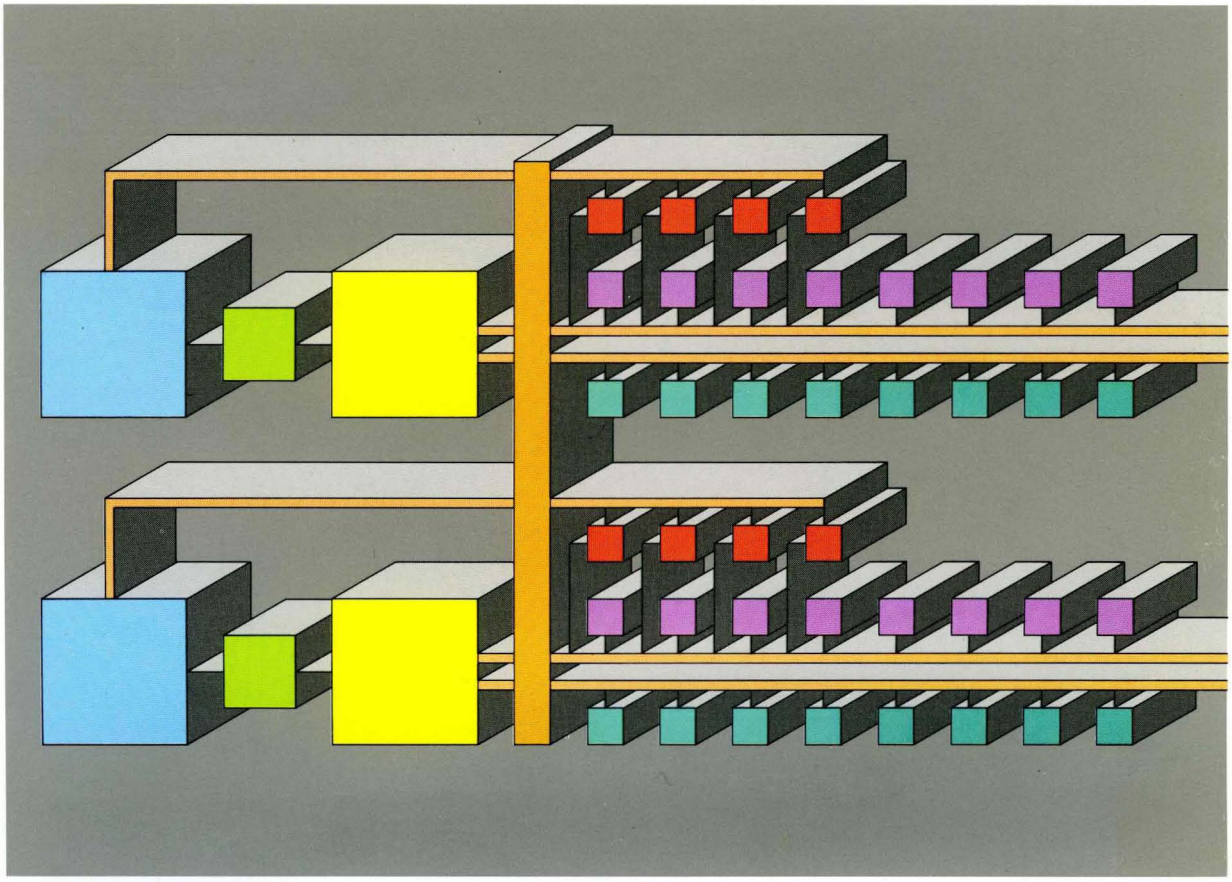
IBM 3745 Communication Controller Product and Technology Overview



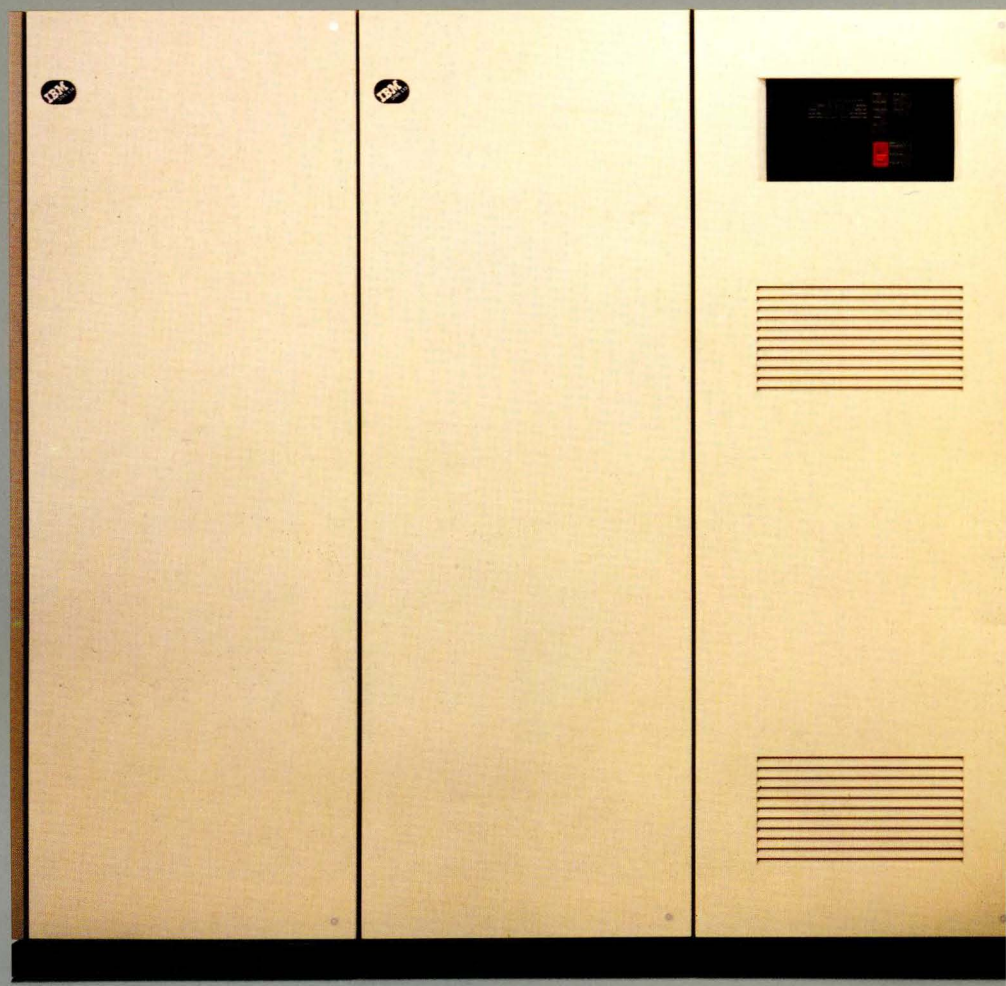
Enhanced technology and functional capability

IBM

IBM 3746
Expansion Unit
Model L14

IBM 3746
Expansion Unit
Model L13

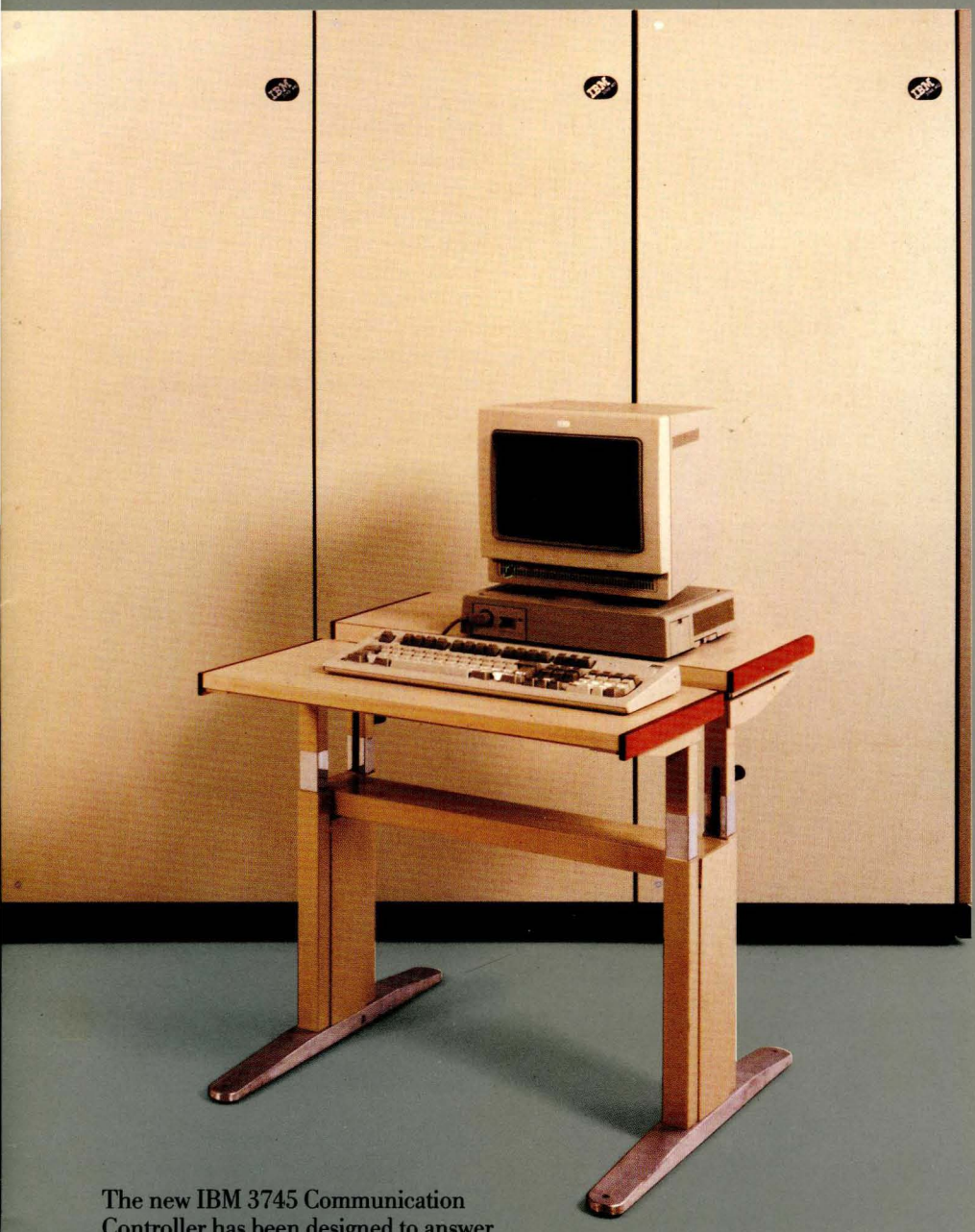
IBM 3745
Communication Controller
Model 210 or 410



Leading-edge technology working for you

IBM 3746
Expansion Unit
Model A11

IBM 3746
Expansion Unit
Model A12



The new IBM 3745 Communication Controller has been designed to answer the primary requirements of customers for enhanced connectivity, performance and availability.

It is a modular, high-function communication controller, offering cost-effective solutions for networks requiring reliable nodes with many connectivity options. By incorporating advanced technology in many fundamental aspects of its design, the 3745 offers users highly sophisticated capabilities in communication controller operations.

Improved performance

The latest generation within the IBM 37XX family of communication controllers, the 3745 takes controller technology a major stage forwards. The basic 3745 model offers approximately twice the performance of the IBM 3725 Communication Controller, whilst expansion options boost connectivity and handling capacity.

In addition, new concepts in product architecture and component relationships have been incorporated to improve the standards of reliability, availability and serviceability already demonstrated by the 37XX family.

New levels of modularity

Modular construction allows users to match connectivity requirements to their needs, and at the same time provides a simple pathway for future system growth and expansion. Modularity also extends to concurrent maintenance, providing the benefits of online diagnostics and component replacement. For improved versatility, 'hot pluggability' allows selection of the configuration which best meets current needs – without impacting other machine functions – so that users can react quickly to changing requirements.

This major advance in communication controllers also reflects the increasing sophistication of the IBM product development process itself. Improved project tracking and even closer co-operation between design and manufacturing divisions have ensured improved product quality, system performance and availability.

New standards of performance at your command

The 3745 answers the three main requirements identified in extensive discussions with existing users of IBM communication controllers; increased availability, improved performance and enhanced connectivity.

Once these objectives were defined, the development of the 3745 was structured to ensure that they would be attained. Tracking methods were refined so that the pathway to Engineering Verification Tests, first of the important 3745 development milestones, was achieved in a single pass – eliminating the iterative steps normally required for such a sophisticated product.

To increase availability, and at the same time provide enhanced speed and performance, provision has been made for duplication of the Central Control Unit (CCU), the 'engine' at the heart of the 3745. This allows operational flexibility from full backup through to much enhanced handling capability with two CCUs operating simultaneously.

In the interests of serviceability, the 3745 has been designed to facilitate both 'hot pluggability' and concurrent maintenance. To improve manageability, a fixed disk provides the capacity to store multiple load modules of the Network Control Program (NCP).

Processing performance has been enhanced by the use of advanced Complementary Metal Oxide Semiconductor (CMOS) technology in many areas of the machine; high-speed bipolar chips for many critical functions; and by a new design for the CCU itself, which now makes use of air-cooled Thermal Conduction Module (TCM) technology.

New high-speed data ports

Meeting the challenge of the latest developments in telecommunications networks, the 3745 offers greatly increased overall line handling capacity, and can also accommodate high-speed T1 and 2 Mbps lines. The 3745 is the first IBM communication controller to provide a unique scanner for T1 and 2 Mbps lines, and has the capacity to handle up to sixteen such lines, of which eight may be active simultaneously.

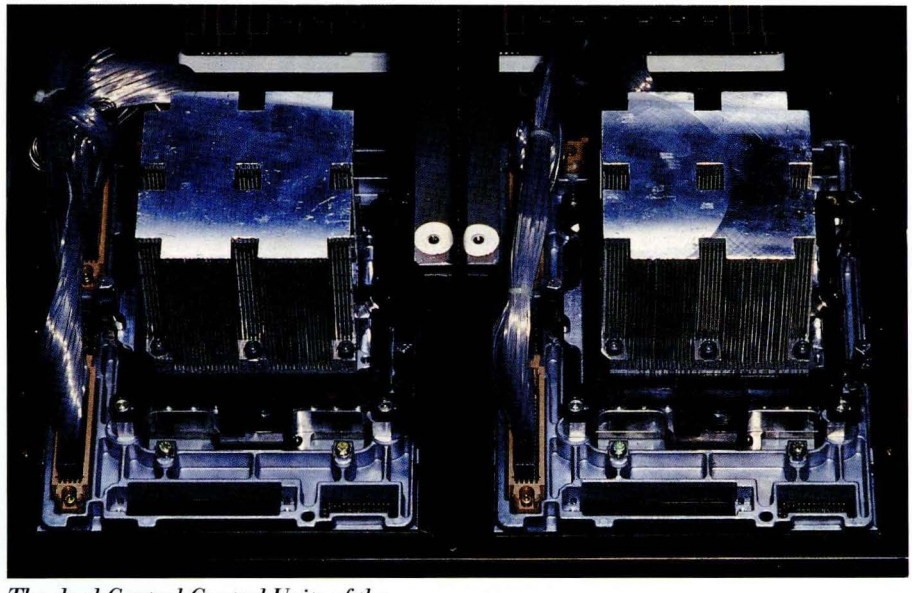
To overcome the potential bottleneck of normal input/output transaction speeds, Direct Memory Access (DMA) technology bypasses the main I/O bus on the new high-speed data channels. The maximum capacity of the DMA bus is approximately 8 megabytes per second.

Better connectivity

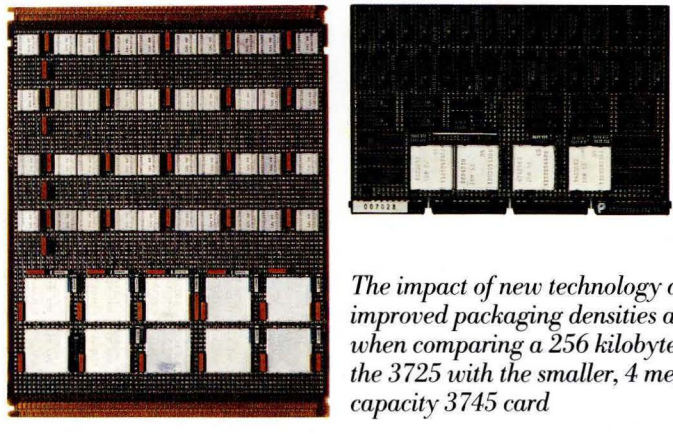
Many design enhancements involve the components directly concerned with connectivity and data handling, namely the Line Interface Couplers (LICs); the scanners which receive and direct data traffic; and the channel adapters, which provide the links to host computers.

Four LIC types provide line attachment for V24, V25, V35 and X21 interfaces, and the scanner incorporated in the 3745 is designed for excellent performance over a wide range of line speeds, from 50 bps to 256 kbps.

In parallel with the improved processing power of the 3745, host connectivity has also been enhanced to include 16 channel adapters. In block multiplexer mode, the 3745 channel adapters also support data streaming, increasing both instantaneous throughput and the maximum permissible channel lengths to 400ft (120m).



The dual Central Control Units of the Model 410 provide complete flexibility from full backup to simultaneous operation



The impact of new technology and improved packaging densities are evident when comparing a 256 kilobyte card from the 3725 with the smaller, 4 megabytes capacity 3745 card

Performance comparison

The single or dual 3745 CCUs, each more powerful than the single CCU of the 3725, operate with a 75 nanosecond cycle time, allowing the 3745 to process instructions significantly faster than the 3725.

In addition to faster processors, Direct Memory Access and design improvements such as increased line capacity, high-speed scanners, and cache memory mean that the new 3745 achieves much better performance when compared with previous IBM communication controllers.

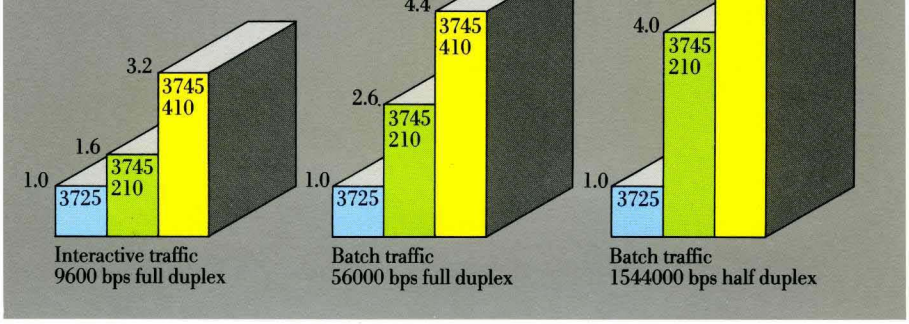
Since communication controller performance depends on line speeds, protocols, message lengths and other traffic characteristics, the graph opposite has been prepared to illustrate the comparative performance of 3745 models with that of the 3725.

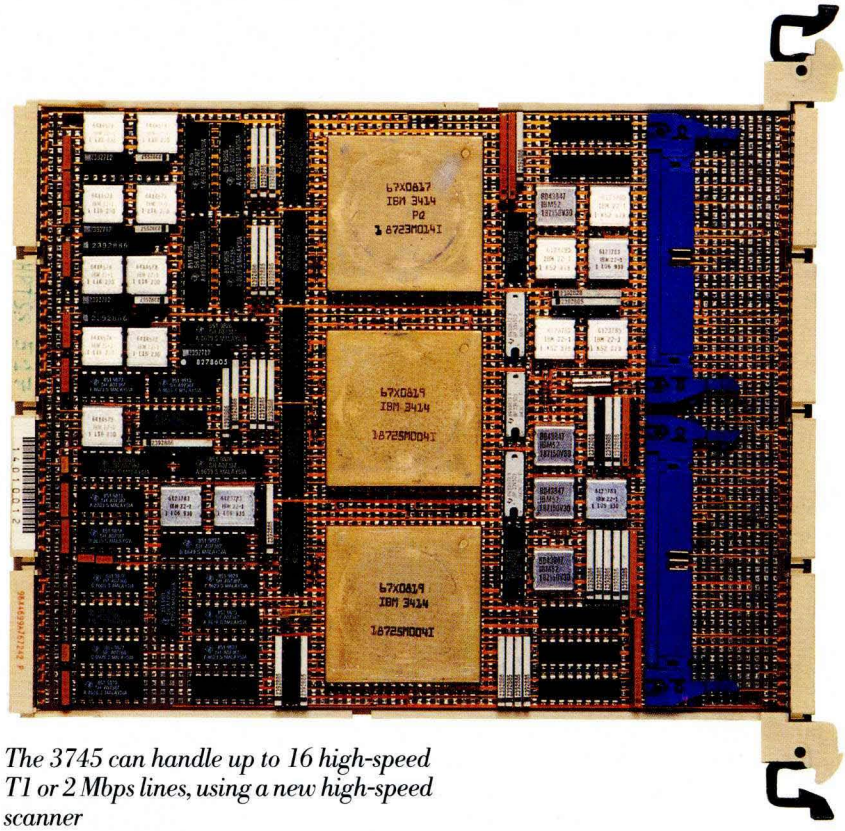
Installation flexibility

The IBM 3745 Communication Controller is available in two models, the Model 210 with a single CCU, and the Model 410 with dual CCUs. Initial choice does not limit future expansions, since the Model 210 may be field upgraded.

A 3745 Model 210 can be connected to up to eight host computers. Also, up to 128 low/medium speed lines, eight T1 or 2 Mbps lines, eight IBM Token-Ring networks, or certain combinations of these, can be supported. Optional IBM 3746 Expansion Units provide additional attachments for up to 16 hosts and 512 lines.

These charts provide examples of typical performance based on the number of active connections which can be supported by the 3725, 3745 Model 210 and 3745 Model 410 for selected line speeds and operating environments. The 3725 has been assigned a value of 1, and 3745 performances are shown in relation to that of the 3725. The first set represents an interactive inquiry application, whilst the second and third represent batch traffic for Intermediate Network Nodes (INN) to a host application





The 3745 can handle up to 16 high-speed T1 or 2 Mbps lines, using a new high-speed scanner

Building on a proven architecture

In developing the IBM 3745 Communication Controller, the challenge was to improve on the highly successful design of the 3725. This has been achieved by designing a package incorporating new technology which is cost-effective, occupies less floorspace and consumes less power, yet which provides higher overall performance.

The most important change to the architecture and function of the 3745 is dual CCU capability, each with its own 4 or 8 megabyte memory, and running its own NCP. Mode switching via a bus switch can provide either full or partial backup, and while each CCU individually provides higher capacity for extra line connectivity, this is further enhanced if backup facilities are not required and both CCUs are operating simultaneously.

More efficient input/output

To boost the efficiency of data transfer, dual I/O buses per CCU reduce traffic congestion on the links between 3745 components, when compared to the single bus of the 3725. Data and instruction flow between the CCU and scanners, and between the CCU and channel adapters, is distributed over the two I/O buses.

However, performance would have been inhibited if all high-speed scanner traffic had to pass through the CCU; the additional Direct Memory Access (DMA) bus is the key to providing increased high-speed line support. The DMA bus is a direct link between the high-speed scanner and main memory for most operations, thus freeing the CCU for other functions.

To speed operations further, a cache memory has been added to the architecture to act as a high-speed buffer, allowing the CCU to fetch and store commonly used instructions and data from memory at CCU speed, thus improving program execution by reducing read/write delays.

Distributed processing and power supply

Microprocessors distributed throughout the machine provide increased efficiency in task performance. These microprocessors run the independently operating 'microcode', which controls low-level functions of scanners, channel adapters, power blocks and other components.

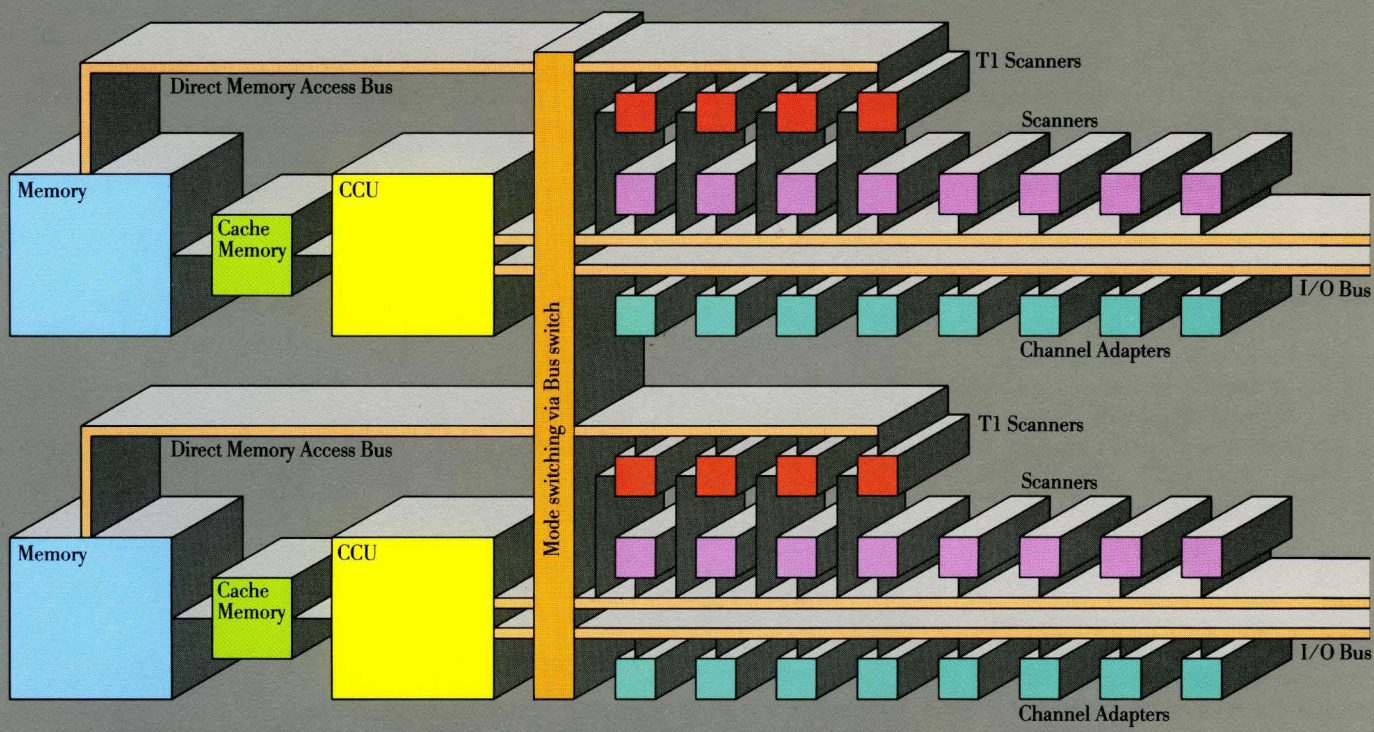
For ease of controller change and growth, the 3745 also has components that perform multiple functions. Protocol-independent Line Interface Couplers support a wide range of speeds, a single scanner type supports line speeds from 50 bps to 256 kbps, while channel adapters support byte, block and selector attachment.

Selective scanning is a further enhancement in that the scanner in the 3745 scans only those LICs that have activated lines. This means that users can configure their system so that the scanner can support different configurations at various time periods. For example, the same scanner can both support a large daytime interactive application and handle a nightime batch traffic application.

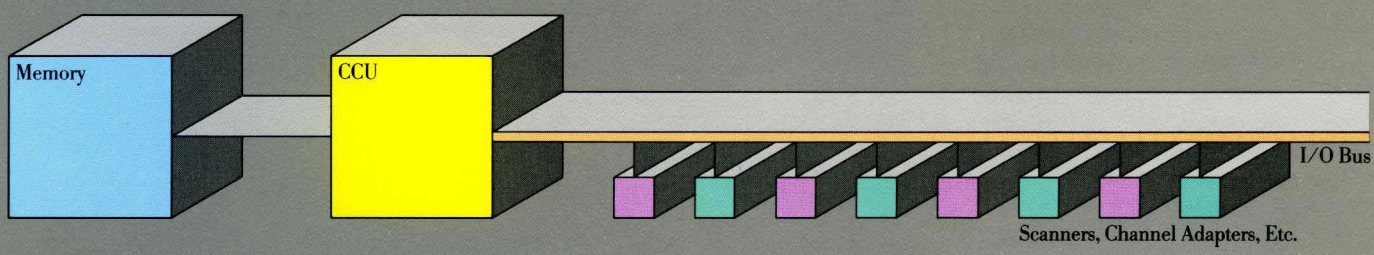
In addition to the distributed microprocessor architecture, a distributed power system with individual power blocks for each important component means that, whichever configuration is selected, electrical supply demands are matched to the configuration.

This distributed power system enables the 3745 to offer concurrent maintenance, which allows diagnostics to be run and components to be replaced while the controller remains operational.

3745 Architecture



3725 Architecture



Schematic of 3745 layout compared with that of 3725

Technological advances harnessed in the IBM 3745

The 3745 has been designed throughout using the latest IBM technology.

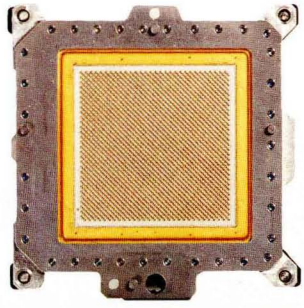
CCU

The Central Control Unit (CCU) of the 3725 consisted of ten cards mounted on a logic board, and required complex connection arrangements to ensure that clocking variations were kept to a minimum. In the 3745, the ten cards have been reduced to a single air-cooled module containing 104 high-speed chips, resulting in a processor cycle time of 75 nanoseconds. Advances in packaging design have made possible this high processor density, overcoming inter-chip wiring delays and power dissipation inequalities, and achieving gate delays of 1 nanosecond and RAM access times of less than 10 nanoseconds.

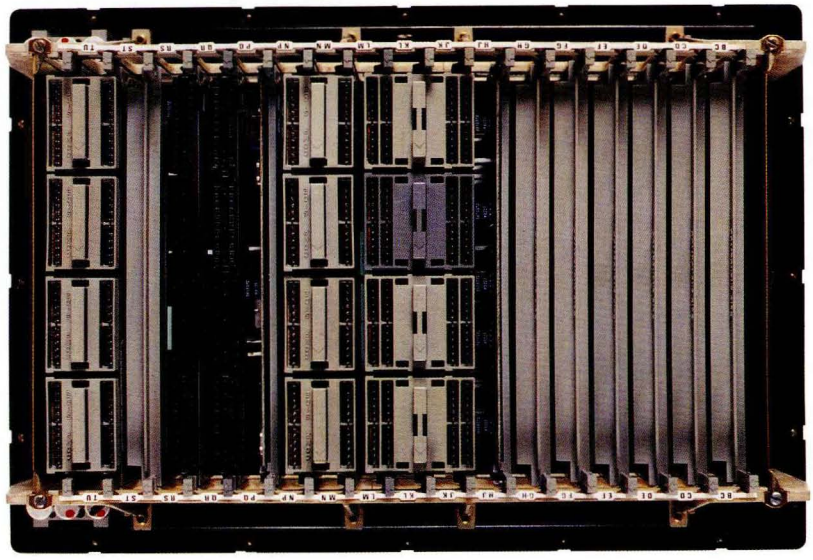
TCM

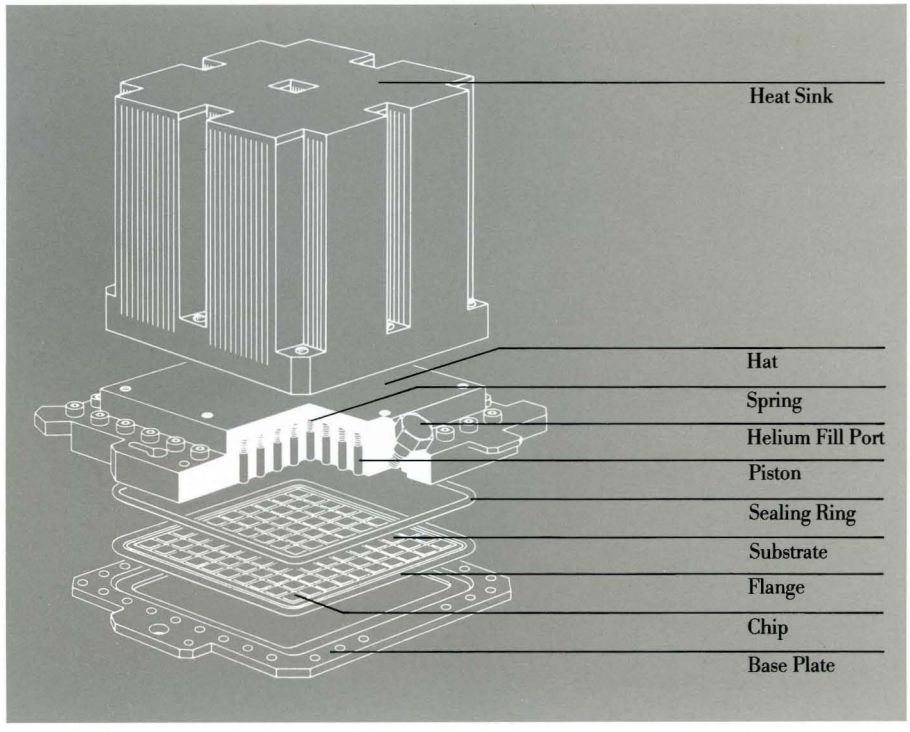
The air-cooled Thermal Conduction Module (TCM) houses and cools the 104 bipolar chips containing the processor logic, cache memory and control storage, mounted on the surface of a multilayer substrate. The substrate is clamped between a base plate and a 'hat' with spring-loaded metal pistons. Each piston presses against a chip, conducting heat to a heatsink bolted on top of the 'hat'.

The cooling system adopts the same successful approach as that of the IBM 9370 Information System, the TCM giving up the heat to ambient temperature air passing over it by forced convection. As part of the distributed microprocessor subsystem, air flows are closely controlled, with automatic shutdown in the event that temperatures ever exceed safe operating limits.



3745 CCU module compared with the 3725 CCU





One-megabit memory chip

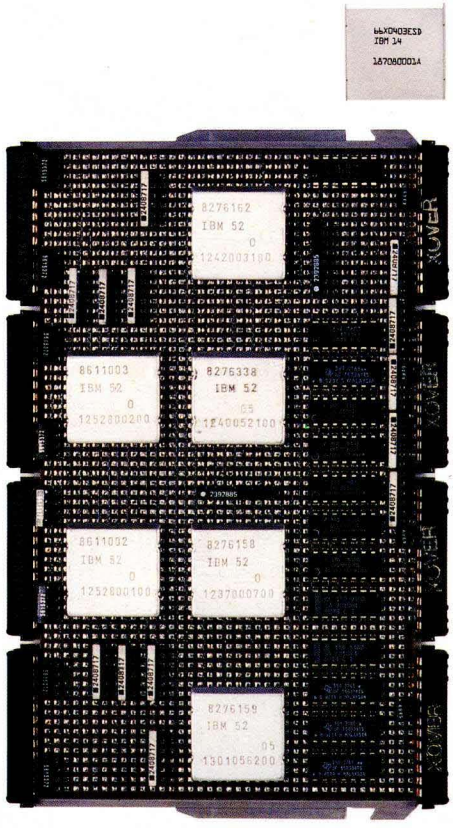
Industry-leading IBM one-megabit chips are used on the storage cards, expanding available memory up to either 4 or 8 megabytes. These high-density memory modules have increased resistance to 'soft' errors caused by background radiation, and special logic error circuitry helps to detect and correct failures.

CMOS technology

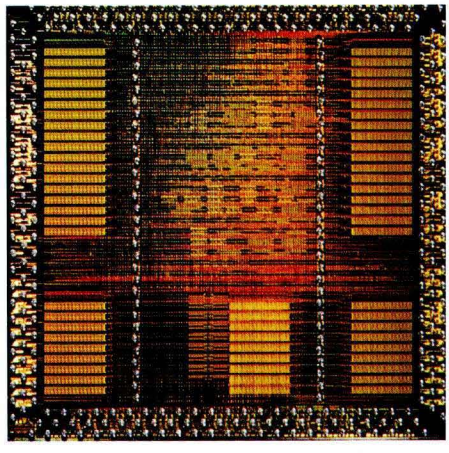
To increase packaging density, reduce power consumption and enhance processing power, CMOS gate array technology has been used for much of the CCU interface, direct memory access and I/O bus switching functions. These gate arrays offer ease of design and reduce circuit delays, and can incorporate densities of up to 10,000 circuits per chip.

The low speed scanners use CMOS technology for a majority of the logic design, with bipolar chips to interface with the memory. Use of high density CMOS gate arrays, associated with 256 kilobit memory chips, reduces a five card design in the 3725 to two cards in the 3745.

The high-speed scanner uses the latest IBM 1-micron logic CMOS design, and is one of the first IBM products to implement this leading-edge technology, providing a capacity of 40,000 standard cells per module. These high density modules allow much of the NCP buffer chaining functions to be integrated into the hardware and thus support T1 and 2 Mbps line performance.



3745 one-megabit chip compared with a 3725 memory card



The IBM 40,000-cell chip used in the high-speed scanner (actual surface is less than 1 cm sq.)

New features for improved operational control

The 3745 introduces an even higher level of controller manageability than the 3725, via the enhanced Maintenance and Operator Subsystem (MOSS). Menu selection screens guide the operator through tasks, eliminating many of the indicators and switches of earlier controllers.

MOSS provides microprocessor-controlled access to the 3745, from initial load, the control of bus switching between CCUs, and the management of operational modes, through to running of diagnostics, and the recording and analysis of events.

Enhanced MOSS function

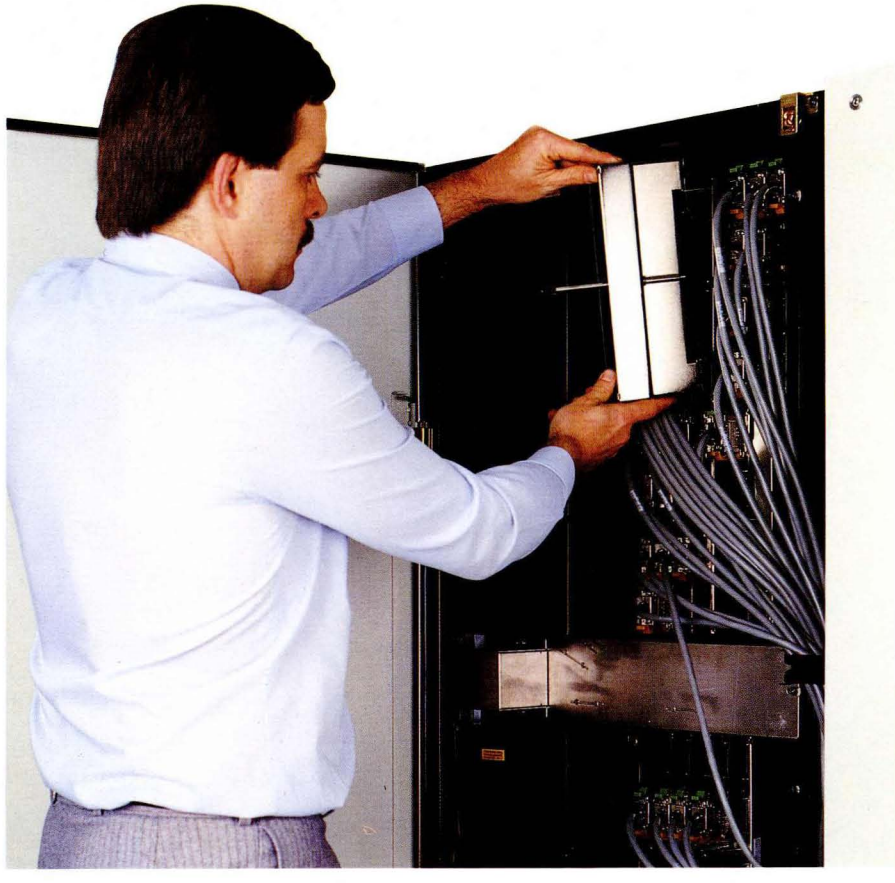
Many operations are carried out via microcode, which distributes instructions from storage to microprocessors throughout the 3745. These microprocessors not only control power supply sequencing, but also many of the functions formerly carried out by service personnel, thus providing considerable additional hardware flexibility.

This configuration flexibility includes the setting of direct attachment line speeds from NCP. In addition, the setting of subchannel addresses is a new function carried out by MOSS during microprogram load and which can be modified via the MOSS console. Channel adapters can also be enabled and disabled from the MOSS console, instead of via switches at the control panel. Another operational feature, implemented via MOSS, is port swapping, the ability to bypass a failing controller port.

Online changes

In addition, the 3745 has customer-accessible areas, allowing appropriate customer personnel to carry out 'hot pluggability' operations, to adapt the controller quickly and easily to network change and growth. LICs, packaged in protective cassettes, can be removed and added with power on, without affecting even those LICs supported by the same scanner.

The IBM 3745 Communication Controller is supported by NetView™, the IBM integrated network management program. Error information is provided to the host network operator, who can use the information to identify the cause of network problems, thus providing improved network control and increased availability for end-users.



Altering LIC configurations is now a simple online operation

™NetView is a trademark of International Business Machines Corporation.

Enhanced design for better availability

Every new IBM product is required to demonstrate that it has attained the qualities of RAS (reliability, availability and serviceability) appropriate to its stature as the latest development in a given field. This demanding design directive has ensured that the 3745 not only offers improved performance, but also eminence in other equally important areas.

Dual CCU modes

A primary 3745 feature for availability is the provision of dual CCUs on the Model 410, which can operate in any of three modes:

□ Twin-in-standby mode, with only one CCU active. Scanners and channel adapters on a disrupted CCU can be switched to the alternate CCU, either manually or automatically.

□ Twin-in-backup mode, in which a CCU can take over all or part of the traffic of the second CCU.

□ Twin-in-dual mode, with both CCUs operating independently to their full capacity, handling the maximum volume of traffic.

A 45-megabyte fixed disk makes a significant contribution towards availability, and also to the suitability of the 3745 for remote and unattended site installation. The Network Control Program (NCP) may be downloaded without disrupting network traffic and held locally, ready to initiate a rapid restart if required. The fixed disk can store two load modules per CCU, together with a dump of memory contents for later analysis.

Improved fault handling

Other aspects of design also focus upon availability. For example, since scanner events are often temporary, caused by unusual line traffic, the ability to automatically reload microcode reduces scanner outages. Diagnostics may be run from MOSS, and the modular distributed power supplies allow maintenance to be performed concurrently with 3745 operation. Individual power on/off switches to LICs, scanners, channel adapters and other components may be selectively disabled, allowing safe replacement.

The 3745 incorporates improved data capture and analysis systems. Reports are made to MOSS and can also be made available to the optional Remote Support Facility (RSF). The worldwide IBM RETAIN database is used to identify the fault type, so that a local IBM Customer Engineer can be despatched rapidly with the appropriate replacement. If the problem is in the microcode, highly trained specialists can interrogate the 3745 remotely via telecommunications links and MOSS to provide corrections, a facility which also extends to communicating known fixes to microcode problems.

Improved controller management is provided by enhancements to the Maintenance and Operator Subsystem (MOSS)

Providing rapid solutions to customer problems is the task of the highly trained engineers of the Remote Support Facility

Achievement in manufacturing excellence

IBM 3745 Communication Controller Model 210 base unit – offering attachment capability for up to eight host computers, as well as up to 128 low/medium speed lines, eight T1 or 2 Mbps lines, eight IBM Token-Ring networks, or certain combinations of these

In the development of the 3745, manufacturing specialists have formed a permanent part of the 3745 team right from early concept stages. They were therefore able to provide the benefits of their experience with the 3725, and an increased awareness of advances in production techniques. The elimination of potential sources of manufacturing problems at the outset eased the transition from development to manufacturing phases, reducing the time to product launch, and providing a further assurance of the high quality of this product.

Quality assurance is naturally at the heart of the 3745 manufacturing process. Only components of the highest quality have been selected for use in the 3745, and sophisticated tracking procedures have been established to monitor component performance.

The manufacture of this worldwide IBM product takes place in Raleigh in North Carolina, USA; Havant in the UK; and Fujisawa in Japan.

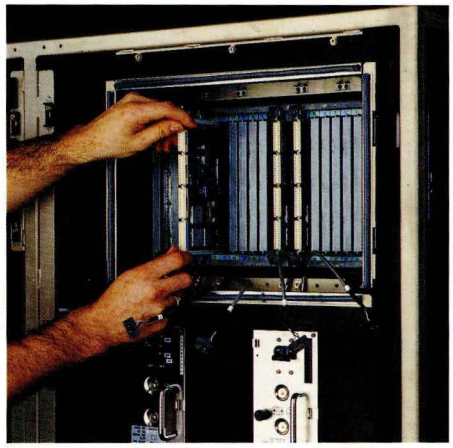
Improved efficiency

The 3745 production process makes use of the advanced manufacturing concept known as Continuous Flow Manufacturing (CFM). CFM, taken together with the high degree of early manufacturing involvement with the project, reduces manufacturing complexity as well as the manufacturing cycle time.

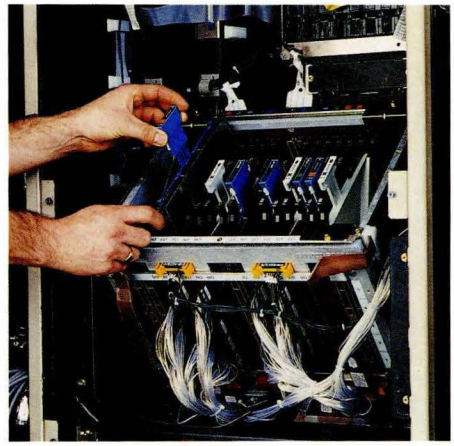
Automated test stations using IBM PC ATs functionally test each completed communication controller, and an IBM computer-controlled system monitors overall test data.

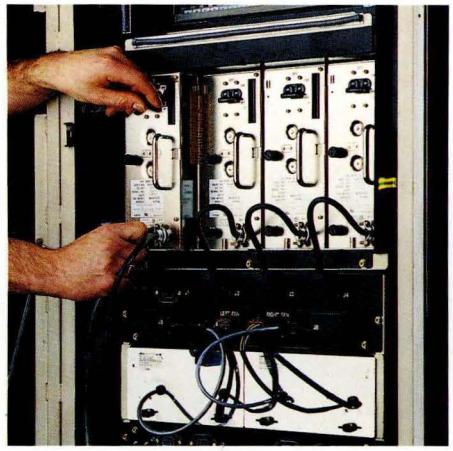
Yet, whilst technologically advanced methods of production ensure optimum efficiency in the process itself, the care and attention to detail which have been invested in the manufacture of the 3745 are the important factors in providing users with the reassurance of improved product quality and enhanced reliability.

The scanner used in the 3745 supports all line speeds from 50 bps to 256 kbps

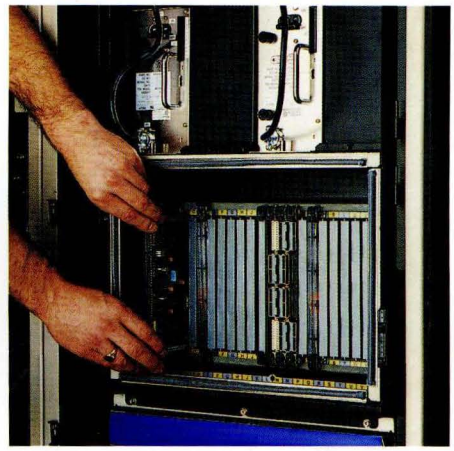


The installation of the CCU/TCM module demands highly skilled technicians

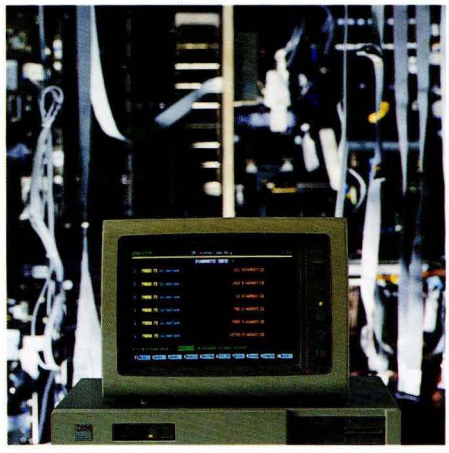




Installation of one of the many distributed power supply blocks, which ensure improved availability for the 3745



Assembly of one of the 16 channel adapters which provide host connectivity



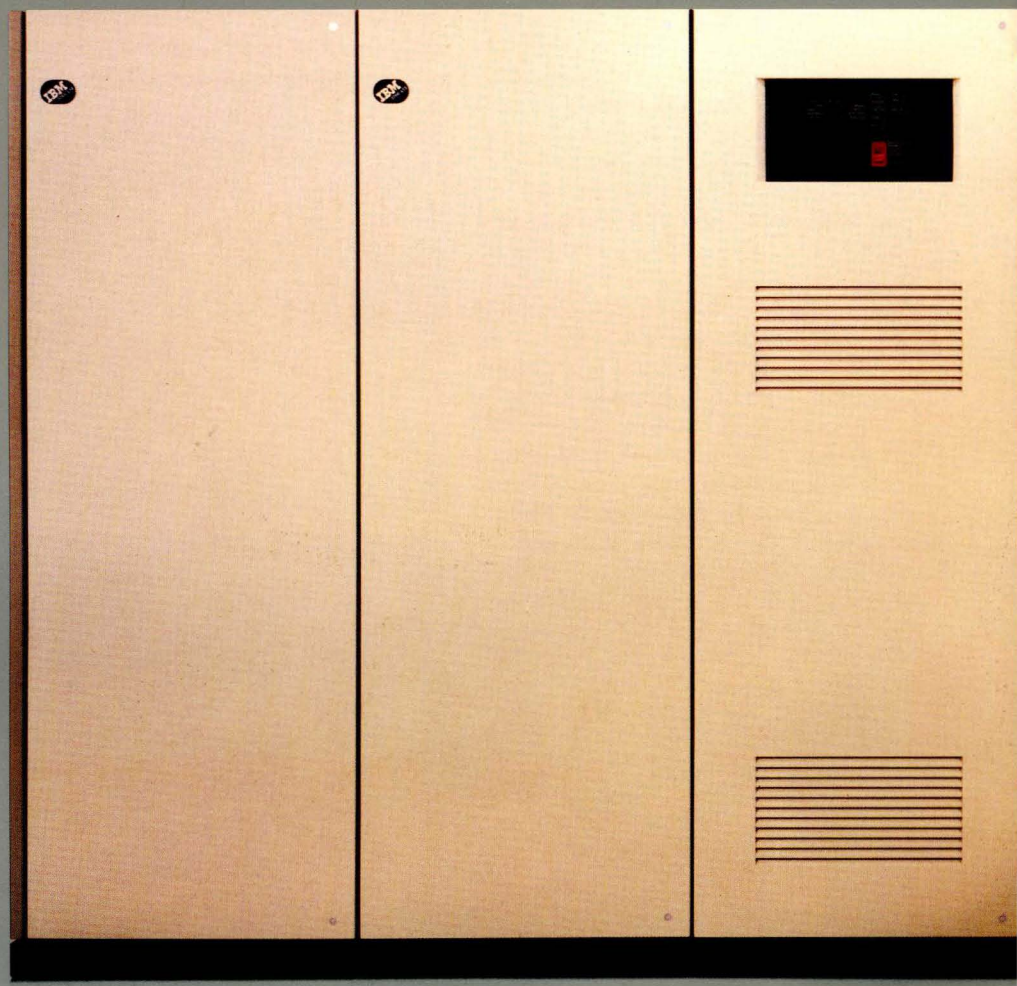
Completed units are comprehensively tested by purpose-designed diagnostic software run on an IBM PC AT

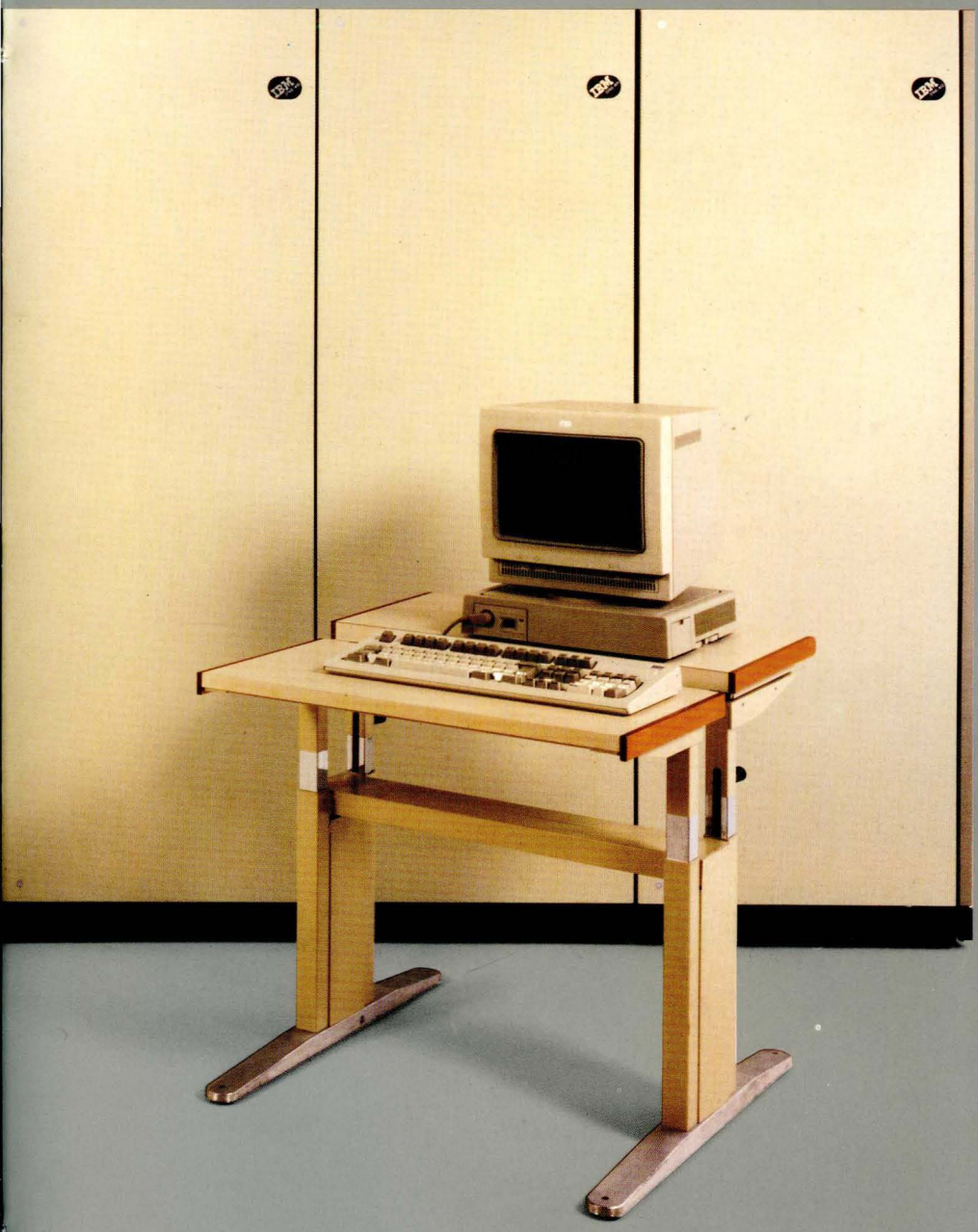
The IBM 3745 – evolutionary advance in communication controller design

Based on the proven architecture of the IBM 37XX controller family, the new IBM 3745 Communication Controller has been designed to provide the benefits of higher performance and availability.

It incorporates features aimed at achieving better serviceability and manageability, together with options for enhancement and expansion to provide increased flexibility for future system growth and change.

Through the use of new technology, the 3745 also offers improved capabilities in high-speed data handling. With the capacity to cope with increasingly demanding requirements for enhanced connectivity and capacity in data communication systems, the 3745 is a major advance in communication controller design.





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In general, comparisons in this brochure are made with the performance and characteristics of the IBM 3725 Communication Controller and earlier models.

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