

NCR 721-II Communications Processor



The NCR 721-II (foreground), depicted here with an NCR Criterion 8500 mainframe, features a readily accessible control panel and dual cassette unit (on top of unit) for program loading, data input, and memory dumping.

MANAGEMENT SUMMARY

The NCR 721-II Communications Processor is an evolution of the older Model 621 and 721 front ends. An extended set of hardware and software modules has been developed that permit a large number of configurations to be tailored for specific applications.

The 721-II is built around a minicomputer that utilizes a 16-bit word structure. Memory capacity is 128K bytes, expandable to 256K bytes in one 128K-byte increment. The 721-II can support up to 95 half-duplex and up to 62 full-duplex communications lines. Standard 721-II system components include a communications multiplexer, an operator console (an NCR 260 thermal printer/keyboard terminal), and two magnetic cassette tape drives. System peripheral options include a 300 lpm line printer, a magnetic tape unit, and a CRT display.

While most comfortable in an NCR Criterion or Century mainframe environment, the 721-II is also capable of operating with an IBM System/370 or compatible system via communications lines, though not in a front end capacity. Up to three host connections can be made, and NCR can custom-develop channel adapters for most mainframes.

When operating as a front end on the same site with the mainframe, transfer rates of up to 1M bps are achievable. When used as a remote concentrator or nodal processor in an NCR/CNA system, the data transfer protocol, NCR's DLC, is bit oriented and can be considered as a subset of ISO's HDLC or a superset of IBM's SDLC. ➤

A highly flexible system of hardware and software modules that can be configured as a front end for NCR Century or Criterion CPU's, as a remote communications concentrator, as a message switcher, or as a unit performing combinations of these functions.

As the central hardware element of NCR's Data Communications Utility (DCU), the 721 is capable of connecting up to 95 half-duplex or 62 full-duplex lines. Asynchronous operation at up to 9600 bps and synchronous operation at up to 56K bps are accommodated. The base system comes equipped with 128K bytes of memory and is expandable to 256K bytes in one 128K-byte increment. The 721 can accommodate bit-oriented protocols such as HDLC, SDLC, and NCR's DLC. Options include integral modems and AT&T 801 automatic calling unit compatibility.

A Model 721 equipped with 10 asynchronous attachment points, 4 bisynchronous attachment points, one host attachment, and 128K bytes of memory can be rented on a three-year lease for \$1,772 per month, including maintenance, or can be purchased for approximately \$56,700.

The software package (Transaction Oriented Executive - TOX) to support the configuration described can be obtained for a one-time license fee of \$15,000 or rented for \$334 per month. The one-time fee includes software maintenance for one year; thereafter, software maintenance is provided for approximately \$83 per month.

CHARACTERISTICS

VENDOR: NCR Corporation, Main & K Streets, Dayton, Ohio 45479. Telephone (13) 449-2000.

DATE OF ANNOUNCEMENT: August 1977.

DATE OF FIRST DELIVERY: 1975 (specialized version); April 1978 (general release).

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: NCR Corporation.

CONFIGURATION

NCR's 721-II Communications Processor consists of four interconnected hardware components packaged in a single ➤

NCR 721-II Communications Processor

TABLE 1. NCR 721-II HOST INTERFACES

Software Product	Systems Interfaced
Poll-Inward Communications Driver	IBM 370 mainframe via IBM 3705; TRW 4000 Credit System Controller
B1 Common Trunk Interface	NCR Century or 8500 Series
Common Trunk	Local NCR 725-DCU Retail System Controller
B2 or VRX (non-DNA) Common Trunk Interface	NCR Century or 8500 Series
VRX (DNA) Common Trunk	NCR Century or 8500 Series
NCR Comten Interface	Comten 3600 Series Communications Processors
HASP Multileaving Communications (High Order)	Any host system that supports HASP Multi-leaving protocol
VRX Transparent Mode Interface	NCR V8500 Series

➤ The normal number of data frames that can be transferred before acknowledgement required is 128 as opposed to HDLC's 255 (maximum option) or SDLC's 7. The number is programmable and does not need to be the same for all incoming lines. Operator alert with manual restart can also be programmed independently for each line based on retransmission counts.

Communication line adapters to handle asynchronous (ASCII or BCD), bisynchronous, HDLC, SDLC, BSC, and NCR's DLC protocols are available in any mix. The 721-II does not support automatic code/speed recognition or current loop interface at the present time. It does support external 801-type automatic calling units, automatic dialing and answering, and a number of integral line drivers and modems.

Since NCR's purchase of Comten, Inc. in July 1979, the company's focus seems to be on development of Comten's 3600 Communications Processor line as its primary offering in this market. The Comten systems, originally designed for IBM compatibility, now also support some degree of compatibility with NCR's mainframes. As the NCR-related features become more fully developed, it is expected that the NCR 721-II will continue to decline in importance in the NCR product line. □

➤ unit, which interface host processors and remote and local devices. The components are the central processor and memory, the multiplexer, the multiplexer-processor interface, and a set of adapters for up to 16 half-duplex lines.

The MO5 Central Processor is a one-address, 16-bit mini-computer. Single and double-word length instructions are provided. The processor provides I/O ports, and contains decimal and binary arithmetic and logic instructions. Addressing methods which may be used include indexed, relative, direct, indirect, literal, and combinations thereof. There are 16 program-accessible registers. The MO5 uses MOS memory with a maximum cycle time of 1.2 microseconds. The basic system includes 128K bytes of memory, which is expandable to 256K bytes in one increment of 128K bytes.

The 621-903 High-Speed Communications Multiplexer performs most of the control logic for the adapters, and together with the adapters, provides the physical interface for up to 95 communication lines. Each message is stored

without interrupting the MO5 CPU operation following the transmission of each character. Only upon message termination is the MO5 processor operation interrupted. (Optional adapters are available for devices which require interrupt service on a per-character basis.) The multiplexer performs a variety of error checking functions including vertical parity generation and verification, block checking, and cyclic redundancy checking; it also handles the control functions of transparent-text mode. An interval timer is built in. The multiplexer throughput capacity for any configuration of lines is 320K bps if the highest speed line is less than 40.8K bps, and up to 560K bps, if all attached lines are high-speed (e.g., 56K bps.)

There are several factors which affect message throughput capacity, some of which are a result of the software application (TOX 721). For example, as a consequence of using message level adapters, throughput decreases slightly as message length increases. Also, as a result of the applications software (TOX 721), a minimum amount of in-core data movement within the 721 occurs, which further decreases throughput in the case of lengthy messages, because an increased amount of message processing is necessary. Similarly, throughput is a function of the communications protocol used. Full-duplex protocols, such as SDLC or HDLC, result in more efficient line utilization than half-duplex protocols. With a half-duplex usage of BSC, for example, throughput decreases with decreasing message size because of the line overhead per transmission required for acknowledgement sequences.

The multiplexed common trunk interface connects the multiplexer to the MO5 processor, accesses 256 control words, and performs packing and unpacking.

The basic system provides support for up to 16 half-duplex lines. If more lines are required, a common adapter trunk plus Auxiliary Bay Connectors can be added to provide for the attachment of up to eight Auxiliary Cages. Each Auxiliary Cage has its own power supply and driver cards and can hold up to 26 additional adapter cards. Auxiliary cabinets are similar in size to the 721 itself. Each cabinet holds up to two Auxiliary Cages.

TRANSMISSION SPECIFICATIONS

A wide variety of line adapters can be utilized. Asynchronous adapters are available for handling up to 9600 bps. Standard transmission speeds include 300, 600, 1200, and 1800 bps. Synchronous adapters are available for handling up to 56K bps, also in standard speeds.

The 721 adapter system offers line compatibility with dial-up, auto-dial, auto-answer, two- and four-wire lines, Western Union broadband lines, Bell System wideband private lines, and Bell DDS. Adapters which accommodate asynchronous

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TABLE 2. NCR 721-II TERMINAL INTERFACES

Software Product	Terminals Interfaced
Bisynchronous Communications (TRW 4000)	TRW 4000 Credit Controller
Bisynchronous Communications (7300/3270)	NCR 7300 (EBCDIC); IBM 3271
General Purpose Bisynchronous Communications	NCR 796-501, 6440 (K033), 7300 (ASCII), 796-101, 751-600/700, 230-550, 2151, 2152, 260; American Express Credit System devices
HASP Multi-leaving Communications (Low Order)	Any HASP Multi-leaving compatible device
BSC Communications (2780/3780)	NCR 8270 with RBS package; NCR Century with RBE package; IBM 2780/3780
BSC Communications (751-600/700)	NCR 751-600/700
POS Interface	NCR 280-120/125, 751-150, 724/825, 260, 796-101
Asynchronous Point-to-Point Communications	TTY-compatible terminals
Multipoint Asynchronous Communications	NCR 270, 275, 279, 399, 770, 724/825, 796-301, 751-150, 6440, 1770
KSR Teletype Autodial/Data Collect	NCR 721 console, 796-101/201/401, 260
NCR/DLC Communications	NCR T-8160, 2140

► (ASCII or BCD,) bisynchronous, HDLC, SDLC, or NCR's Data Link Control (DLC), a bit-oriented protocol recently released, are available.

SOFTWARE

The primary software package for the NCR 721-II Communications Processor is the Transaction Oriented Executive (TOX 721). The software is multitasking; more than one task may be active concurrently. The basic package, supplemented by a number of software modules, is oriented towards high volume transaction throughput, characterized by little data movement in the 721 itself. TOX 721 is tailored for each installation depending on whether the 721 is a node, local, or remote communications processor.

When the 721 serves as a node the operating system makes it work as a store and forward unit within the network, collecting an entire error-free message before re-transmitting it. TOX 721 permits easy expansion of a node to include additional lines and higher speeds as long as the network architecture remains the same; i.e., interconnections among 721's are unchanged.

TOX 721 includes a scheduler (which permits communications between tasks), a set of service routines, I/O routines, and "data structures."

The basic components of TOX 721 are tasks and processes. A task is the smallest entity in the system that can be scheduled. A process is simply a combination of one or more tasks particular to a certain situation.

Tasks are defined by a "data structure," which points to the appropriate software module to be executed. Tasks are either I/O routines, device or communications line drivers, or applications. A process such as switching a transmission from one line to another requires I/O routines, line drivers, line applications, and a message switcher.

An I/O routine operates on an interrupt level and is thereby protected from other tasks in resource contention. Line drivers operate on a program level, use standard modules from the TOX 721 library, control devices on lines, and handle data transfers using I/O routines. Application tasks also operate on a program level and deal with devices using drivers.

Under TOX 721, tasks are not preempted, but are always allowed to run to completion. All tasks have roughly the

same execution time and the same execution priority. They all deal with communications and keep transmissions moving through the system.

The scheduler, using a multiple queue scheduling algorithm, accomplishes the assignment and execution of tasks with regard to priority scheduling. Priorities within this algorithm are determined and fixed at system generation time.

A task points to its pre-assigned Task Queue Header (TQH) and receives a fixed priority on the TQH list. The scheduler loops around the TQH list looking for a data structure queued on the list. Finding one, it dequeues the structure and passes it to its appropriate task, which activates the task. On return to the TQH list, the scheduler looks first to see if an interrupt occurred in the meantime. If so, it goes to the top of the TQH list; if not, it resumes where it left off on the list.

Also under control of the scheduler is dedication of storage space. Data is read from and into storage buffers, acquired from dynamic memory storage. Buffers are passed among tasks by the scheduler. Memory, which is shared among tasks, is allocated automatically by a dynamic storage allocation algorithm which divides and stacks free memory and allocates portions to tasks as needed. If no memory is available, the request is put in queue until available, at which time the task is notified.

For planning purposes, the basic Transaction Oriented Executive with necessary additional software operating modules occupies about 40K bytes of memory. Each additional software module occupies from two to eight kilobytes.

PERIPHERALS

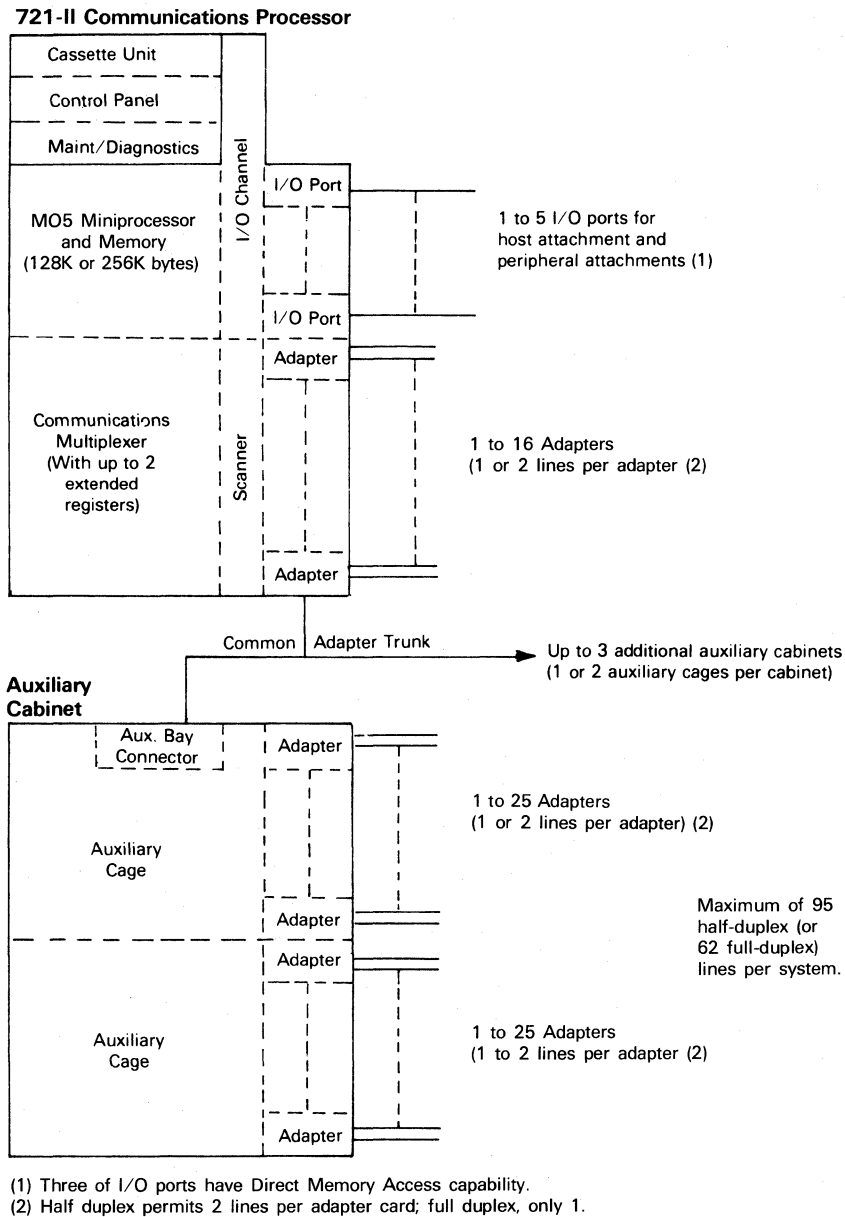
The 721-II basic system includes several peripherals, and others are available on an optional basis. There are a total of eight I/O slots.

Among the standard attachments are dual magnetic tape cassette drives. One drive is used for program loading, the other is provided for other functions such as data input or memory dump. A switch on the control panel allows either cassette to be used for program loading. The cassette unit occupies one of the eight I/O slots.

The control panel is the primary means of communication between the operator and the system. The panel contains sense and option switches and a set of status lights, which

NCR 721-II Communications Processor

Configuration



are under program control. Four switches (LOAD, HALT, RESET and COMPUTE) provide direct control. A 16-key keyboard and selector switches are provided for interrogating and changing processor registers and memory. The control panel also occupies one of the I/O slots.

A third I/O slot is reserved for running diagnostics.

Four I/O slots, three of which can use DMA, are available for attachment of optional devices.

A DMA Peripheral Interface is available that can accommodate up to eight peripheral control devices for magnetic tape units or printers. Data transfer via the Peripheral Interface is at a maximum rate of 315K bytes per second.

If needed, one additional Peripheral Interface can be accommodated.

The 721, when performing as a front-end, requires an interface with an NCR Century/Criterion Common Trunk (CTI), which must be a dedicated DMA line between the 721 and the host. Data transfer via this channel is at a maximum rate of one million bytes per second. An additional Common Trunk Interface is available.

PRICING

The NCR 721-II is available for purchase or one- or three-year lease. Lease prices include maintenance. A separate maintenance contract is available for purchased systems.

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	Monthly Lease*		Purchase Price	Monthly Maint.
	1-yr.	3-yr.		
NCR 721-II Basic System. Includes one MO5 minicomputer with 128K bytes of MOS memory, high-speed communications multiplexer, control panel, one thermal printer KSR, dual cassette unit and switch, console alarm, transparency mode detection, poll outward bucket-in, horizontal mounting bracket, console cover, and adapter cover plate	\$1,523	\$1,340	\$44,223	\$303
Additional Memory; 128K-byte memory increment; 256K bytes maximum	417	362	9,010	50
In-House Clock Driver	84	74	2,120	19
COMMUNICATIONS COMPONENTS				
Auxiliary Cabinet; required when total adapter counter exceeds 16; holds up to 25 additional adapters. With an additional card cage, can hold up to 50 adapter boards per cabinet. Up to 5 Cabinets can be chained to one 721 processor	272	232	8,110	5
Auxiliary Bay Connection Cable & Kit; for common adapter trunk; required for each auxiliary cabinet	48	42	1,325	6
Auxiliary Card Cage	134	116	3,950	11
In-house Line Coupler	29	25	530	1
On-Line, Auto Dialer; includes necessary cable attachments	55	49	1,695	13
Synchronous Adapter Connection Cable Kit; for connection to in-house clock	15	13	475	2
Wide Band Interface	22	19	725	2
Asynchronous Adapter, Teletype; one required with basic system to accommodate maintenance console	50	44	1,230	10
Two Asynchronous Adapters; includes cable; constitutes one async adapter card	50	44	1,230	10
Two Synchronous Adapters includes cable; constitutes one sync adapter card	66	58	1,590	10
Data Link Control Adapter	66	59	2,120	16
Integrated Asynchronous Modem; includes cable, plug, and receptacle	36	32	1,000	9
Free-standing External Modem; includes cable, plug, and receptacle	35	32	700	12
Extended Register Group; required on multiplexer if adapter count exceeds 16 half-duplex lines; for up to 95 half-duplex lines	34	30	850	10
Additional Extended Register Group; required if over 128 half-duplex lines, or equivalent scanner positions, are incorporated	34	30	850	10
PERIPHERALS				
First Peripheral Interface; accommodates up to 8 peripheral control units	87	77	2,545	17
Second Peripheral Interface	87	77	2,545	17
First Century/Criterion Common Trunk	109	96	3,180	23
Second Century/Criterion Common Trunk	109	96	3,180	23
300 lpm free-standing Printer with Controller	758	669	21,600	162
Selector for 6/8 lpi spacing	17	15	675	1
Magnetic Tape Unit with Controller; 9-track, 1600 bpi PE, 25 ips, 40KB; can control up to 3 additional tape units	802	702	19,875	138
Additional Magnetic Tape Unit	343	304	7,420	85
Dual Mode Electronics for Tape Unit; required for controller and each tape unit	21	20	668	11
CRT Terminal; conversational-mode, TTY-compatible	94	89	2,000	27

*Includes maintenance.

**Disk unit use with 721 system is contingent on NCR marketing of disk control software module, expected in first quarter of 1979.

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► SOFTWARE

	<u>One-Time License Fee</u>	<u>Monthly Support Charge</u>	<u>Monthly License Fee</u>
System Executive (TOX 721)	\$15,000	\$83	\$334
Poll Inward Communications Driver (Bisync, IBM 3705)	1,500	8	34
Bisync Communications Driver/Control (TRW 4000)	1,500	8	34
Bisync Communications Driver/Control (NCR 7300 & IBM 3270)	1,500	8	34
KSR Teletype Autodial/Data Collect	1,600	9	36
POS Driver/Control (NCR 280-120/125)	1,500	8	34
Common Trunk Interface to Century/Criterion (B1 I/F)	1,400	7	32
Trunk I/F to NCR 725	1,400	7	32
HASP Multi-leaving Driver/Control for remote entry station	1,600	9	36
BSC Communications (IBM 2780/3780, ASCII/BCD)	1,500	8	34
NCR/DLC Communications (2140 Auto Dial)	1,500	8	34
Common Trunk Interface to Century B2 (VRX non-DNA)	1,400	7	32
Common Trunk Interface to Criterion (VRX DNA)	1,400	7	32
BSC Communications (NCR 751-600/700)	1,500	8	34
Multipoint Asynchronous Communications	1,500	8	34
Asynchronous Point-to-Point Communications (TTY)	1,500	8	34
On-Line File Transport (cassette/magnetic tape)	2,000	11	45
Automatic Transfer Logging	2,000	11	45
Table Transfer (721 to Century B2 host)	1,500	8	34
Remote Console I/O Writer	700	4	16
Remote System Executive	10,000	55	223
General Purpose Bisynchronous Communications (NCR 796-501 & AMEX)	1,500	8	34
NCR Comten Interface	1,500	8	34■

NCR 721 Communication Processor



The NCR 721 (foreground), depicted here with an NCR Criterion 8500 mainframe, features a readily accessible control panel and dual cassette unit (on top of unit) for program loading, data input, and memory dumping.

MANAGEMENT SUMMARY

The NCR 721 Communication Processor is an evolution of the older Model 621 front end. An extended set of hardware and software modules has been developed that permit a large number of configurations to be tailored for specific applications. The 721 was originally offered on a limited basis to a small number of customers having large terminal installations, notably Montgomery Ward and Japan's Sumitomo Bank. By the fall of 1977, NCR had developed enough modules to satisfy most applications, and the firm consequently released the product to the general marketplace in the spring of 1978.

While most comfortable in an NCR Criterion or Century mainframe environment, the 721 is also capable of operating with an IBM System/360, /370, or equivalent via communications lines, though not in a front end capacity. The 721 is now capable of distinguishing priorities from message header content and will be capable of down-line program loading when operating as a remote concentrator in the first quarter of 1979. Total system load balancing will be available later in 1979 as Distributed Network Architecture (NCR's DNA) software releases are brought to market. The 721 has physical accommodations for up to 253 half-duplex or 126 full-duplex communication line attachments. When operating as a front end on the same site with the mainframe, transfer rates of up to 560K bps are achievable. When used as a remote concentrator or nodal processor in an NCR/DNA system, data transfer, NCR's DLC, is bit oriented and can be considered as a subset of ISO's HDLC or a superset of IBM's SDLC. The normal number

A highly flexible system of hardware and software modules that can be configured as a front end for NCR Century or Criterion CPU's, as a remote communications concentrator, as a message switcher, or as a unit performing combinations of these functions.

As the central hardware element of NCR's Data Communications Utility (DCU), the 721 is capable of physically connecting up to 253 half-duplex or 126 full-duplex lines. Asynchronous operation at up to 9600 bps and synchronous operation at up to 56K bps are accommodated. The base system comes equipped with 32K bytes of memory and is expandable to 128K bytes in 32K-byte increments. The 721 can accommodate bit-oriented protocols such as HDLC, SDLC, and NCR's DLC, and can also be used as the hardware/software combination to gain access to an X.25 packet network. Options include integral modems and AT&T 801 automatic calling unit compatibility.

A Model 721 equipped with 10 asynchronous attachment points, 4 bisynchronous attachment points, one host attachment, and 96K words of memory can be rented, on a one-year lease, for \$2,475 per month, including maintenance, or can be purchased for approximately \$67,000.

The software package (Transaction Oriented Executive - TOX) to support the configuration described can be obtained for a one-time license fee of \$31,500 or rented for \$940 per month. The one-time fee includes software maintenance for one year; thereafter, software maintenance is provided for approximately \$150 per month.

CHARACTERISTICS

VENDOR: NCR Corporation, Main & K Streets, Dayton, Ohio 45479 Telephone (513) 449-2000.

DATE OF ANNOUNCEMENT: August 1977.

DATE OF FIRST DELIVERY: 1975 (specialized version); April 1978 (general release).

NUMBER DELIVERED TO DATE: Over 350 worldwide; approximately 30 U.S.

SERVICED BY: NCR Corporation.

CONFIGURATION

NCR's 721 Communications Processor consists of four interconnected hardware components packaged in a single unit, which interface host processors and remote and local

NCR 721 Communication Processor

▷ of data frames that can be transferred before acknowledgement required is 128 as opposed to HDLC's 255 (maximum option) or SDLC's 7. The number is programmable and does not need to be the same for all incoming lines. Operator alert with manual restart can also be programmed independently for each line based on retransmission counts.

The 721 is built around a minicomputer with a 1.2 microsecond cycle time. Up to three host connections can be made, and NCR can custom develop channel adapters for most mainframes. Memory is available from 32K bytes to 128K bytes in 32K-byte increments. Communication line adapters to handle asynchronous (ASCII or BCD), bisynchronous, HDLC, SDLC, NCR's DLC, and X.25 protocols are available in any mix. When providing access to an X.25 network, the 721 formats the line data but does not function as a true nodal processor because it does not provide error analysis or storage and retry capabilities as a true X.25 node does.

The 721 does not support automatic code/speed recognition or current loop interface at the present time. It does support external 801-type automatic calling units, automatic dialing and answering, and a number of integral line drivers and modems. Communication line and mass storage data transfers from and to main memory are via Direct Memory Access (DMA). Each DMA channel is capable of a burst rate of 315K bytes per second. The DMA and other data transfers interrupt memory only upon completion of a message transfer.

In addition to DMA, which is designed for high speed data transfer and requires the least amount of processor cycles, the I/O capabilities of the 721 also feature intermediate and slow speed data transfer. These are termed Auto Data Transfer and Programmed Data Transfer, respectively. Programmed Data Transfer is the slowest and also requires the most processor cycles.

The 721 is built around a minicomputer with a 1.2 microsecond cycle time. However, NCR maintains that in some cases a small slave computer is attached to the 721 in order to perform some processing functions, which might include data base/file maintenance and/or transaction logging, but to do so is not considered economically feasible and is discouraged. Limited communications-related applications can be executed without attachment of a slave.

Several options and techniques are available to provide simple backup redundancy in a 721 communications system. Each technique requires multiple 721 processors, which increases cost but does not provide additional communications capability. □

▶ devices. The components are the central processor and memory, the multiplexer, the multiplexer-processor interface, and the adapter complex.

The MO5 Central Processor is a one-address, 16-bit minicomputer. Single and double-word length instructions are provided. The processor provides I/O ports, and contains decimal and binary arithmetic and logic instructions. Addressing methods which may be used include indexed, relative, direct, indirect, literal, and combinations thereof. There are 16 program-accessible registers. The MO5 uses core memory with a maximum cycle time of 1.2 microseconds. The basic system includes 32K bytes of memory, which is expandable to 128K bytes in increments of 32K bytes.

The C-621-903 High-Speed Communications Multiplexer performs most of the control logic for the adapters, and together with the adapters, provides the physical interface for up to 253 communication lines. Each message is stored without interrupting the MO5 CPU operation following the transmission of each character. Only upon message termination is the MO5 processor operation interrupted. (Optional adapters are available for devices which require interrupt service on a per-character basis.) The multiplexer performs a variety of error checking functions including vertical parity generation and verification, block checking, and cyclic redundancy checking; it also handles the control functions of transparent-text mode. An interval timer is built in. The multiplexer throughput capacity for any configuration of lines is 320K bps if the highest speed line is less than 40.8K bps, and up to 560K bps, if all attached lines are high-speed (e.g., 56K bps.)

There are several factors which affect message throughput capacity, some of which are a result of the software application (TOX 721). For example, as a consequence of using message level adapters, throughput decreases slightly as message length increases. Also, as a result of the applications software (TOX 721), a minimum amount of in-core data movement within the 721 occurs, which further decreases throughput in the case of lengthy messages, because an increased amount of message processing is necessary. Similarly, throughput is a function of the communications protocol used. Full-duplex protocols, such as SDLC or HDLC, result in more efficient line utilization than half-duplex protocols. With a half-duplex usage of BSC, for example, throughput decreases with decreasing message size because of the line overhead per transmission required for acknowledgement sequences.

The multiplexed common trunk interface connects the multiplexer to the MO5 processor, accesses 256 control words, and performs packing and unpacking.

The last basic component is the adapter interface. The 721 contains 14 internal adapters, each of which can interface with either two half-duplex lines or one full-duplex line. If more lines are required, a common adapter trunk must be attached to one of the 721 cards, which reduces the number of 721 internal adapters to 13. The common adapter trunk, via Auxiliary Bay Connectors, handles the attachment of up to eight Auxiliary Cages. Each Auxiliary Cage has its own power supply and driver cards and can hold up to 15 additional adapter cards. Auxiliary cabinets are similar in size to the 721 itself. Each cabinet holds up to two Auxiliary Cages.

TRANSMISSION SPECIFICATIONS

A wide variety of line adapters can be utilized. Asynchronous adapters are available for handling up to 9600 bps. Standard transmission speeds include 300, 600, 1200, and 1800 bps. Synchronous adapters are available for handling up to 56K bps, also in standard speeds.

The 721 adapter system offers line compatibility with dial-up, auto-dial, auto-answer, two- and four-wire lines, Western Union broadband lines, Bell System wideband private lines, and Bell DDS. Adapters which accommodate asynchronous (ASCII or BCD,) bisynchronous, HDLC, SDLC, or NCR's Data Link Control (DLC), a bit-oriented protocol recently released, are available.

PERIPHERAL EQUIPMENT

The 721 basic system includes several peripherals, and others are available on an optional basis. There are a total of eight I/O slots. ▶

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NCR 721 COMMUNICATIONS WITH OTHER DEVICES

Device	Connection to 721
NCR Century Criterion Mainframe	Common trunk interface
Another 721 Processor	Any communications lines/protocols, including X.25
NCR 725 Controller	Remote via synchronous communications lines local via common trunk interface
IBM 370 Mainframe	IBM 3705 Communications Processor via synchronous communications lines; 3271 Bisync protocol
TRW 4000 (Credit) Controller	Synchronous communications lines
IBM 3270 Visual Display Terminal	IBM 3271 controller via synchronous communications lines
NCR 796-301 Visual Display Unit	Asynchronous communication lines
NCR 796-501	Synchronous communication lines
NCR KSR Thermal Printer (NCR 260-2 or NCR 796-101)	Remote via NCR Digital Concentrator and asynchronous communications lines
Most NCR Retail and Financial Terminals	Asynchronous or synchronous communications lines

► Among the standard attachments are dual magnetic tape cassette drives. One drive is used for program loading, the other is provided for other functions such as data input or memory dump. A switch on the control panel allows either cassette to be used for program loading. The cassette unit occupies one of the eight I/O slots.

The control panel is the primary means of communication between the operator and the system. The panel contains sense and option switches and a set of status lights, which are under program control. Four switches (LOAD, HALT, RESET and COMPUTE) provide direct control. A 16-key keyboard and selector switches are provided for interrogating and changing processor registers and memory. The control panel also occupies one of the I/O slots.

A third I/O slot is reserved for running diagnostics.

Four I/O slots, three of which can use DMA, are available for attachment of optional devices.

A DMA Peripheral Interface is available that can accommodate up to eight peripheral control devices for magnetic tape units or printers. Data transfer via the Peripheral Interface is at a maximum rate of 315K bytes per second. If needed, one additional Peripheral Interface can be accommodated.

The 721, when performing as a front-end, requires an interface with an NCR Century/Criterion Common Trunk (CTI), which must be a dedicated DMA line between the 721 and the host. Data transfer via this channel is at a maximum rate of one million bytes per second. An additional Common Trunk Interface is available.

Another peripheral feature is an integrated disk unit and controller capable of handling up to three additional disk units. The disk drives are standard NCR units; each accommodates two disks, one removable and one fixed. The total 8-disk capacity is 39.8 megabytes. The disk controller and interface have a maximum transfer rate of 312K bytes per second.

SOFTWARE

The primary software package for the NCR 721 Communications Processor is the Transaction Oriented Executive

(TOX 721). The software is multitasking; more than one task may be active concurrently. The basic package, supplemented by a number of software modules, is oriented towards high volume transaction throughput, characterized by little data movement in the 721 itself. TOX 721 is tailored for each installation depending on whether the 721 is a node, local, or remote communications processor.

When the 721 serves as a node the operating system makes it work as a store and forward unit within the network, collecting an entire error-free message before re-transmitting it. TOX 721 permits easy expansion of a node to include additional lines and higher speeds as long as the network architecture remains the same; i.e., interconnections among 721's are unchanged.

TOX 721 includes a scheduler (which permits communications between tasks), a set of service routines, I/O routines, and "data structures."

The basic components of TOX 721 are tasks and processes. A task is the smallest entity in the system that can be scheduled. A process is simply a combination of one or more tasks particular to a certain situation.

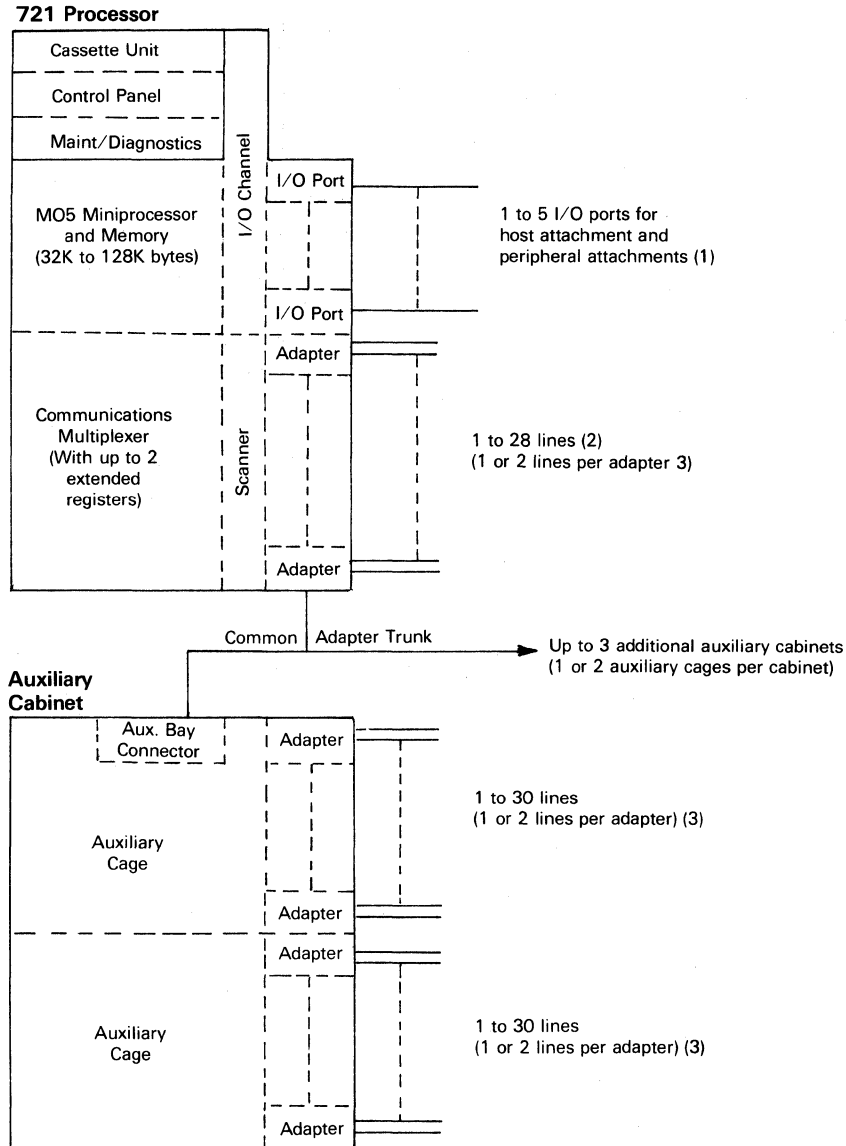
Tasks are defined by a "data structure," which points to the appropriate software module to be executed. Tasks are either I/O routines, device or communications line drivers, or applications. A process such as switching a transmission from one line to another requires I/O routines, line drivers, line applications, and a message switcher.

An I/O routine operates on an interrupt level and is thereby protected from other tasks in resource contention. Line drivers operate on a program level, use standard modules from the TOX 721 library, control devices on lines, and handle data transfers using I/O routines. Application tasks also operate on a program level and deal with devices using drivers.

Under TOX 721, tasks are not preempted, but are always allowed to run to completion. All tasks have roughly the same execution time and the same execution priority. They all deal with communications and keep transmissions moving through the system. ►

NCR 721 Communication Processor

NCR 721 Communications Processor Configuration



- (1) Three of I/O ports have Direct Memory Access capability.
- (2) If auxiliary cabinet is used, line capacity decreases to 26.
- (3) Half duplex permits 2 lines per adapter card; full duplex, only 1.

► The scheduler, using a multiple queue scheduling algorithm, accomplishes the assignment and execution of tasks with regard to priority scheduling. Priorities within this algorithm are determined and fixed at system generation time.

A task points to its pre-assigned Task Queue Header (TQH) and receives a fixed priority on the TQH list. The scheduler loops around the TQH list looking for a data structure queued on the list. Finding one, it dequeues the structure and passes it to its appropriate task, which activates the task. On return to the TQH list, the scheduler looks first to see if an interrupt occurred in the meantime. If so, it goes to the top of the TQH list; if not, it resumes where it left off on the list.

Also under control of the scheduler is dedication of storage space. Data is read from and into storage buffers, acquired from dynamic memory storage. Buffers are passed among

tasks by the scheduler. Memory, which is shared among tasks, is allocated automatically by a dynamic storage allocation algorithm which divides and stacks free memory and allocates portions to tasks as needed. If no memory is available, the request is put in queue until available, at which time the task is notified.

For planning purposes, the basic Transaction Oriented Executive with necessary additional software operating modules occupies about 40K bytes of memory. Each additional software module occupies from two to eight kilobytes.

NETWORK ARCHITECTURE

As is the case with most of the mainframe manufacturers, NCR has also announced a series of terms and concepts that relate to networking. ►

NCR 721 Communication Processor

► Data Network Architecture (NCR's DNA) is the firm's highest level of network topology and is similar in concept to IBM's SNA.

The 721 fits into the network as the hardware element of NCR's Data Communications Utility, which consists of the 721 loaded with the Transaction Oriented Executive (TOX) operating system software. Transmission protocol within DNA is NCR's Data Link Control (DLC), a bit-oriented protocol. An advantage of DLC is that it results in a network transparent to code, speed and terminal type. These techniques are valuable when one or more 721's are acting as remote concentrators connected back to the host site through a 721 front end, thus reducing communications line costs and offloading communications house-keeping functions from the mainframe. Because the 721 operates in a store-and-forward mode, it can also function as a message switch, with limitations.

One other subset of NCR/DNA is Data Transport Networks (DTN). When a number of geographically scattered 721's are connected together and operate as nodes in the network, the associated host CPU's are independent with no master/slave relationship. All data is routed by the 721's to the proper logical and physical elements in the network with transparency between the end user and the system resources. Interconnections between 721's also allow the data to be automatically rerouted in the case of an element failure.

In a DTN application, a terminal would enter into its connected 721 the English name for the logical element it wants to address. The 721 then examines its resource table to determine if the resource is local or remote. If it is remote, the 721 reviews its tables for the geographical

location of the resource and determines the best communications path to use. Having made these various determinations, the 721 creates a header with the applicable information and tacks it onto the original message. At the appropriate time, the message is entered into the data stream on the selected path and routed to the next 721 in the network. The 721 receiving the message performs a table search similar to that performed by the sending 721. If the receiving 721 has control over the requested resource and the resource is available, the path control header is stripped and the message passed on. If the resource is not available or not at that location, the header is stripped and the message placed in queue while a table search is performed. A new header is created, and the message is forwarded to the next 721 in line. This process is repeated until the proper destination is reached.

Transmission in the network is full-duplex with messages or filler being transmitted continuously. DTN is intended to be configured so that each 721 node has at least two transmission paths to every other node, even though the data may go through several intermediate nodes before it reaches its final destination. This alternate routing technique greatly enhances reliability. The 721, in the performance of its communications function, promotes a key aspect of NCR/DNA: the separation of communication processing from application processing.

PRICING

The NCR 721 is available for purchase or one- or five-year lease. Lease prices include maintenance. A separate maintenance contract is available for purchased systems.

Monthly Lease*

	1-yr.	5-yr.	Purchase Price	Monthly Maint.
NCR 721 Basic System. Includes one MO5 minicomputer with 32K bytes of core memory, high-speed communications multiplexer, control panel, one thermal printer KSR, dual cassette unit and switch, console alarm, transparency mode detection, poll outward bucket-in, horizontal mounting bracket, console cover and adapter cover plate	\$1,463	\$1,320	\$43,000	\$325
Additional Memory; each 32K-byte memory increment; 128K bytes maximum	163	147	4,800	39
In-House Clock Driver	77	—	2,000	18
COMMUNICATIONS COMPONENTS				
Auxiliary Cabinet; required for over 26 half-duplex lines; holds up to 15 additional adapters. With an additional card cage, can hold up to 30 adapter boards per cabinet. Up to 5 Cabinets can be chained to one 721 processor	255	230	7,650	5
Auxiliary Bay Connection Cable & Kit; for common adapter trunk; required for each auxiliary cabinet	45	41	1,250	6
Auxiliary Card Cage	126	114	3,725	11
On-Line, Auto Dialer; includes necessary cable attachments	52	—	1,600	13
Synchronous Adapter Connection Cable Kit; for connection to in-house clock	14	—	450	2
Wide Band Interface	21	—	685	2
Asynchronous Adapter, Teletype; one required with basic system to accommodate maintenance console	46	42	1,160	10
Two Asynchronous Adapters; includes cable; constitutes one async adapter card	46	42	1,160	10
Two Synchronous Adapters includes cable; constitutes one sync adapter card	61	55	1,500	10
Integrated Asynchronous Modem; includes cable, plug, and receptacle	34	—	1,000	8
Free standing External Modem; includes cable, plug, and receptacle	33	—	700	10
Extended Register Group; required on multiplexer if adapter count exceeds 14; for up to 128 half-duplex lines	31	28	800	10
Additional Extended Register Group; required if over 128 half-duplex lines, or equivalent scanner positions, are incorporated	31	28	800	10

NCR 721 Communication Processor

	Monthly Lease*		Purchase Price	Monthly Maint.
	1-yr.	5-yr.		
PERIPHERALS				
Peripheral Interface; accommodates up to 8 peripheral control units	81	73	2,400	17
Century/Criterion Common Trunk	102	92	3,000	22
300 lpm FST Printer with Controller	653	—	24,150	125
Magnetic Tape Unit with Controller; 9-track, 1600 bpi PE, 25 ips, 40KB. can control up to 3 additional tape units	655	—	25,830	138
Additional Magnetic Tape Unit	272	—	10,500	78
Dual Mode Electronics for Tape Unit; required for controller and each tape unit	18	—	630	10
656 Disk Unit; accommodates two disks, one removable and one fixed; each disk has a capacity for 4.98 megabytes	**	**	**	**
Disk Control Unit; can handle up to four disk units with a transfer rate of 312.5K bytes per second	**	**	**	**

*Includes maintenance.

**Disk unit use with 721 system is contingent on NCR marketing of disk control software module, expected in first quarter of 1979.

SOFTWARE

	One-Time License Fee	Annual Support Charge	Monthly License Fee
System Executive (TOX 721)	\$31,500	\$1,800	\$940
Poll Inward Communications Driver (Bisync, IBM 3705)	400	36	13
Bisync Communications Driver/Control (TRW 4000)	400	36	13
Bisync Communications Driver/Control (NCR 796-501)	500	48	16
Bisync Communications Driver/Control (NCR 7300 & IBM 3270)	500	48	16
Teletype Communications Driver	500	48	16
KSR Teletype Autodial/Data Collect	300	24	10
POS Driver/Control (NCR 280-120/125)	600	60	20
Async Communications Driver/Control (NCR 751-150, 796-301 Multipoint, 6440 Multipoint, 7200, 270, 275, 279, 2500, 770, 724/285)			
Common Trunk I/F to Century (B2 I/F)	500	48	16
Common Trunk I/F to Century (B1 I/F)	400	36	13
Trunk I/F to NCR 725	500	48	16
HASP Multi-leaving Driver/Control for remote entry station	600	60	20■