOVE DATA COMMANDS

MOVE B RIGHT TO LEFT
MOVE A LEFT TO RIGHT
MOVE A RIGHT TO LEFT

Move commands reduce software overhead by permitting hardware manipulation of data.

LOGIC COMMANDS

DECODE TO DELIMITER
DECODE ALL
LOGIC (OPTIONAL)

Logic commands permit bit manipulation based on Boolean logic, decoding, and bit substitution.

TRANSFER COMMANDS

JUMP
TEST CHARACTER EQUAL
TEST CHARACTER UNEQUAL
TEST BIT
BRANCH OVERFLOW
BRANCH LESS
BRANCH EQUAL
BRANCH LESS OR EQUAL
BRANCH GREATER
BRANCH LESS OR GREATER
BRANCH GREATER OR EQUAL
BRANCH UNCONDITIONAL

If the specified condition is met, all transfer commands set the Control Register to the address specified by the A portion of the command, causing a branch to a subroutine.

SPECIAL COMMANDS

SET IP ON
SET IP OFF
RESTORE
OPTION SWITCHES INPUT
REPEAT
WAIT
INOUT

The special commands are used by the software executive to control peripheral activity and to perform necessary housekeeping functions.

PROCESSOR DESIGN

The NCR Century 101 arithmetic/logic processor performs all command setup, execution, and logical decision using live registers, reserved memory areas, flags, and indicators. During command setup, the processor calculates memory locations and stores them in live registers where they can be readily accessed during command execution. The adder portion of the processor performs all arithmetic functions and establishes the conditions necessary for logic decisions based on the results of arithmetic comparisons. Arithmetic comparisons set flags or indicators to show equal, less, greater, overflow, and similar conditions.

Live Registers

Live registers, part of the hardware, are storage areas that permit the processor to access their contents without requiring a memory cycle. Live registers are used during command setup and execution and in the performance of various other functions to increase processor efficiency.

Reserved Memory Areas

Reserved memory areas are storage areas that contain such data as program status words, error status words, and I/O control words. Unlike live registers, these areas require a memory cycle to transfer information to the processor.

Flags and Indicators

Flags and indicators are used throughout the system to reflect a variety of situations that can occur during operation. Flags, for example, are used to specify the results of comparisons and indexing mode considerations. Indicators, in effect, perform the same function as flags, denoting such things as a repeat condition, an error condition, or a command code trap condition. Flags and indicators may be interrogated directly by the hardware without cycling through memory.

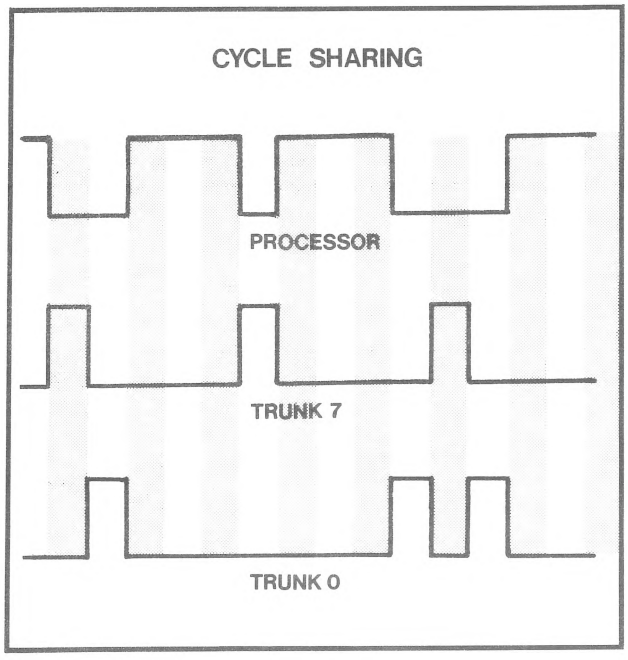
INPUT/OUTPUT OPERATION

The NCR Century 101 Input/Output Unit operates with a minimum I/O configuration of two common trunks, up to a maximum I/O configuration of four common trunks. To permit this growth potential, the I/O control unit has various trunk controls – a data control section with direct access to memory and a peripheral selection control.

I/O operation is initiated by the processor, using information derived from the INOUT command. After the processor initiates peripheral selection on one of the system's trunks, the proper response from the peripheral unit frees the processor to issue another INOUT command for a peripheral on another trunk or to return to processing subsequent program instructions. In either case, the I/O control takes charge of all processor/peripheral communication. An I/O termination must occur on one of the selected trunks before subsequent INOUT commands can be processed on that trunk.

If I/O control and the processor simultaneously request a memory cycle, I/O control takes priority. Since peripheral servicing does not require all the memory cycles available within a given time frame, the processor shares unused cycles and continues processing during data transfer, thus providing the NCR Century 101 with effective simultaneity.

As an example, it is possible to read data from disc, process other data, and carry out transfers on trunk zero, simultaneously. Without the cycle sharing technique, each operation would have to terminate before the next could begin; with cycle sharing, all three operations can proceed within the same time frame.



COMMON TRUNK CONCEPT

The term "common trunk" as used in the NCR Century series does not indicate a single, physical trunk but rather refers to the concept that the processor selects all peripherals with a single hardware command, regardless of the media involved. This approach is possible because trunk interface hardware is located in each peripheral, multiplexor, or control unit. The common trunk concept provides a wide range of input/output facilities for batch, online, and real time applications.

The NCR Century 101 minimum system configuration includes two trunks – one low speed (trunk 0) and one high speed (trunk 7). Two optional trunks – low-speed trunk 1 and high-speed trunk 6 – may be added to the system; each optional trunk provides 8 additional positions. The following table specifies trunk transmission rates for all trunks available with the NCR Century 101. (Transmission rate is measured in kilobytes per second.)

TRUNKS	TRANSMISSION RATE
7	416KBS
6	277KBS
1	166KBS
0	120KBS

I/O Priority

The NCR Century 101 I/O Control unit assigns priority to the trunks connected to the system. Highest priority is assigned to the COT followed by trunk 7, trunk 6, trunk 1, and trunk 0. Trunk 0 has position priority logic as follows:

- PO – Card or punched tape reader
- P3 – Communications interface
- P4-7 – Freestanding peripherals
- P2 – Input/Output writer
- P1 – Console input switches

The I/O control unit contains a priority scanner that monitors all positions on trunk 0 for a data ready signal. Upon receipt of a data ready signal, a path is opened to the I/O logic data flow, which transfers the data character. Upon completion of data transfer, trunk 0 returns to an idle state waiting for another data ready signal. This technique increases system throughput by permitting multiple, simultaneous transmissions from low speed peripherals.

SYSTEM BANDWIDTH

Considering that the total number of memory cycles available for internal processing and input/output to peripherals is the reciprocal of the memory speed, the total system bandwidth of a 1.2 microsecond memory is 833 cycles per second. The maximum number of cycles required for input and output of one character is shown on the table.

The number of cycles is an empirical average based on the extent of buffering on each trunk and the priority scheme outlined above which in certain cases implies some waiting times. Multiplying the number of cycles per character for each trunk by the transfer rate of the highest speed peripheral on that trunk gives an indication of the probability of a given configuration fitting within the total system bandwidth.

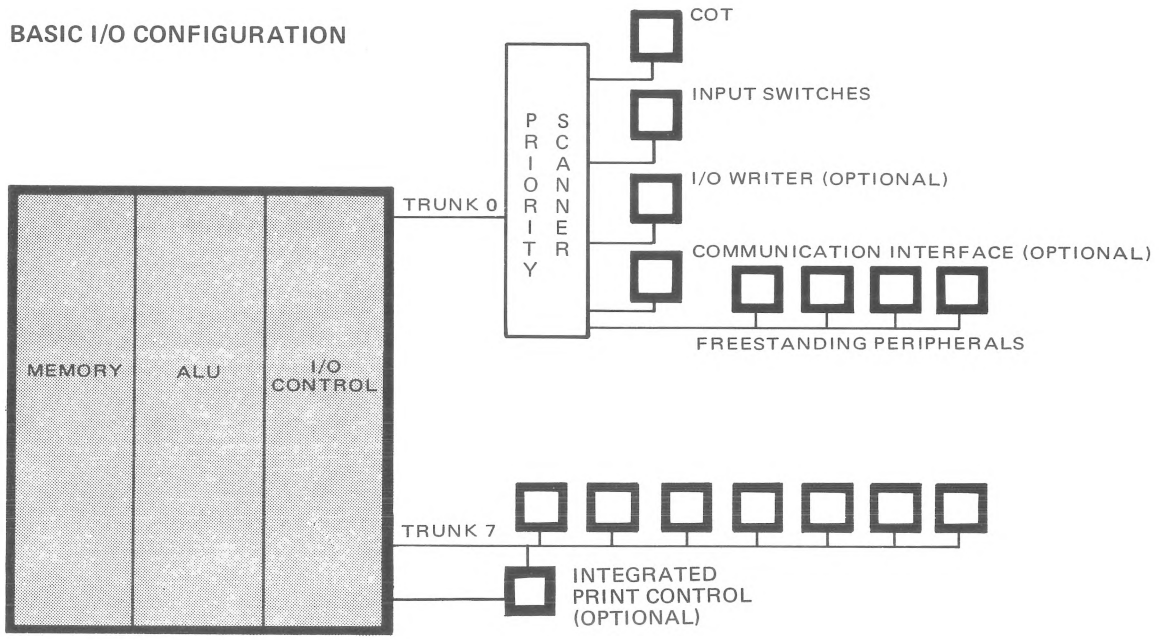
TRUNKS	NUMBER OF CYCLES PER CHARACTER *
7	2
6	3
1	6
0	6

(* Maximum)

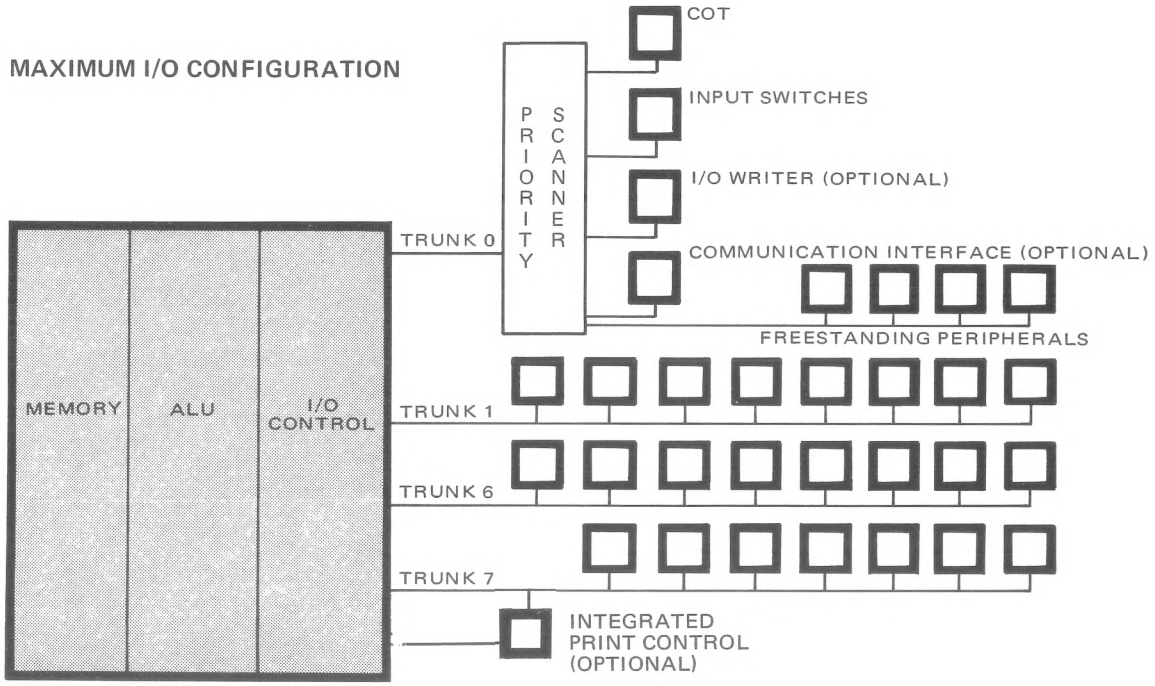
COMMUNICATIONS INTERFACE

The NCR Century 101 can be equipped with online communication capabilities either by adding the integrated communications interface option to position 3 of trunk 0, or by adding a freestanding 621-103 communications multiplexor to any available low-speed common trunk position. The integrated communications interface, which is capable of servicing up to 10 adapters, is designed to satisfy the needs of smaller online systems; the freestanding communications multiplexor (621-103), which is capable of servicing 253 adapters, is designed for larger online systems that require a large number of terminals. The user may elect to begin online processing with the integrated communications interface, then graduate to the multiplexor as his system requirements increase. Thus, the NCR Century 101 can function as a host computer, communicating with a variety of terminals or with another Central Processor.

BASIC I/O CONFIGURATION



MAXIMUM I/O CONFIGURATION



INPUT/OUTPUT DEVICES

The peripherals included in basic systems provide users with powerful and flexible processing systems. However, as processing needs grow, the system can be expanded to meet those needs. In addition to increased memory and two optional trunks, systems based on the NCR Century 101 offer a full range of freestanding peripherals. The variety of peripheral equipment available permits considerable latitude in the design of system configurations. Most peripheral units are offered in several performance levels. This means that a user can select the system that meets his current requirements most economically and can expand the initial system incrementally as the need arises. All peripherals are selected and handled identically by the processor, simplifying programming and operating procedures. High-speed devices are provided with a full range of control units and can be connected to any available position on a trunk provided the peripheral transfer rate does not exceed the trunk transfer rate and the total configuration does not exceed the system bandwidth. The wide range of performance capability and media selection provides a truly flexible system that can be designed to meet most data processing situations.

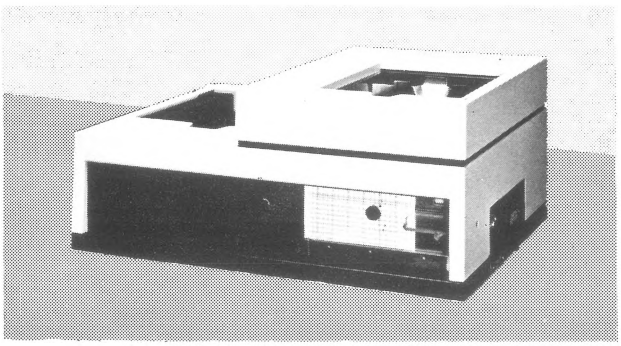
PERIPHERAL CONTROL UNITS

Peripheral control units are used to regulate data transfer between the processor and certain peripherals. These freestanding units provide the interface for level-2 peripherals (peripherals not connected directly to the trunk). Most control units permit several like peripherals to be connected to a single trunk position. Generally, higher speed magnetic file devices are the only peripherals that require control units.

Data is checked for validity within the control unit's logic; for example, parity and sum checks for magnetic tape units are made at the proper time to prevent invalid data from being stored in memory. Since these functions occur offline, they do not affect processing time.

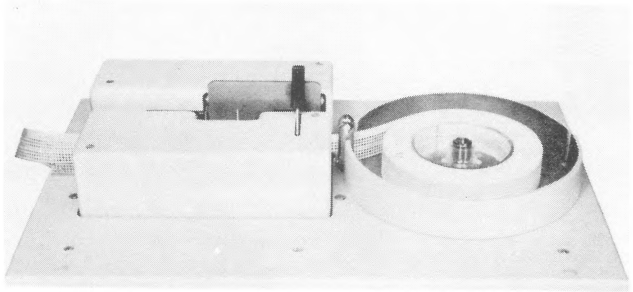
INTEGRATED PUNCHED CARD READER

Photoelectrically reads 80-column Hollerith coded cards at a rate of 300 cards per minute. Reads serially, column by column. Input and output hopper capacities of 1000 cards.



INTEGRATED PAPER TAPE READER

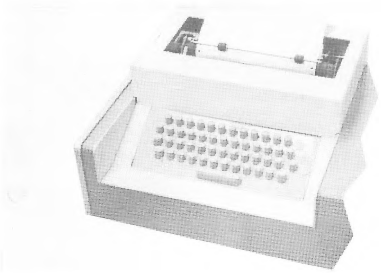
Reads strips of punched tape up to 350 feet in length at 1000 characters per second. Reads 5, 7, or 8 channel tape--any code.



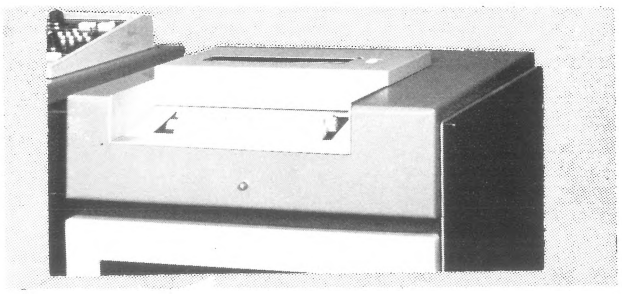
INPUT/OUTPUT WRITER

This device permits keyboard entry of data in response to WAIT messages and provides printed output of software and program messages. Two models are available – an impact printer model and a thermal printer model.

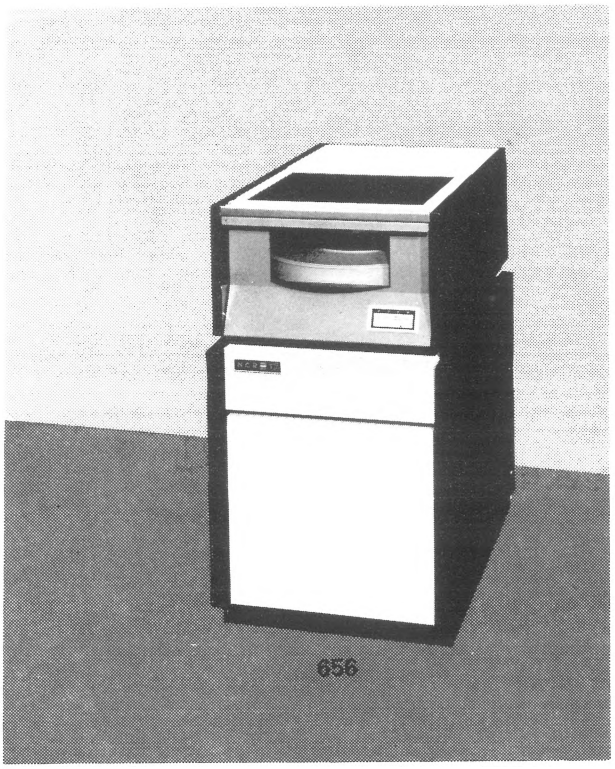
The impact printer features a pin-feed platen on which three-part forms can be typed, keyboard, audible end-of-line signal, line feed, and carriage return. The unit has a transfer rate of six characters per second with a line length of 72 characters.



The thermal printer produces type-written copy using a non-impact printing mechanism. A single print-head consists of small thin-film heating elements arranged in a five by seven dot matrix. A character is printed by heating selected elements of the matrix and bringing them into light contact with a heat-sensitive paper. These features make it possible for the thermal printer to print rapidly and quietly; printing rate is 30 characters per second, 80 characters per line. The thermal printer is equipped with a standard typewriter keyboard.



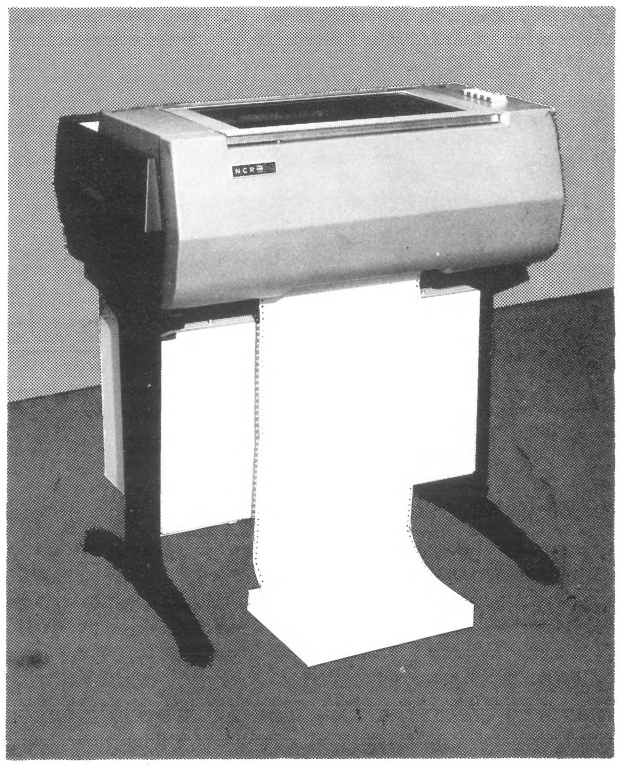
THE 656 DISC UNIT



The 656 Disc Unit is a single spindle unit that holds one removable, and optionally one fixed, 2 surface disc cartridge. Each disc cartridge has a capacity of almost 5 million bytes. The disc drive, common trunk control unit and power supply are all housed in one low profile cabinet. If the fixed cartridge option is taken, almost 10 million bytes of directly accessible storage are provided per disc unit.

DISC UNIT SPECIFICATIONS	
Average Transfer Rate	312.5 kb
Rotational Speed	2400 rpm
Average Latency	12.5 ms
Head Positioning	
Minimum	10 ms
Maximum	70 ms
Average	35 ms
Average Access Time	47.5 ms
Read-Write Heads/Surface	1
Accessible Surfaces	2 or 4
Sectors/Track	12
Sectors Size (Bytes)	512
Tracks/Surface	406
Bytes Cylinder	12,288
Pack Capacity (megabytes)	4.9

THE 649 PRINTER



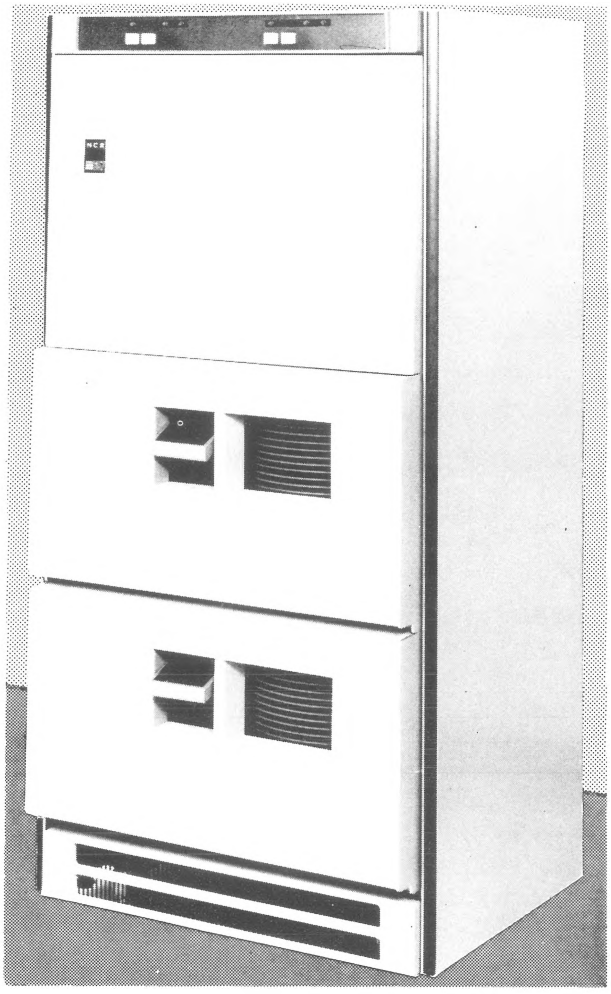
The new 649 line printer is available in three versions : 300, 200 and 150 lines per minute. The 150 l.p.m. model is designed to print in languages requiring more than 64 discrete characters. The 649 print mechanism, drive electronics, and controller are contained in a single cabinet mounted on a pedestal.

Printers are designed to accommodate an original and up to five copies. A full range of paper and printing impression adjustments is provided on all printers. Vertical spacing can be changed from 6 to 8 lines per inch with an optional selection switch available on all models. Line skip is 15 inches per second on the 649.

Printer selection, line spacing, and other items of page format are handled automatically by the standard input/output instruction.

PRINTERS			
Model	Character Set	Columns	Lines/Minute
649-300	63 plus space	132	300 alphanumeric
649-200	63 plus space	132	200 alphanumeric
649-150	126 plus space	132	150 alphanumeric 300 numeric

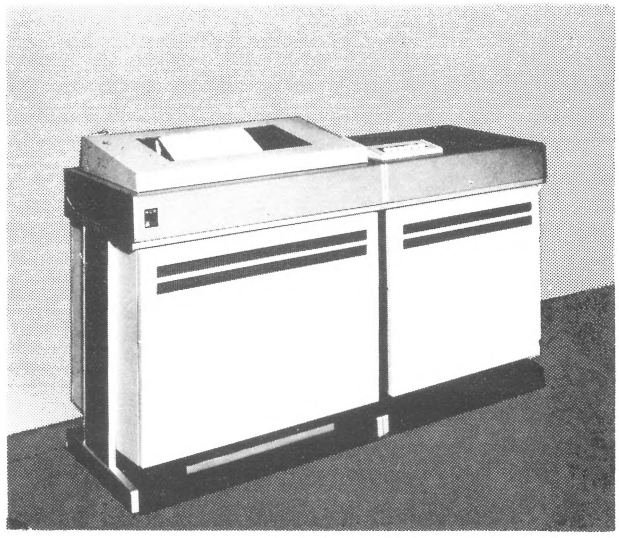
THE 657 DISC UNIT



The 657 Disc Unit is available in either a single or dual spindle model, each spindle holding a removable, 20-surface disc pack. Up to four disc units (eight spindles) can be interfaced to a single trunk position through the 625-201 Control Unit, which records data at a density of 2200 bpi and has a maximum transfer rate of 315 kb.

DISC UNIT SPECIFICATIONS	
Peak Transfer Rate	315 kb
Rotational Speed	2400 rpm
Average Latency	12.5 ms
Head Positioning	
Minimum	17 ms
Maximum	115 ms
Average	60 ms
Average Access Time	72.5 ms
Read-Write Heads/Surface	1
Accessible Surfaces	20
Sectors/Track	1 or 8
Sector Size (Bytes)	7459 or 810
Access Arm Positions	200
Accessible Bytes/Position	149, 180 or 129, 600
Pack Capacity (megabytes)	29.8 or 25.9

THE 640-300 PRINTER



The 640-300 printer can achieve up to 1200 single-spaced lines per minute. It is designed to accommodate an original and up to five copies. A full range of paper and printing impression adjustments is provided.

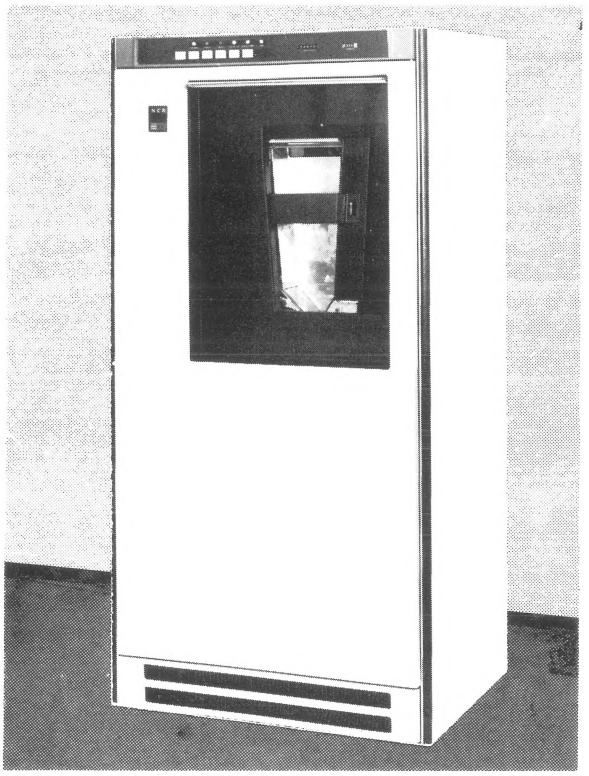
Vertical spacing can be changed from 6 to 8 lines per inch with a selection switch. Line skip is 17 inches per second for fewer than 6 lines and 90 inches per second for more than 6 lines; the change in rate is made automatically. Paper can be adjusted both horizontally and vertically while the printer is operating.

Printing occurs as a response to data-transfer instructions issued from the central processor through a printer controller which is the 626-101. Line spacing, and other items of page format are handled automatically by the standard input/output instruction.

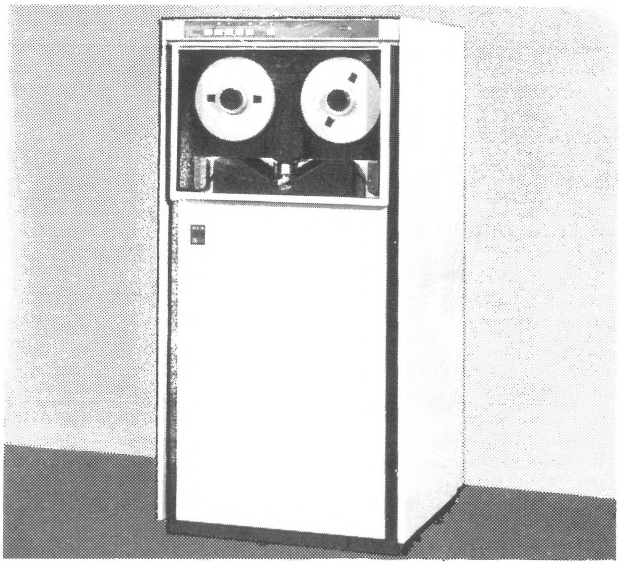
PRINTERS			
Model	Character Set	Columns	Lines/Minute
640-300	64 115	132 132	1200 Alphanumeric 600 (Extended character set)

CRAM (Card Random Access Memory)

NCR's CRAM (Card Random Access Memory) is a high capacity storage device designed for large-file, random access applications on NCR Century systems. Data is recorded on oxide-coated mylar cards. Each card is notched with an individual binary configuration that permits the processor to select only that card containing the required information. Up to eight CRAM units can be connected to the trunk through each CRAM control unit, providing access to more than 1 billion characters per trunk position.



CRAM SPECIFICATIONS	
CHARACTERISTICS	**SPECIFICATIONS**
CARTRIDGE CAPACITY	145 MILLION BYTES
RECORDING DENSITY	1750 BITS PER INCH (bpi)
CARDS PER CARTRIDGE	384
TRACKS PER CARD	144
BYTES PER TRACK	2623
TRANSFER RATE	83kb
DROP TIME	90-125 ms
REACCESS TIME	24 ms average
HEADS	36 TRACK HEADS, MOVABLE TO 4 POSITIONS
HEAD MOVEMENT TIME	APPROXIMATELY 25 ms
CHECK	READ-AFTER-WRITE
PROGRAMMABLE FUNCTIONS	SELECT, CARD DROP, CARD RELEASE, READ, WRITE, DROP READ, AND DROP WRITE



MAGNETIC TAPE UNITS

Six models of magnetic tape units are available for use with NCR Century systems; all handle standard 1/2-inch tape. Five models process 9-channel tape, and a 7-channel model is available to aid in conversion from other systems. Operations handled by the tape control unit include:

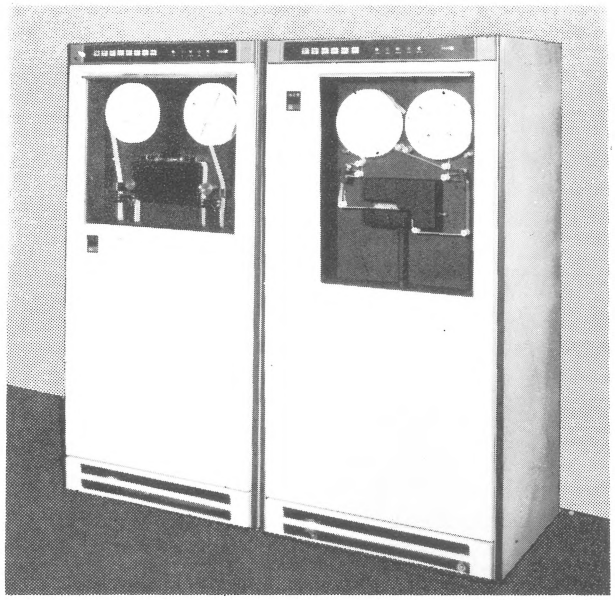
- Read forward
- Write forward
- Backspace one record
- Rewind and release
- Erase

Data transfer rates, as shown in the accompanying table, range from 10,000 to 240,000 characters per second.

Vacuum techniques, which have an exceptional record for error-free operation, are used to drive and stop the tape. To prevent accidental loss of information, each unit can ensume that a magnetic tape is equipped with a write-enable ring before a write operation can take place.

MAGNETIC TAPE HANDLERS					
MODELS	**633-111/121***	**633-211**	**633-311**	**633-117**	**633-119**
TRANSFER RATE	80kb	144kb	240kb	10/28/ 40kb	40kb
CHANNELS	9	9	9	7	9
DENSITY	1600bpi	1600bpi	1600bpi	200/556/ 800bpi	800bpi
SPEED FORWARD REWIND	50ips** 150ips	90ips 240ips	150ips 380ips	50ips 150ips	50ips 150ips
RECORDING METHOD	PHASE MODULATION	PHASE MODULATION	PHASE MODULATION	NON-RETURN TO ZERO	NON-RETURN TO ZERO

* Indicates two units in a single cabinet.
** ips = inches per second.



PUNCHED TAPE EQUIPMENT

All NCR punched tape readers and punches process 11/16, 7/8, or 1-inch tape in 5, 7, or 8-channel format. The readers read 1500 characters per second; the punch rate is 200 characters per second. Since these unbuffered units interface directly to the trunk, no additional control unit is required. The units can be operated continuously or in a start-stop mode; all are designed to stop within a frame's length, which ensures a reliable reading of the first and last frames in a record.

Parity can be generated by the program in preparation for punching and checked by the program when reading. End-of-tape and other special codes can be used to set program-tested indicators.

PUNCHED CARD EQUIPMENT

Freestanding card reader, punch, and read/punch units are available for inclusion in systems that lend themselves to punched-card processing. These units are available as summarized in the accompanying table. The latest card-handling techniques ensure that cards are always under positive control in the units, substantially increasing card life. A photoelectric read system ensures reliable reading. A light-dark check is made between columns in a read operation, and an echo check verifies punching. Errors are identified for immediate correction.

Operations specified for the card equipment are performed immediately on demand from the processor. In continuous operation, up to 800 cards per minute can be read. Punching is performed at up to 294 cards per minute, depending on the number of columns punched. Mixed reading and punching operations can be programmed for the read/punch unit.

PUNCHED TAPE EQUIPMENT

CHARACTERISTICS	READER (660)	PUNCH (665)
READ/PUNCH RATE	1500 CHARACTERS/ SECOND	200 CHARACTERS/ SECOND
TYPE OF READ	PHOTOELECTRIC	
TAPE WIDTH	11/16, 7/8, 1 INCH	11/16, 7/8, 1 INCH
CHANNELS	UP TO 8	UP TO 8
STOP	ON A CHARACTER	ON A CHARACTER
REEL SIZE	8 INCHES STANDARD 10 1/2 INCHES OPTIONAL	8 INCHES STANDARD
REWIND	150 INCHES/SECOND	NONE
OPERATION	CONTINUOUS OR STOP-START	CONTINUOUS OR STOP-START
TAPE	STRIP OR REEL PAPER OR MYLAR	REEL PAPER OR MYLAR

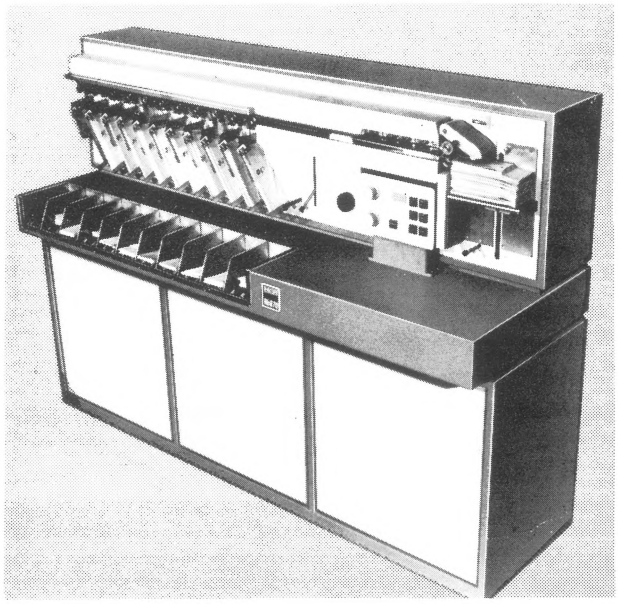
PUNCHED CARD EQUIPMENT

Characteristics	Model	Rate CPM	Columns	CARD CAPACITY Input	CARD CAPACITY Output
Read/ Punch	686-102	800/ 83-294**	80, standard 51, optional	1500	3700*
Read/ Punch	686-111	560/ 60-180**	80, standard 51, optional	1500	3700*
Punch	686-302	83-294**	80	1500	3700**
Punch	686-311	60-180**	80	1500	3700**
Read	680	1200	80, 51	4000	4000

*Two 1800-card program selectable output stackers plus 100-card reject stacker.
**Varies with number of columns punched.

MICR SORTER

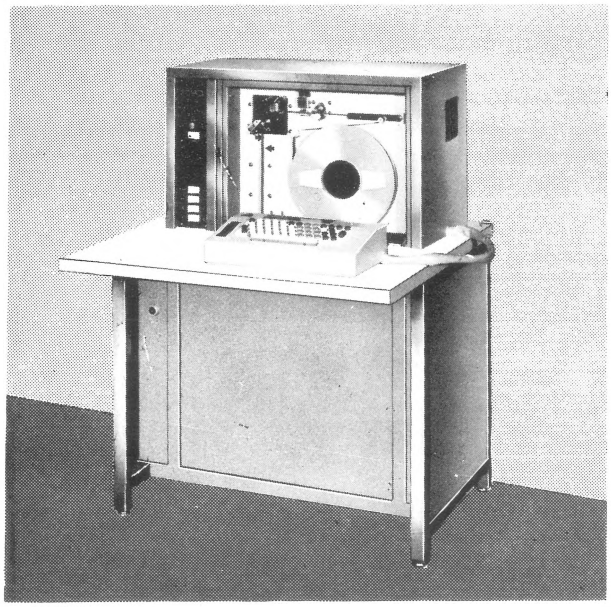
The availability of two magnetic ink character reader/sorters equips NCR Century systems to handle an extensive range of banking and similar application. The 670 reader/sorter is capable of sorting 600 documents



per minute into 11 pockets. The 671 reader/sorter can sort up to 1200 documents per minute into 17 pockets. Both peripherals operate in either an online or offline environment.

MAGNETIC TAPE ENCODERS

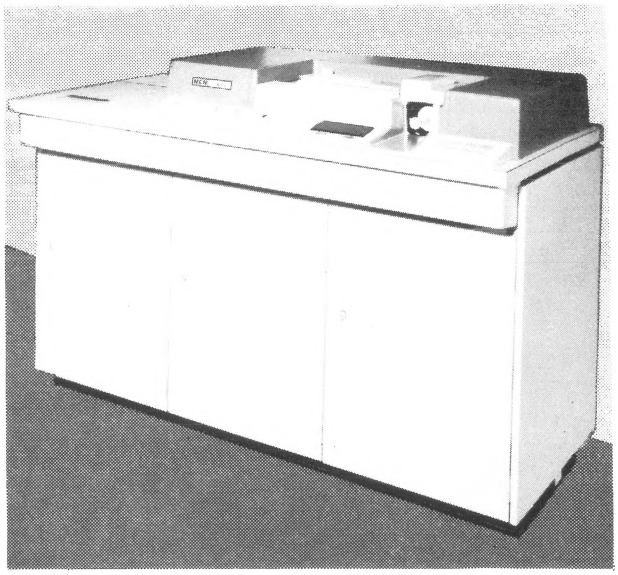
Magnetic tape encoders serve a dual purpose : they function as a low-cost input/output tape handler in addition to providing keyboard entry to magnetic tape.



Magnetic tape encoders offer a convenient way to increase system throughput by encoding and verifying directly from source documents to magnetic tape on the same unit. Verified output from these encoders is immediately available for input to NCR Century systems. Other models can perform such functions as proof-tape printing, report printing, control total accumulation, punched tape or card to magnetic tape conversion, or remote data transmission offline.
Magnetic tape encoders are connected to the common trunk through the 622-201 controler.

OPTICAL CHARACTER READER

Optical character reading is a particular valuable tool for many applications that have a large number of transactions to be processed. The journal tape taken



from a cash register, an adding machine, or an accounting machine becomes the original entry document. No time-consuming manual processing is needed to prepare the document for machine processing.

The NCR 420 Optical Character Reader processes tapes imprinted with machine-recognized NOF, a special typeface developed by NCR for optical machine reading. The 420 reads up to 32 characters per line at 52 lines per second. A keyboard is provided for making manual entries. Character recognition circuity is totally contained within the OCR; rereading is provided for missed characters. Counters record the number of lines reread and the number of lines rejected.

These OCR units are connected to the common trunk through the 633-301 OCR control unit.

COMMUNICATIONS

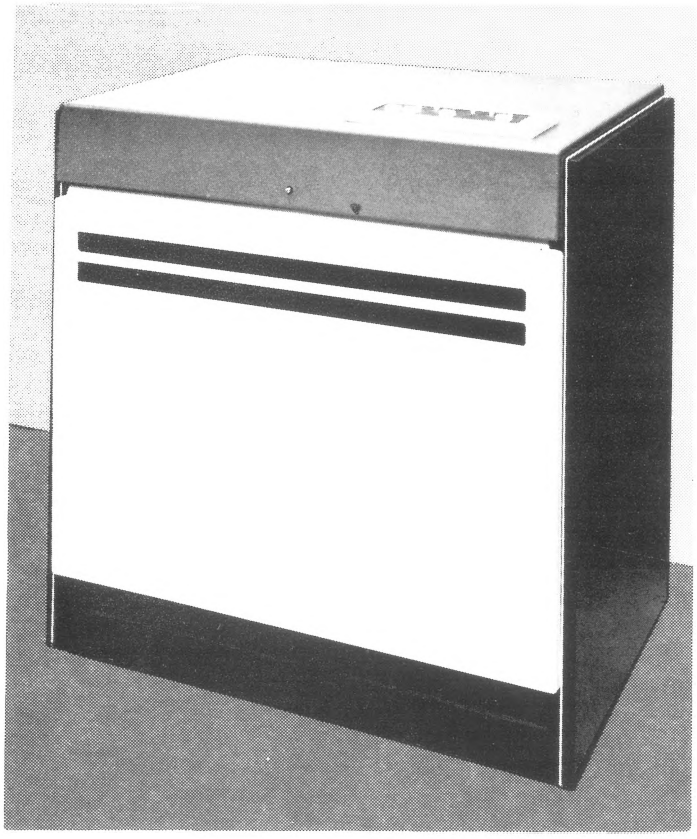
Online systems provide for the communication of data between remote terminals and a central computer, or from computer to computer, for processing and file storage. A wide variety of online applications is permitted through use of either the integrated communications interface or the 621-103 freestanding communications multiplexor. With either of these control units, data from a terminal in a remote location can be transmitted over public telephone network communication lines to the central processing system. A number of remote terminals can be connected to each communication line. These terminals may be such devices as teller machines, visual display units, and remote printers.

INTEGRATED COMMUNICATIONS INTERFACE

The optional integrated communications interface and its associated adapters are contained wholly within the 101 processor cabinet. A modified version of the freestanding communications multiplexor (621-103), the interface provides the necessary ports to which a maximum of 10 adapters and an interval timer may be attached. With the exception of hardware-assisted software queueing, all of the functions of the 621-103 multiplexor are performed by the integrated communications interface.

621-103 COMMUNICATIONS MULTIPLEXOR

Designed for use with the WASAR (wide application system adapter) series of adapters, the 621-103 is a communication control device that permits the connection of up to 253 communication lines. The multiplexor unit consists of two basic components: (1) a scanner, which is a portion of hardware circuitry that continuously scans the adapters for a request for service, and (2) a series of racks designed to hold the various adapters and their associated logic. Of the multiplexor's 256 ports, two are used for hardware-assisted software queueing, one is used for the interval timer, and 253 are available for adapters. Hardware-assisted software termination queueing (HASQ) is a standard feature of this multiplexor. It eliminates the need for the processor to scan long series of control words after I/O termination by storing, in the processor's memory, the response numbers of adapters that have ended I/O operations. Among the multiplexor's other standard features are control character detection, vertical parity control, block checking, cyclic redundancy checking, and reverse channel control. The multiplexor and its adapters can be used in a variety of systems – single-unit lines (one terminal per link), polled systems (many terminals per link), and satellite processing systems.



TERMINALS

The optional communication controller and adapters that can be built in the processor will handle a wide range of existing and planned terminals. These include :

- General purpose teletypes, such as the 33, 35, 37, ASR and KSR.
- A new line of teleprinters using thermal printing and offering printing speeds of up to 30 characters per second.
- General purpose CRT's (Cathode Ray Tubes).
- Special purpose Financial Terminals. These include the well known NCR 42 Teller machines and the new line of 270 terminals.
- Special purpose Retail Terminals.
- General purpose 'heavy' terminals (Electronic Accounting Machines).

A further possibility is the interface with other computers either of the Century family or of other makes.

SOFTWARE

LANGUAGES AND COMPILERS

Initial release of the NCR Century systems provided three compilers : NCR Century NEAT/3, NCR Century COBOL, and NCR Century FORTRAN. Continuing development of both hardware and software has resulted in expanded versions of these compilers, so that the full capabilities of these languages are now available to NCR Century users. Each compiler was developed within a framework that permitted the sharing of common techniques, the employment of common approaches to similar problems, and compatibility with NCR Century operating systems.

NEAT/3

NCR Century NEAT/3 is a comprehensive programming language that can be used for all general business applications. Sophisticated in concept, NEAT/3 is much easier and more efficient to use than assembler languages. Where assembler languages require one-to-one coding for the simplest functions, NEAT/3 accomplishes the majority of functions with a single, near-English command at the macro level. The facilities and user protection provided by the NEAT/3 language are on the same level as those provided by COBOL. Coding lines are written in a fixed format, which encourages a disciplined approach to programming and eliminates many of the syntax errors possible with free format languages.

ADVANCED NEAT

Advanced NEAT has been incorporated into the NEAT/3 language to provide the user with the facility of handling quickly the unusual or sophisticated situations not commonly dealt with by high level languages. The complete user protection and full compatibility with all other NCR software, inherent in Advanced NEAT, ensure that user programs are transferrable between NCR Century systems of equivalent or higher power without any reprogramming.

Over 50 Advanced NEAT statements offer :

Character string handling
Fast specialised functions, for tables, translating, editing, scanning, etc.
Operating System Commands for processing program parameters, for dynamically selecting file specifications, etc.
Bit-level processing.
Non-standard Magnetic-Tape processing. Etc.

SPUR

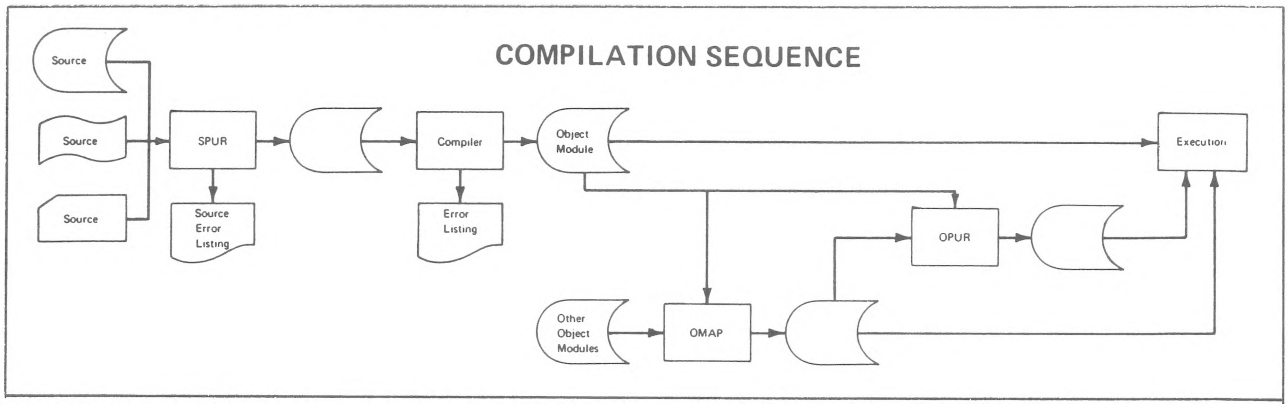
The primary function of SPUR (Source Program Utility Routines) is to convert all source statements to a standard format and store them on disc for input to the compiler. In the process, SPUR prints an annotated list of any source statements containing format errors or untranslatable characters, permitting the programmer to correct such errors before the compilation run. SPUR may also be used by the programmer to delete erroneous statements, to eliminate duplicate entries, and to copy source lines from previously-coded programs. SPUR gives the user the option of printing a precompilation list of all source statements and of sorting and renumbering source statements. On request, SPUR also creates control strings that permit several associated production programs to be run in sequence with a minimum of operator intervention.

OPUR

OPUR is an optional set of Object Program Utility Routines that can be used to copy an object program from one disc to another and to maintain an up-to-date library of compiler subroutines. OPUR also permits the relocation of object programs, the addition of buffers to a program to take advantage of unused memory space, and the insertion of independently compiled overlays into a program.

OMAP

The implementation of large programs can often be made more efficient if they are divided into separate modules. A further advantage is provided if each module can be coded in the most suitable language and processed separately by the appropriate compiler. The execution of such a program would then involve the binding together of the modules into a single executable object program. OMAP (Object Module Assembler Program) can bind together program modules written in NEAT/3, Advanced NEAT, and COBOL. OMAP can accept up to 15 groups of 255 modules of object coding, the residency of such modules in memory during program execution can be decided upon at module binding time. OMAP offers thus a considerable amount of flexibility in the segmentation of a program into a hierarchy of modules, for example based upon frequency and pattern of use. Furthermore, the same set of modules can be bound together in different ways, to produce the same program with different memory requirements. This provides users operating in a multiprogramming or Teleprocessing environment with the opportunity of making best possible use of memory available.



COBOL

COBOL is an industry-standard, near-English programming language designed primarily for business and financial applications. Recognizing the value of COBOL, NCR software designers have made it available on every member of the NCR Century series. Furthermore, the COBOL offered for the smaller NCR Century systems is fully compatible with the more powerful COBOL provided for the larger members of the series. The COBOL compiler is also fully compatible with other NCR Century software, sharing the same basic philosophy and design.

NCR Century series COBOL was released in two stages:

- Stage I is a subset of basic COBOL-68 designed for use with the smaller memory systems.
- Stage II is a comprehensive set of high, medium, and lower level elements.

COBOL Compilation

The NCR Century COBOL compiler requires only one pass to generate an executable object program directly from source statements on cards; editing or further processing of the object program is not required. Source statements can be stored on disc for easy updating and fast compilation. To aid debugging, the compiler-generated source listing prints diagnostic messages directly under erroneous source statements. In addition, the user may direct the compiler to produce a cross-referenced listing of the source statements and a listing of the machine code generated from the source lines.

Optionally, the NCR Century COBOL compiler allows the programmer to include special debug statements in his source program. When the program is compiled in the debug mode, these special statements are included in the object program, facilitating program testing and debugging.

FORTRAN

In contrast to NEAT/3 and COBOL, which are general-purpose file and data oriented languages used primarily in the areas of commerce and finance, FORTRAN is a universal programming language designed specifically for engineering, scientific, and mathematical applications. Like NEAT/3 and COBOL, NCR Century FORTRAN was introduced in logical stages to complement hardware capabilities. Intermediate and Full FORTRAN IV are both available with NCR Century systems.

The NCR Century FORTRAN language supplies all the instructions necessary to perform calculations, define data, reserve memory, transfer data to and from peripherals, generate sub-programs, and transfer logic control within a program and between programs. In addition, the FORTRAN compiler provides subroutines to execute common mathematical computations such as square roots, logarithms, and trigonometric functions.

FORTRAN Compilation

Compilation of FORTRAN programs follows the same SPUR-compiler-OPUR procedure used for NEAT/3; it functions under the standard NCR Century operating systems. The source program may be retained on disc for recompilation if desired.

As with the NCR Century compilers, operating system design has been concurrent with hardware development, resulting in the elimination of costly redundancies and the evolution of fully integrated hardware/software systems. Fundamental to this concept is the use of a systems disc from which operating software is called into memory as needed. In addition to reducing memory overhead, the use of a common storage medium has provided the key to upward compatibility among all members of the NCR Century series.

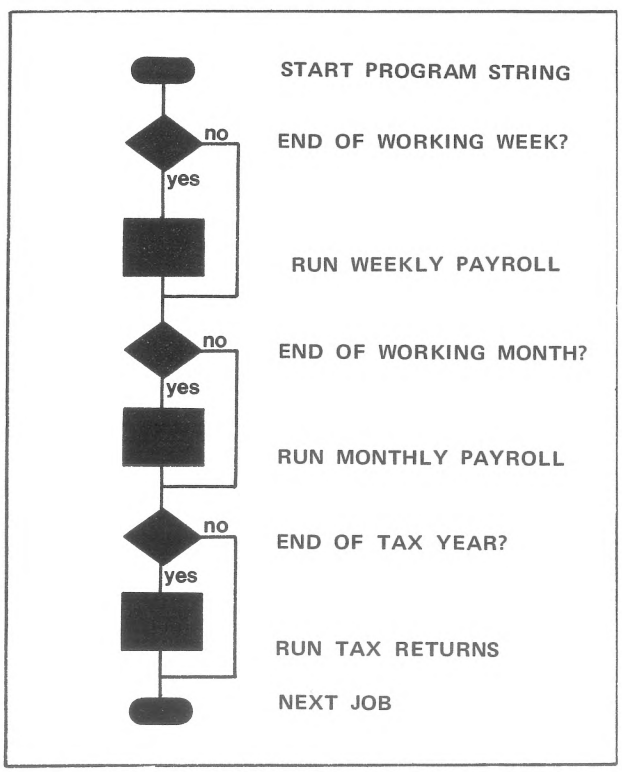
Two comprehensive, completely-tested operating systems are provided for systems based on the NCR Century 101. The batch processing executive features uniform treatment of peripheral units, permitting the programmer to initiate input/output instructions without regard for the degree of simultaneity of the particular system or the number of I/O buffers assigned to the program. This approach means that any system can readily accommodate new peripheral units as they become available and be unaffected by changes in the peripheral mix. The online/real time executive is a continuation and extension of the batch processing executive that accommodates a dedicated online system or dual programming.

MONITOR

Monitor functions as the between-runs supervisor, operating from a single job control string.

Loading and Linking of Programs

Monitor selectively loads individual user programs and permits the automatic linking of a predetermined series of programs. This automatic program linking provides efficient operation of the system with minimum operator intervention.



Dating Scheme

A user-defined, three-year calendar enables programs to be run selectively, depending on calendar information or other information in memory. This calendar also permits the programmer to specify the number of relative work periods during which a magnetic file is to be protected for back-up purposes.

Communication

The user enters all operating information under the control of Monitor. This operating information for system control includes such items as current dates, peripheral unit assignments, and requests for certain programs.

SYSTEM LOG MAINTENANCE

Various portions of the software operating system maintain a system log on the system disc packs. The system log serves to :

- Maintain chronological entries regarding daily operations.
- Point out normal or abnormal operating conditions.
- Record equipment functions or malfunctions at the time of their occurrence.
- Assist in system failure diagnosis.
- Provide printed reports describing all these conditions.

The operating system automatically maintains the system log for one working day. However, software is available to copy daily logs to another disc file, enabling the user to accumulate system log data over any period of time.

DISC MANAGEMENT

The disc management software controls disc pack changes on NCR Century systems. It allows any removable disc in a system to be changed, including the current system disc. When a request is made to change the current system disc, the system log, current program parameters and overlays, and the Monitor control string linkages are copied to the alternate system disc, which is then designated the current system disc. Whenever a new disc pack is mounted, the disc management software automatically checks that the software is the same version as that on the current system disc, if not it is updated. In this way additions and improvements to the software are automatically propogated throughout every disc pack.

BATCH PROCESSING EXECUTIVE (B-1)

The batch processing executive is a basic executive that handles all input and output functions and contains the routines necessary to permit automatic simultaneity of these functions. The executive complements the hardware to a greater degree than any other software item.

In the past, most executive systems treated each peripheral unit differently. In contrast, the NCR Century executives operate all peripheral units uniformly. This uniform approach results in two distinct advantages:

- The user's program may initiate I/O instructions without regard to the degree of simultaneity of the system or the number of I/O buffers assigned to the program.
- The system readily accommodates new hardware designs and different peripheral mixes.

The executive employs two major concepts: captured I/O instructions and hierarchical subroutine organization.

- Captured I/O instruction – The simple I/O instructions in the user's program do not directly affect the hardware; instead, they use memory-resident software subroutines to perform the desired I/O functions.
- Subroutine organization – Any software logic that is common to two or more subroutines is not duplicated, thereby saving memory space.

The programmer directs the functions of the executive by preparing a preprinted file specification sheet for each file used in a program. The programmer's answers to the questions on the file specification sheets are compiled with the source program and become part of the object program. The executive uses these answers, in their compiled form, to perform the necessary input and output functions during the running of a program. Following are brief descriptions of some of the functions that may be of special interest to the user.

Opening of Files

The executive must "open" input and output files before the program can use them. The programmer may let the executive open a file automatically at the beginning of a program, or he may call for opening of a file at any point in the program.

Before opening an existing magnetic source file, the executive checks the file identification label and file date to verify the validity of the source file. Before opening an existing magnetic destination file, depending upon the type of media, the executive scans the file directory (or checks the file label) and the expiration date to determine if the file is invalid and can be used. If the date indicates the file to be protected, the file cannot be used. Before opening a magnetic destination file for the first time, the software checks the file medium to determine that the desired space is available for the file. Once this is confirmed, the software makes entries in the file directory to provide for future identification of the file.

Closing of Files

The programmer may let the executive close a file automatically at the end of a program, or he may call for closing of a file at any point in the program. To close a file, the executive completes all functions connected with the file. A closed file is protected. Unless the file is reopened, it is no longer available to the program.

Error Handling

During the running of a program, the executive takes any corrective action that may be required to assure error-free data input and output.

ROLL-IN/ROLL-OUT

The use of batch processing enables high productivity to be obtained from a computer system, but does not provide the real-time information which is so often vital to the administration or the operational control of business. Usually to provide this information one of two extreme approaches is taken :

The use of visible records, maintained manually or with the assistance of a computer, provides a modest system which can rapidly become unwieldy; or

A full-scale teleprocessing computer system, which might not be economically justifiable.

To provide an intermediate solution, the batch processing functions of B1 have been complemented by a Roll-in/Roll-out facility.

Roll-in/Roll-out supports both batch processing and teleprocessing on NCR Century systems with minimum memory size, where the teleprocessing requirements necessitate only a few, teletype-compatible, terminals and a small number of enquiries.
Programs are run normally in the batch mode, and have complete use of the processor until a terminal operator requests service. When this happens, the Roll-in/Roll-out software allows all the current I/O operations to terminate and then rolls-out the batch program, that is, stores it on disc. The interrupt program, which is a teleprocessing program, is then rolled-in into memory from disc and starts working, allowing the terminal operator to continue the conversation with central after a few seconds. At the end of the conversation between a terminal and central, the Roll-in/Roll-out software first checks if any other terminals are requesting service. After all terminal requests have been serviced, the interrupt program is rolled-out and the original batch program is rolled back in and restarted from the point of interruption. All the routines necessary for handling communications are automatically included in the interrupt program during compilation. The user need only write routines for handling messages in much the same way as record are handled in batch processing, for example : opening files at the start of day; recognising and reacting to the contents of messages; closing files at the end of day.
Roll-in/Roll-out combines the productivity of batch processing and the alertness of a real time system, for applications where the enquiry requirements are low. Furthermore, the implementation of the teleprocessing program is as simple as that of a batch application.

ONLINE/REAL TIME EXECUTIVE (B-2)

The online/real time executive is a more powerful executive that incorporates the software concepts of the basic executive plus the added concepts of real time processing of data from remote terminals. Under this executive, both an online program and a batch program may be resident in memory at the same time. When the online program is inactive, the batch program is processed. This feature, known as dual programming, permits maximum use of processing time.

Monitor loads both the online program and the batch program at the beginning of the processing day; the online program is maintained in memory throughout the day. Background programs may be processed in sequence by using the same control string technique used for the basic executive. As each batch program is completed, Monitor is called in and another program is loaded.

Task Management

Task management, a feature of this executive, allows the real time program to be subdivided into multiple processing functions called tasks, thereby allowing the processing time of one input request to be shared with that of another.

Queue Handling

Queuing, the technique of storing input messages on a list for subsequent processing or transmission, is an automatic function of the online/real time executive. Queuing enables separate tasks to process multiple input requests concurrently within the system.

The real time system uses queues in three basic situations:

- The executive places input messages on a queue for processing by the user program.
- One task of the user program may place messages on a queue for processing by another task.
- The executive places output messages on a queue for subsequent transmission to a remote terminal.

Dynamic Storage

The online/real time executive can dynamically assign memory storage areas for messages being processed by the system. Areas are assigned at the time the message is received according to the number of characters needed. Multiple segments of the same message are chained together and need not be assigned contiguous memory space.

System Communication

The online/real time executive permits the operator to initiate specific processing routines within the online program through the console. The operator may also print out portions of memory without disrupting online processing and alter the contents of programming variables in memory through the I/O writer.

JETS (Job Executive and Transput Satellite)

JETS provides, within the scope of medium scale NCR Century systems, the main advantages of operating systems designed for more powerful, multiprogramming machines.
JETS performs two pseudo off-line I/O conversions, at almost maximum practical speed between mechanical and magnetic peripherals, for example punched cards to disc or magnetic tape to printer. And at the same time it allows the execution of a stream of batch jobs, in which the low speed peripherals are automatically replaced by high speed virtual peripherals (Magnetic media devices containing files created - or to be used - by the pseudo off-line conversions).
The conversions and the batch jobs are scheduled by JETS according to their relative priority and the availability of virtual peripheral files. A simple job control language is used to specify the whole operation, and the corresponding statements can be accepted by the system at any time, without stopping the production work.

JETS is based on the dual programming mode of the multitasking B2-executive, and allows the simultaneous performance of :

Satellite Conversions

Up to two pseudo off-line operations can be carried out between slow mechanical devices and magnetic storage devices. The mechanical devices include punched card readers, paper tape readers and printers. The magnetic storage devices, which can include 657 discs, 656 discs and 9 channel magnetic tapes, are known as System External Storage (SES).

Production Work

A background batch process in which I/O operations for low speed peripherals are automatically trapped, if they have been declared by the user as high speed virtual peripherals : JETS replaces these by equivalent I/O operations to the SES. Normal Monitor run to run linkages are carried out, but between jobs, the Job Scheduler intervenes in the background to log accounting information and to select the next job to be performed. The jobs to be performed are held in a Job Queue, and the Job Scheduler bases the selection upon the priorities specified by the user in the Job Statements.

System Communication

An operator-interface task allows communication between the operator and the system, including submission of application, job or conversion statements to be catalogued in the Job Library or to be passed to the Job Queue as execution requests.

System Functions

A system task performs all the time consuming operating system functions, examples of which are the alternation of magnetic tape handlers in the SES, and the input validation of the Job Control Statements.

To summarise the facilities of JETS :

- A stream of batch jobs is automatically scheduled according to user defined Job Control Statements.
- Up to three magnetic files can be substituted for low speed devices in batch jobs.
- Up to two streams of satellite conversions between low speed and magnetic peripherals can be scheduled and carried out simultaneously.
- Basic accounting information is produced.
- Full flexibility in operating functions is provided, for example : conversions can easily be suspended and resumed.
- The throughput of a normal B1 machine is substantially increased, without any reprogramming or recompilation, when the necessary additional memory and SES have been included in the configuration.

SUPPLEMENTARY SOFTWARE

A complete set of supplementary software is available for use with NCR Century Systems including utility routines, file management software, and packaged application programs. This software has been designed to save programming time and to simplify system operation by automatically performing certain functions that are common to the majority of installations.

UTILITY ROUTINES

In addition to the SPUR, OPUR, and OMAP routines described in the section on languages and compilers, NCR Century software also includes complete routines for sort generation, data handling, and media initialization.

Sorts and Generators

The General Sort Program provides the user with a highly efficient method of sorting disc, magnetic tape, or CRAM files, involving a minimum of programming effort. The programmer supplies certain control parameters, such as memory size, input/output block sizes and file names, sorting media, and type and position of sort keys within a record. This information permits the general program to condition the exact routines necessary to handle the specific sorting task. The sort program generated can add or delete file records based on decisions incorporated in a user code section.

All sorting and merging is done on the basis of up to seven keys within a record. If records are encountered with identical primary keys, the program compares secondary keys, and so on, until it determines which record will be output first.

A disc file input to the General Sort Program cannot exceed one disc pack. The user may, however, run a Disc Preblock Program to divide a multipack file into a number of separate single-pack files prior to sorting. He simply establishes a range of keys for each single-pack file to be created. The Disc Preblock Program then extracts from each pack of the file those records that fall within the range and creates a separate file containing only those records. The individual files created are then input to the General Sort Program, and the user can piggyback the individual preblocked files back into a single file after sorting.

A Calendar Generator uses data input through request parameters to create a 3-year calendar for file protection and conditional running of programs. This calendar is stored on the systems disc for use by the entire system. The standard calendar comprises five tables:

- Work-day table
- Beginning-of-work-week table
- End-of-work-week table
- Beginning-of-work-month table
- End-of-work-month table

If the standard calendar does not fill the user's needs, he may use the calendar generator routines to generate non-standard tables that meet his particular requirements.

Data and Media Oriented Routines

A package of routines that condition media to accept data, transfer data between media, and alter or reformat existing data is available for use with any NCR Century system. These are:

- Initializer Routines for Magnetic Media
- Directory Maintenance Routines
- General Utility Copy Routines
- All File Copy Routines
- Site Code Change Routines
- Quick Disc Copy Routine
- Verification Routine
- System Log Maintenance Routines

- Initializer Routines for Magnetic Media

  These initializer routines are used to condition a file storage medium for system use or to make changes to a previously initialized file. These changes include: altering the size of certain areas reserved during initialization; changing volume header information such as the file and version numbers, the volume serial number, and the owner's identification code; and reinitializing a file to include updated system software overlays without destroying files, file mapping, skip assignments, or the skip directory. With magnetic tape, the programmer may specify that the data be recorded in NCR Century code, NCR 315 BCD code, IBM BCD code, or in IBM EBCDIC code.

- Directory Maintenance Routine

  The Directory Maintenance routine allows the user to :

- Print the entire disc directory, skip directory, and versions list.
- Delete all user file entries from the disc directory.
- Delete specific file entries from the disc directory.
- Change the file name, creation date, expiration date, or generation number within an object program file entry.

  The routine automatically records in the systems log any deletions or changes made to the disc directory. The user may obtain a printout of these changes if he desires.

- General Utility Copy Routines

  The general utility copy routines permit the user to create a new file by copying, deleting, duplicating or modifying the records in an existing file. These routines provide facilities for :

- Copying the entire source file onto the destination file.
- Omitting from the destination file certain records contained in the source file.
- Altering a record.
- Repeatedly recording one source record on a destination file.
- Creating a data file for program testing.

- All File Copy Routine

  The All File Copy routine may be used to copy all user files from one magnetic tape to another.

- Site Code Change Routine

  The NCR Century series offers the user a variety of codes for punched media. These codes are recognized by software and converted to NCR Century for use by Monitor and SPUR. The specific code in use at any given installation, called the site code, is always stored on the current system disc. The Site Code Change routine enables the user to change the site code, or to copy it from one system disc to another as he desires. The routine also permits him to incorporate his own non-standard punched tape code as the selected site code. Any non-standard code of eight channels or less may be used as long as one vertical row of punches in the tape can be translated into one NCR Century character.

- Quick Disc Copy

  This routine provides a method of copying the disc directory and all user files from one disc pack to another pack in about 20% of the time required using other routines. This routine may also be used to copy specific files or groups of files from one disc to another.

- Verification Routine

  The Verification routine performs a record-by-record comparison of two source files and prints out any records that contain errors. Source files may be from like or unlike media.

Program Associated Routines

In addition to SPUR and OPUR, NCR has provided certain program associated utility routines to aid the user in debugging and documenting his programs.

- Language Directory List Routine

  The Language Directory List routine is used to obtain a printed copy of the current error comment directory, which is supplied with each new release of the compiler. This directory contains error codes and comments as well as such other information as compiler release notification and reserved memory and file system tags.

- Symbolic Debug Routine

  The Symbolic Debug routine is used by the programmer to locate logic errors in his coding. It permits him to debug NEAT/3 and COBOL programs at the source level, rather than the more time-consuming debugging at the object level.

  Two types of request parameters are available, DUMP and BRPATH (branch path). The routine interprets these requests and provides the programmer with specific data at strategic points during the debugging run. From this information, the programmer is able to determine if logic errors exist and in what portion of the program and under what conditions they occur.

  The DUMP request parameter specifies a printout of specific data at a particular page and line number in the program. The BRPATH request asks for a listing of certain branches during a program – or any portion of a program – and the setting of the greater/less/equal flag at the execution of the instruction.

FAMOUS

FAMOUS is a File and Record Management System, designed to handle large files, resident of CRAM or 657 Disc, efficiently and safely. The fundamental objective of FAMOUS is to provide for :

- A general and versatile approach to the file organisation and processing problem.

  Practical requirements are that : a file can be processed in several ways - sequential, sequential-selective and direct access; record-level specifications be flexible and the provision of accessing, modification and insertion facilities. Also there is a trend towards the integration of conventional files into a data set, avoiding duplication and providing communication between subsets.

- A solution to the system problems which grow exponentially with file size.

  This mainly concerns file back-up and rebuild facilities, processing restore-restart capabilities, the density -overflow conflict, compatibility with the basic software (operating system, utilities) and the throughput.

- An easy and hardware-independent programming language.

  The programming statements are either declarations which are answers to predefined questions or comprehensive execution functions at the application level.

- A FAMOUS file can reside on CRAM units or 657 Disc units. It is sequentially organised on the system-key the user selects and built to fit the requirements of his application. This organisation results in high throughput for sequential jobs which still represent an important part of the workload of any system.

- Despite its sequential organisation, FAMOUS automatically provides sequential, selective-sequential, direct-sequential, random and any combined file processing.

- FAMOUS allows variable-length records, multiple records with same key, multi-section files, and, with simultaneity, multi-file processing.

- The FAMOUS software dynamically solves file overflow situations by automatic :

  Record redistribution between blocks,
  Block splitting,
  Quadrant or sub-cylinder splitting,

  according to a hardware-oriented allocation and with automatic updating of the indices.
  This avoids wastage of storage capacity, frequent file reconstructions and reduced performance.

- The FAMOUS system supports :

  file creation
  bulk insertion
  file back-up
  back-up updating
  file rebuilding
  processing restore-restart.

NCR