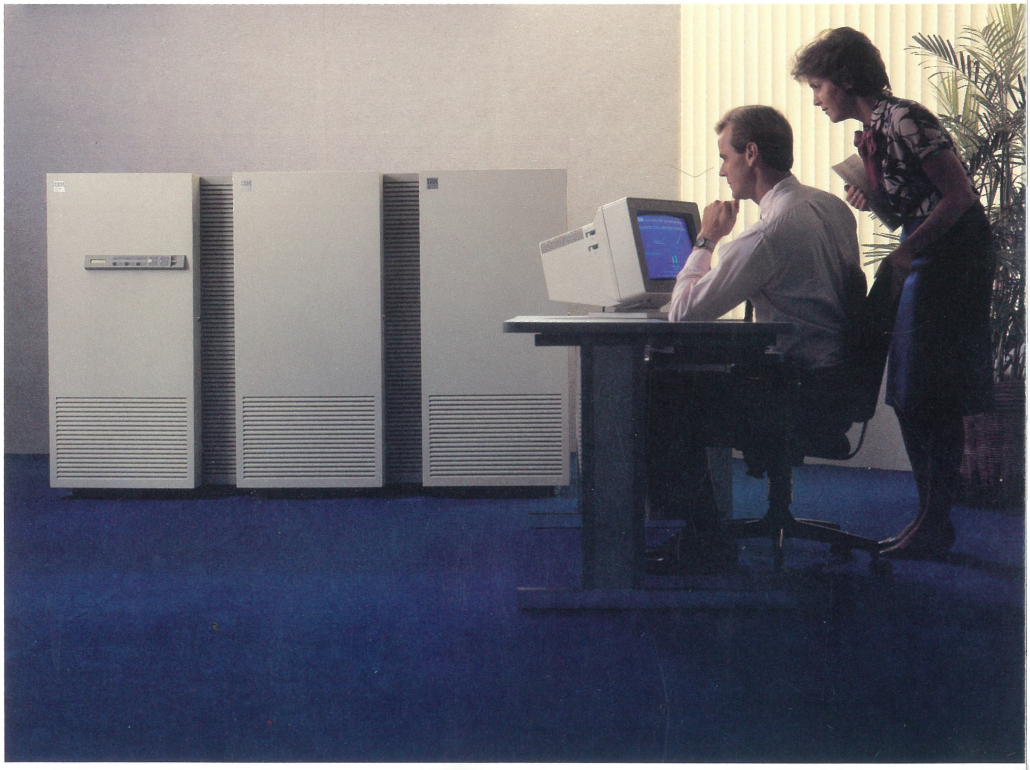
System|88

Digest: Products and Services for the System/88



IBM

System|88

Digest: Products and Services for the System/88

First Edition (December 1988)

This is a major revision of, and obsoletes, GA34-0301-1 and the Digest Supplement, GA34-0812-0.

Information for System/88 products and services is included as of December 1988. Changes are made periodically to the information herein; any such changes will be reported in subsequent revisions or supplements.

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Executive overview

The IBM System/88 computer system is a high-availability system designed to meet the needs of customers who require highly reliable online processing. System/88 combines a duplexed hardware architecture with sophisticated operating system software to provide a fault-tolerant system.

The System/88 provides horizontal growth through the attachment of multiple System/88 modules through the System/88 Link and the System/88 Network. The System/88 provides vertical growth through model upgrading. With proper planning, horizontal and vertical growth can be accomplished, in some cases, without interrupting system operations.

The System/88 is designed to detect a component failure when and where it occurs, and to prevent errors and interruptions caused by such failures from being introduced into the system.

Since fault tolerance is a part of the System/88 hardware design, it does not require programming by the application developer. Fault tolerance is accomplished with no software overhead or performance degradation.

The System/88 supports a wide range of peripherals, including fault-tolerant communication controllers and direct access storage device (DASD) subsystems.

The entry-level 4578 processor

The high-end 4576 processor with expansion cabinets

The IBM System/88 is particularly appropriate for transaction processing applications that require high availability, horizontal growth, distributed processing, and a variety of communication protocols.

User online environments may be categorized by differing processing requirements:

Stand-alone transaction processing
Stand-alone transaction processing is the processing of online transactions on a separate, perhaps dedicated system with no dependence on a host for completion of a transaction. Some common examples are:

- Processing automated teller machine (ATM) transactions
- Processing point-of-sale transactions
- Processing shop floor transactions.

This kind of processing typically has the following requirements:

- Very high availability
- Limited interchange of data with a host system
- Very high security
- Transaction and message integrity (in addition to data integrity)
- Connection of peer systems, local or remote, for data access, data distribution, and horizontal growth
- Support for asynchronous, bisynchronous, and Synchronous Data Link Control (SDLC) devices.

Coordinated transaction processing
Coordinated transaction processing is the online processing of transactions on a separate, perhaps dedicated system that depends on a host for completion of some or all transactions. If the host system should fail, the front-end system could continue to operate by means of stand-in processing of a subset of the application functions and data base. Some examples are:

- Consumer transaction switch
- Communications industry customer service
- Banking or financial switch.

This kind of processing usually has the following requirements:

- Very high availability
- Single-system image to end users
- Very high security
- Transaction and message integrity (in addition to data integrity)
- Stand-in processing when host is not available
- Asynchronous, bisynchronous, and SDLC device support.

Front-end routing and processing
The System/88 is also appropriate for front-end routing and processing because of the need for high availability, user programmability, queuing, and for the ability to add processing power without disrupting service. The System/88 can also serve to isolate the network control program from configuration changes where the System/88's ability to re-configure on the fly and to map multiple downstream devices onto a different number and configuration of upstream systems can contribute to network availability and reduce the need for communications programming changes.

Typically, a transaction would enter the System/88 from an end user's terminal for destination determination and routing to any of multiple attached hosts for processing. The response would then be routed back through the System/88 to the end user's terminal. The System/88 could also serve as a stand-in processor for all, or some subset, of the transactions. This is beneficial in the event of failure of the host, communications controller, or any lines upstream of the System/88.

In other environments, the System/88 may complement the online system availability as perceived by end users when used in conjunction with a Multiple Virtual Storage/Extended Architecture (MVS/XA) processor and the Extended Recovery Facility (XRF).

Highlights of the System/88 include:
- Hardware approach to fault-tolerant processing
- Duplexed components
- Single-system image
- Vertical and horizontal growth
- Hot pluggability
- Data integrity
- Continuous hardware component checking
- Remote/automatic service
- Full capability 32-bit processor design
- New input/output (I/O) processor subsystem.

Hardware approach to fault-tolerant processing
The System/88 is designed to offer high availability through a fault-tolerant hardware approach. Because fault tolerance is built into the System/88 hardware, it does not require additional programming by the application developer.

Duplexed components
The System/88 achieves fault tolerance through the duplication of major components, including processors, memory, I/O controllers and direct access storage devices (DASD). If a duplexed component fails, its duplexed partner automatically continues processing, and the system remains available to the end user.

Duplicate power supplies with battery backup for storage retention during a short-term external power failure are also provided.

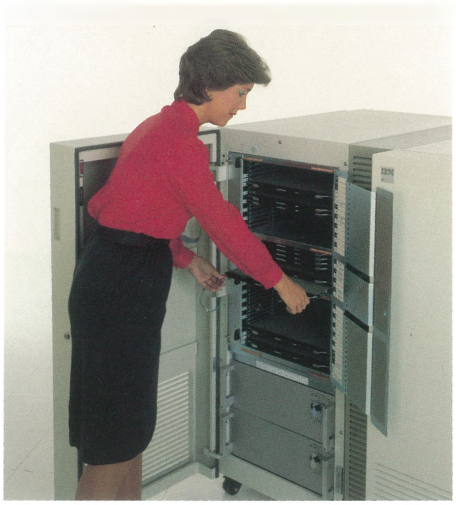
Single-system image
The System/88 and its software products offer ease of expansion, the sharing of resources among users, and solutions to complex requirements while maintaining a single-system image to the end user.

Vertical and horizontal growth
With proper planning, the System/88 processing capacity can be expanded:
- While the System/88 is running
- While maintaining a single-system image to the end user.

Vertical growth is accomplished by upgrading models. Horizontal growth is accomplished by linking multiple processing modules to systems using the System/88 Link, and by connecting multiple systems to a network using the System/88 Network.

A System/88 processing module is a complete, stand-alone computer. A System/88 system is either a single module or a group of modules connected in a local network with the System/88 Link. The System/88 Network, using remote transmission facilities, is the means used to interconnect multiple systems to form a single-system image to the end user.

Hot pluggability
Hot pluggability allows hardware replacements to be made without interrupting system operation. The System/88 takes a failing component out of service, continues service with its duplexed twin, and lights an indicator on the failing component – all without operator intervention. The customer or service personnel can remove and replace a failed duplexed component



while processing continues. The benefits to a customer include timely repair and reduced maintenance costs.

Although the System/88 is a fault-tolerant, high-availability system, there are times when machine operation will need to be stopped; some examples: to update the System/88 Operating System, to change the hardware configuration for certain models, and to perform certain service procedures.

Data integrity

The duplexed System/88 components and the System/88 software help maintain data integrity. The System/88 detects a failure or transient error at the point of failure and does not propagate it throughout the application or data. Data is protected from corruption, and system integrity is maintained.

Continuous hardware component checking

Most components contain their own error-detection logic and diagnostics. The error-detection logic compares the results of parallel operations at every machine cycle.

If the system detects a component malfunction, that component is automatically removed from service. Processing continues on the duplexed partner while the failed component is checked by internal diagnostics. Note that this action does not apply to some I/O devices.

Remote/automatic service

Every System/88 is capable of remote/automatic service. Off-site IBM personnel can help determine the cause of failure, provide software fixes, and identify hardware corrective actions.

Error-detection functions will automatically remove a failing duplexed component from service and run diagnostics on it while processing continues on its duplexed partner. If the diagnostics determine that the component needs to be replaced, the System/88 can automatically call the System/88 Support Center to report the problem. The customer benefits from quick repairs and low maintenance costs.

Note that some I/O devices, such as tape units and printers, do not generate a call to the Support Center.

Full capability 32-bit processor design

System/88 offers 32-bit processor design in some models. A 32-bit-wide data and instruction path provides high-performance processing power that can support high volumes of transactions.

New I/O processor subsystem

The new I/O processor subsystem offers improved price/performance and configuration flexibility. In addition to providing the capability to attach disk, tape, and communication devices, this new subsystem also provides the capability to attach programmable communication adapters for handling unique and standard protocol requirements.

The System/88 offers a variety of storage sizes, processing speeds, and I/O devices.

Processors

Multiple compatible processors allow for nondisruptive expansion of your computer system to accommodate your requirements now and into the future.

- *4578 Models 408 and 416* (36-inch-high chassis) support 8 and 16 megabytes (Mb; one M equals 1 048 576) of duplexed memory; a maximum of 1.56 gigabytes of duplexed, direct access storage; and a maximum of 40 communication ports.

  Model 408 can be upgraded to a Model 416.
- *4579 Models 408, 416, 508, and 516* support 8 and 16 Mb of duplexed memory; a maximum of 2.34 gigabytes of duplexed, direct access storage; and a maximum of 96 communication ports.

  Models can be upgraded to higher 4579 models.

  Each processor supports terminals and printers through its communication ports.
- *4576 Model 40* supports from 4 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports.
- *4576 Model 50* supports from 8 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports.

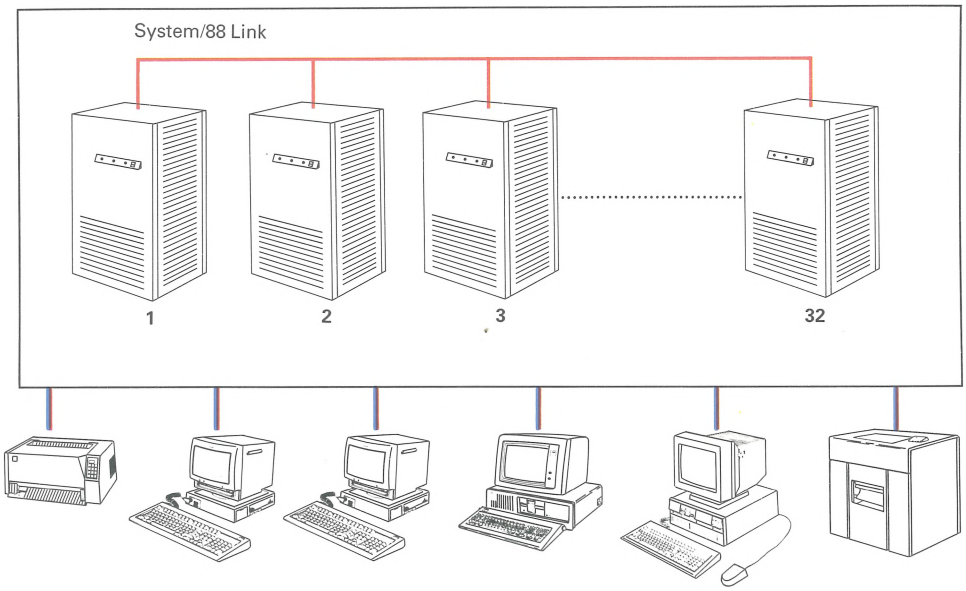
  The Model 50 can be upgraded to an 8X model.
- *4576 Model 60* supports from 8 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports.

  The Model 60 also has 48 kilobytes (Kb; one K equals 1024) of high-speed cache memory integrated into the processor unit, as well as arithmetic assist for both floating-point and packed decimal arithmetic functions.
- *4576 Models 81–86* have 32-bit processor design and support from 8 to 96 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports.

  Models 81–86 also have the following integrated into each processor board: 16K by 32 bits of high-speed cache memory, 64 by 32 bits of on-chip instruction cache, and a floating-point co-processor for high-performance arithmetic capabilities.

  Models 81–85 can be upgraded to any higher 8X model (up to a Model 86). The Model 86 is the highest-speed System/88 processor.

Multiprocessor design



Expansion units
Three models of expansion units are available.

- *4577 Expansion Cabinet Model 001* provides (for the 4576 Processor) additional power distribution and rack space for disks, magnetic tape drives, communications adapter chassis, plus other standard features.
- *4577 Expansion Cabinet Models 21 and 22* primarily provide (for the 4576 and 4579 Processors) additional rack space for I/O adapter chassis and their supporting power modules. Depending on the configuration, additional rack space may be available for disks, magnetic tape, and cartridge tape drives.

Direct access storage devices
Three types of disk drives are available. They can be installed in multiples, providing large amounts of high-speed, large-capacity disk storage.

- *4581 Disk Drive Model 001* – storage capacity of 448 Mb
- *4583 Disk Drive Models 001, 002, and 003* (for the 4578 and 4579 Processors) – storage capacity of 151, 320, and 781 Mb, respectively
- *4584 Disk Drive Models 001, 002, and 003 (for the 4576 Processor)* – storage capacity of 151, 320, and 781 Mb, respectively.

Tape units
Two magnetic tape units and one cartridge tape unit provide for convenient save/restore of disk data:

- *4585 Autoload Streaming Magnetic Tape Unit* – multiple densities of 6250, 3200, and 1600 bits per inch (bpi)
- *4968 Autoload Streaming Magnetic Tape Unit* – dual densities of 3200 and 1600 bpi.

Both magnetic tape units have streaming and start/stop modes. The autoload function makes tape handling easy, even for an inexperienced operator. The data format at 1600 bpi is ANSI compatible; and, on the 4585, the data format at 6250 bpi is also ANSI compatible.

- *1/4-Inch Cartridge Streaming Tape Unit* (Feature 1425) – formatted capacity of 60 Mb – provides economical save/restore capabilities in a 1/4-inch cassette format.

Printers

- *3812 Page Printer* – up to 12 pages per minute. This tabletop electrographic printer is capable of producing good quality printouts on cut-sheet paper and special use materials, such as preprinted paper, transparencies, labels, and colored paper. Typical uses might include printed reports, invoices, labels, and packing lists.
- *4224 Printer* – up to 400 characters per second, depending on the model. This wire-matrix serial printer is versatile. It can be used for computer-data printouts, text drafts and manuals, letters and reports, labels, and optical character recognition (OCR) or bar codes.
- *4245 Printer* – up to 2000 lines per minute. This line impact printer is especially suited for high-volume printing requirements, such as the production of lengthy report listings, daily work status printouts, and batch listings of daily transactions.
- *5262 Printer* – up to 650 lines per minute. This line impact printer is especially suited for heavy-duty printing requirements, such as the production of lengthy report listings, daily work status printouts, and batch listings of daily transactions.
- *6262 Printer* – up to 1400 lines per minute. This engraved band, high-quality line printer offers exceptional capabilities for forms handling, including six-part "no-carbon-required" forms and those with carbon interleaves.

IBM Personal Computers and Personal System/2s
The IBM Personal Computer, IBM Personal Computer XT,™ IBM Personal Computer AT,® IBM Personal Computer Convertible, and the IBM Personal System/2® Models 25, 30, 50, and 60 can communicate with the System/88, functioning as a system administrator terminal or as an end-user terminal.

Display terminals
Display terminal support for communicating with the System/88 as a system administrator terminal or as an end-user terminal includes:

- 3151 ASCII Display Station
- 3161 ASCII Display Station
- 3162 ASCII Display Station
- 3163 ASCII Display Station
- 3164 ASCII Color Display Station
- 3270 binary synchronous terminals.

System/88 communication hardware
Communication hardware includes duplexed intelligent communication controllers to support communications adapter chassis and line adapters. For the I/O processor subsystem, it

includes duplexed I/O processors and intelligent I/O adapter cards, including three that are programmable, to support communication lines.

System/88 Link

The System/88 Link interconnects multiple local System/88 modules while maintaining a single-system image. The linking of multiple System/88 modules offers extensive capabilities for horizontal growth, the distribution of functions, and the sharing of data files.

System/88 programming support emphasizes productivity through its powerful operating system and many high-level languages that can support diverse application requirements.

System/88 Operating System

The IBM System/88 Operating System provides advanced programming to span a wide variety of data processing environments.

The operating system is a multiprogramming, multiprocessing virtual operating system designed for online transaction processing and high availability in a fault-tolerant environment. It supports the duplexed hardware to provide a fault-tolerant computing system. It is designed to manage the data and services of a configuration consisting of one or more modules connected in a system or in a network.

Transaction processing support

The System/88 was designed for online transaction processing. The following tools assist the application developer in the creation of efficient and user friendly applications:

- Symbolic Debugging Aid
- Text Editor
- Programming Editor
- Transaction Processing Services
- Forms Management System.

SQL/88

SQL/88 is a Structured Query Language-based relational data base management system designed for an online transaction processing (OLTP) environment. SQL/88 provides a multithreaded server architecture. SQL/88 consists of two major components: the SQL/88 SQL Server and SQL/88 Data Workbench.[1] The SQL/88 SQL Server handles data management functions for all SQL/88 users. The SQL/88 Data Workbench consists of a set of visually based tools for application development, data base management, and decision support.

System/88 ORACLE

System/88 ORACLE[2] is a relational data base management system that provides an integrated set of tools for application developers and end users. The SQL is a natural English-like language that combines the capabilities of data query, definition, manipulation, and control.

Communication support

The System/88 communication products support a variety of functions including networking, network management, device emulation, and terminal connectivity. The System/88 supports the IBM 3151, 3161, 3162, 3163, and 3164 ASCII Display Stations, the IBM Personal Computer or Personal System/2, other ASCII terminals, IBM binary synchronous 3270s, ASCII printers, X.25 and X.29 networking, and the communication protocols required to attach many industry terminals. Attachment to other IBM systems is supported with BSC RJE, 3270 emulation – binary synchronous and Systems Network Architecture (SNA) – and X.25 networking. The specific products are:

- System/88 Operating System (asynchronous [ASYNC] and binary synchronous [BISYNC] support)
- Network

[1] Data Workbench is a trademark of Sybase Corporation.
[2] ORACLE is a trademark of Oracle Corporation.

- X.25 Networking Facility
- X.29 Networking Facility
- 3270 Terminal Support
- 3270 Emulator Support
- Synchronous Data Link Control (SDLC) Protocol Support
- SNA Network Interface Support
- Primary SNA
- Secondary SNA
- Advanced Program-to-Program Communications (APPC)
- Communications & System Management (C&SM)
- SNA 3270 Terminal Emulation
- SNA 3270 Cluster Controller
- Remote Job Entry (RJE)
- Distributed System Services.

Programming languages

All the languages (except C) are implemented in an American National Standards Institute (ANSI) standard form, and have been enhanced with powerful extensions. The compilers generate fast, compact code using a common optimizer and code generator, providing cross-language compatibility. The specific products are:

- BASIC
- C
- COBOL
- FORTRAN
- Pascal
- PL/I.

System/88 headquarters marketing support

A full range of marketing support is provided by IBM's High Availability Systems organization in Gaithersburg, Md. Executive and technical briefings, installation planning reviews, and the publication of technical bulletins are among the many services available.

System/88 Support Center and remote maintenance

The IBM System/88 Support Center provides online hardware and software problem diagnosis and resolution. This enhances the high availability provided by the System/88.

All System/88s are designed for remote maintenance. System/88 Support Center personnel determine the cause of a failure, coordinate software fixes, and identify corrective actions needed for hardware repair (including ordering parts and/or dispatching an IBM Customer Engineer, if required). This remote maintenance strategy provides for timely, cost-effective maintenance (see page 54).

Education

Education offerings are available to help your staff use the System/88 (see pages 55-56).

Publications

A full range of publications is available, covering programming and operations of the System/88 (see pages 57-58).

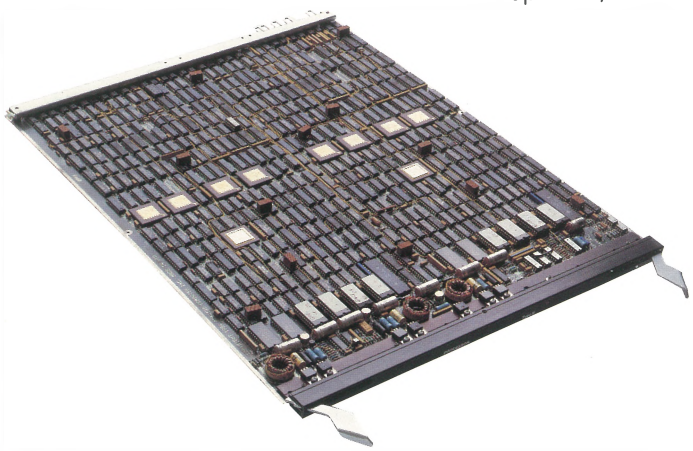
System/88 hardware and software summary

4578 Processor Models 408 and 416

- 36-inch-high chassis
- 4 logical main processors
- 8 and 16 Mb of duplexed memory
- 10 slots for duplexed memory, main processor, input/output (I/O) processor, and optional Link controller (Model 408) boards
- Rack space for up to four 4583 Disk Drives, one 1/4-inch cartridge tape unit, and one I/O adapter chassis (which houses up to fourteen I/O adapter cards).

4579 Processor Models 408, 416, 508, and 516

- 4 logical main processors
- 8 and 16 Mb of duplexed memory
- 10 slots for duplexed memory, main processor, I/O processor, and optional (except Model 416) Link and magnetic tape controller boards
- Rack space for up to six 4583 Disk Drives and one I/O adapter chassis (which houses up to fourteen I/O adapter cards); or up to four 4583 Disk Drives, one 4968 tape unit or 1/4-inch tape unit, and one I/O adapter chassis.



4576 Processor Model 40

- 4 logical main processors
- 4 to 64 Mb of duplexed memory
- 36 slots for attachment of storage, main processor, I/O processor, and controller boards
- Rack space for communication adapter chassis.

4576 Processor Model 50

- 4 logical main processors
- 8 to 64 Mb of duplexed memory
- 36 slots for attachment of storage, main processor, I/O processor, and controller boards
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) or up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards)
- Capability to be upgraded to an 8X model.

4576 Processor Model 60

- 6 logical main processors
- 8 to 64 Mb of duplexed memory
- 40 slots for attachment of storage, main processor, I/O processor, and controller boards
- 48 Kb of integrated high-speed cache memory
- Processors for arithmetic assist for floating-point and packed decimal functions
- Rack space for up to four communication adapter chassis.

4576 Processor Models 81–86

- 32-bit processor design
- 1 to 6 logical high-speed processors
- 8 to 96 Mb of duplexed memory
- 32 slots for attachment of storage, main processor, I/O processor, and controller boards

- 16K by 32 bits of high-speed cache memory, 64 by 32 bits of instruction cache, and a floating-point co-processor for high-performance arithmetic capabilities on each processor board
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) or up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards)
- Models 81–85: capability to be upgraded to any higher 8X model (up to a Model 86).

4577 Expansion Cabinet Model 001

- Rack-mount space for disk drives, magnetic tape units, and communication devices
- Up to four 4581 or eight 4584 Disk Drives per 4577
- Up to four 4585 or 4968 magnetic tape units (one per 4577)
- Up to 12 communications adapter chassis (in 4577s adjacent to the processor)
- Multiple 4577 Model 001s (up to a maximum of eight) can be attached as required to a single 4576.

4577 Expansion Cabinet Models 21 and 22

- Configured to hold one and two I/O adapter chassis and their supporting power modules. Model 21 is configured for one I/O adapter chassis; and Model 22, up to two.
- Up to four 4584 Disk Drives; or two 4584s and one 4585 or 4968 tape unit may also be mounted in the Model 21. Up to two 4584s and one 1/4-inch tape unit may also be mounted in the Model 22.
- 4577 Models 21 and 22 (containing up to a maximum of two I/O adapter chassis) can be attached to a single 4576. A maximum of one (Model 21) can be attached to a 4579.

Communication hardware – I/O controller

- Intelligent communication controllers
- 8-slot communication adapter chassis and expansion chassis
- Line adapter cards for X.25, asynchronous, binary synchronous, and Synchronous Data Link Control (SDLC) protocols
- Communication port/direct-connect support for printers, display stations, and PCs.

Communication hardware – I/O processor

- Intelligent I/O processors and I/O adapters
- 14-slot I/O adapter chassis
- Line adapter cards for X.25, asynchronous, binary synchronous, and SDLC protocols
- Programmable I/O adapters
- Adapter cards for line printers, 4583 Disk Drive, and 1/4-inch cartridge tape unit.

System/88 Link

- Attaches multiple System/88s in a local network providing a single-system image to applications and end users
- Link distance can be extended from 230 meters (750 feet) to approximately 4.7 kilometers (3 miles) by using up to ten 4591 Link Extenders.

Direct Access Storage Devices (DASDs)

- 4581 Disk Drive providing 448 Mb at 25.5 milliseconds (ms) average access time
- 4583 Disk Drive Models 001, 002, and 003 (for the 4578 and 4579 Processors) – providing 151, 320, or 781 Mb at 28.3 or 24.3 ms average access time
- 4584 Disk Drive Models 001, 002, and 003 (for the 4576 Processor) – providing 151, 320, or 781 Mb at 28.3 or 24.3 ms average access time.

4585 Autoload Streaming Magnetic Tape Unit

- 1600, 3200, and 6250 bits-per-inch (bpi) recording densities
- Both streaming and start/stop modes
- 256 Kb of cache memory for faster response and transparent tape buffering
- ANSI compatible at 1600 and 6250 bpi.

4968 Autoload Streaming Magnetic Tape Unit

- 1600 and 3200 bpi recording densities
- Both streaming and start/stop modes
- Compatible with IBM 3420 at 1600 bpi.

1/4-Inch Cartridge Streaming Tape Unit (Feature 1425)

- 60 Mb recording capacity
- Streaming mode
- 64 Kb buffer.

3151, 3161, 3162, 3163, and 3164 ASCII Display Stations

- Tabletop display stations for asynchronous communication with the System/88.

IBM Personal Computers and Personal System/2s

- Personal Computers and Personal System/2s for asynchronous communication with the System/88.

Printers

- 3812 tabletop cut-paper printer
- 4224 desktop/tabletop matrix printer
- 4245 floor-standing, extra-high-speed output printer
- 5262 floor-standing, high-speed output printer
- 6262 floor-standing, high-speed output printer.

Hardware units	Unit is supported by Processor (all models) 4576	4578	4579	Unit can be mounted in Expansion Cabinet 4577-1	4577-21	4577-22
I/O controller subsystem						
Line adapters (mounted in comm. chassis)	●			●		
I/O processor subsystem						
I/O adapters (mounted in I/O adapter chassis)						
4-port full modem	●	●	●		●	●
4-port direct connect	●	●	●		●	●
2-port programmable RS422/232C	●	●[1]	●		●	●
2-port programmable RS423/232C	●	●[1]	●		●	●
2-port programmable V.35/RS232C	●	●[1]	●		●	●
DASD (4583)		●	●			
¼-inch cartridge tape	●	●	●		●	●
Line printer	●	●	●		●	●
Remote support network	●	●	●		●	●
Expansion Cabinets						
4577 Model 1	●					
4577 Model 2X	●		●[3]			
DASDs						
4581	●			●		
4583		●	●			
4584	●			●	●	●
Tape units						
4585	●		●[3]	●	●	
4968	●		●[3]	●	●	●
¼-inch tape unit (Feature 1425)	●	●	●			●
Display terminals						
3151, 3161, 3162, 3163, and 3164	●	●	●			
Personal Computers						
PC, PC XT, AT, and PC Convertible	●	●	●			
Personal System/2s						
Models 25, 30, 50, and 60	●	●	●			
Printers						
3812, 4224, 4245, 5262, and 6262	●	●	●			
Communication hardware						
Communications adapter chassis	●			●		
I/O adapter chassis	●	●	●		●	●
System/88 Link controller	●	●[2]	●[3]			
System/88 Link connector	●	●[2]	●[3]	●	●	●

[1] The online debugging of code to be used in the programmable adapters cannot be accomplished on the 4578 because the process requires two pairs of I/O processors.
[2] 4578–Model 408 only
[3] 4579–except Model 416

System/88 Operating System, designed for
- Virtual storage
- Multiprogramming
- Multiple processors
- High availability environment.

Languages supported
- BASIC (5732-012)
- C (5732-023)
- COBOL (5732-011)
- FORTRAN (5732-014)
- Pascal (5732-015)
- PL/I (5732-013).

Symbolic Debugging Aid (5732-017)
A debugging facility for programs written in any of the System/88 languages.

Text Editor (5732-016)
An interactive, full-screen, menu-driven text editing facility.

Programming Editor (5732-033)
An interactive, full-screen, command-driven text editing facility with multiple language support and backup/recovery file capability.

Transaction Processing Services (5732-006)
Tools and structures that assist in developing online transaction processing applications.

Forms Management System (5732-007)
A facility that simplifies the creation and modification of video display formats.

SQL/88 SQL Server (5732-036) and SQL/88 Data Workbench (5732-037)
SQL/88 is an SQL-based relational data base management system designed for an online transaction processing (OLTP) environment. SQL/88 provides a multithreaded server architecture.

System/88 ORACLE (5732-024)
A relational data base management system that provides an integrated set of tools for end users and application developers.

IBM PC Terminal Support (5732-019)
A PC program that allows the IBM PC or Personal System/2 to be connected to the System/88 as an ASCII terminal.

Communication support
- Network (5732-002)
- X.25 Networking Facility (5732-008)
- X.29 Networking Facility (5732-009)
- SDLC Protocol Support (5732-010)
- Remote Job Entry (5732-003)
- 3270 Terminal Support (5732-004)
- 3270 Emulation Support (5732-005)
- Systems Network Architecture (SNA) Network Interface Support (5732-027)
- Primary SNA (5732-028)
- Secondary SNA (5732-029)
- Advanced Program-to-Program Communications (5732-025)
- Communications & System Management (5732-026)
- SNA 3270 Terminal Emulation (5732-020)
- SNA Cluster Controller Support (5732-021)
- Distributed System Services (5732-030).

System/88 input/output subsystem designs

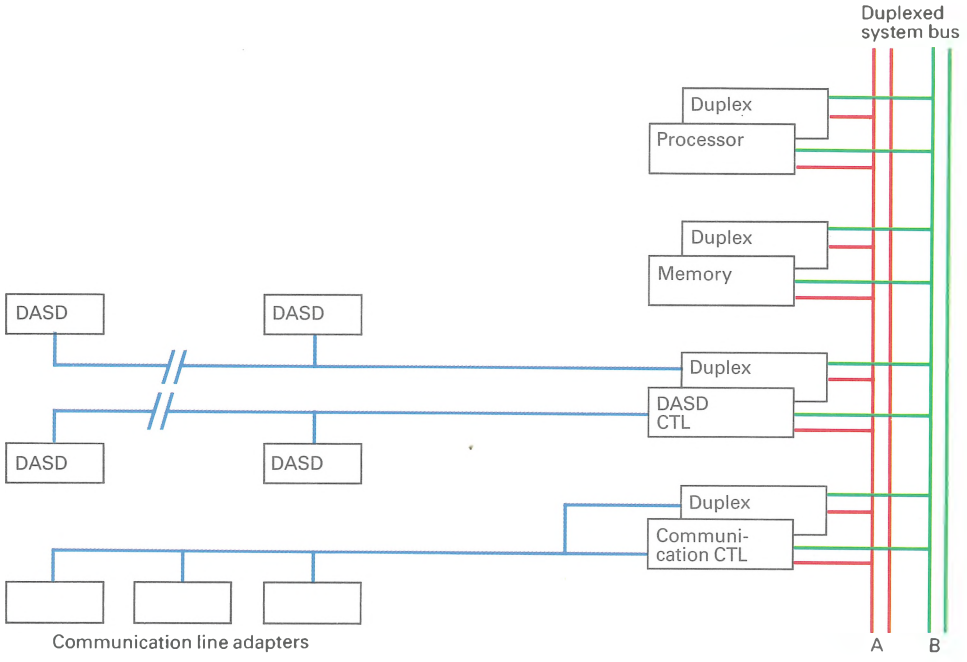
System/88 input/output subsystem designs are the I/O controller subsystem and the newer I/O processor subsystem. These subsystems can co-reside on the 4576 Processors. The 4578 and 4579 Processors use the I/O processor subsystem only.

I/O controller subsystem

The I/O controller subsystem connects DASD directors/controllers to a duplexed system bus that also supports duplexed processors, memory, other I/O and communication controllers for the various communication line adapters. This I/O subsystem also supports duplexed link controllers and simplexed tape controllers that reside on the system bus.

Highlights include:

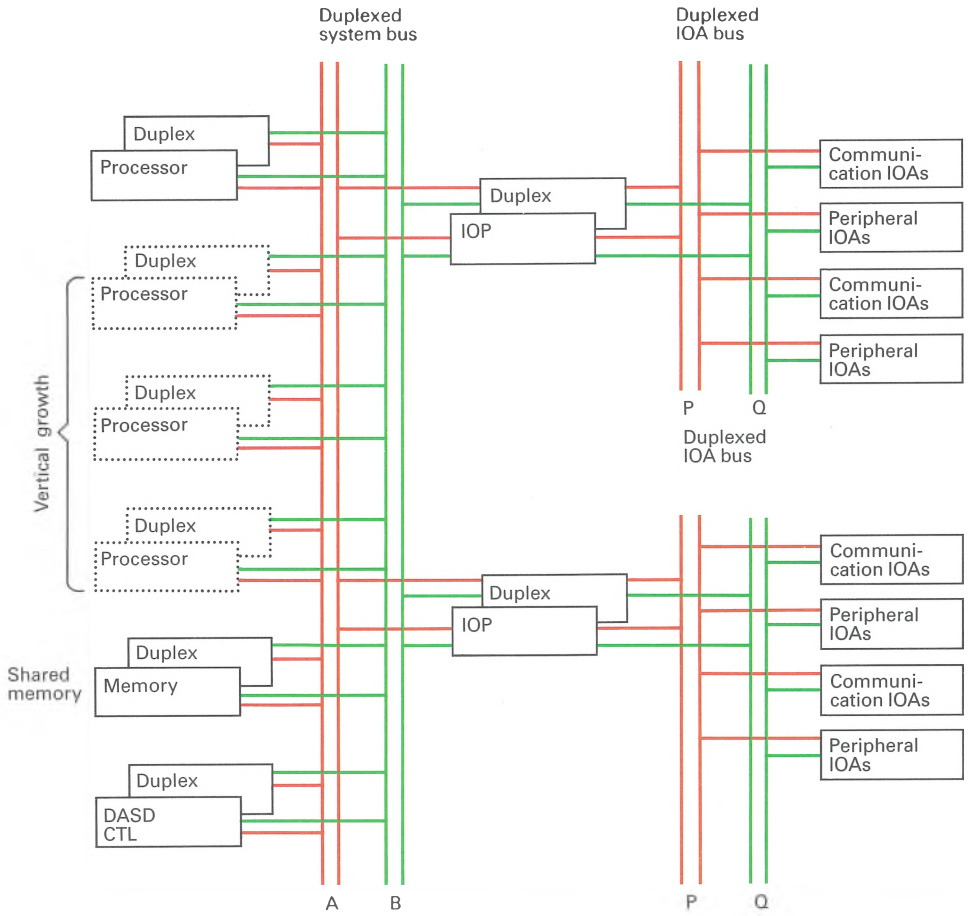
- High-availability, fault-tolerant design through duplexed components
- Integrated checking and comparator logic on each communication board for high levels of data integrity
- Automatic fault detection, isolation, and resolution without performance impact
- Flexibility for ease of expansion
- Communications adapter chassis for holding up to eight communication line adapter cards.



The I/O processor subsystem consists of duplexed I/O processors connected into a duplexed system bus that supports duplexed main processors, memory, and other I/O devices. The duplexed I/O processors drive various communication and I/O adapters via a duplexed I/O adapter bus that provides access to various peripheral and communication I/O adapters through the same I/O processor.

Highlights include:

- High-availability, fault-tolerant design through duplexed components
- Integrated checking and comparator logic on each I/O processor board for high levels of data integrity
- Automatic fault detection, isolation, and resolution without performance impact
- Flexibility for ease of expansion
- I/O processor subsystem for handling I/O and communication support
- Increased fault tolerance through a redundant I/O adapter bus
- Improved price/performance and configuration flexibility for entry-range systems
- Optional programmable I/O adapters
- Card covers on all I/O adapter cards for ease of customer handling
- I/O adapter chassis (with integrated fan mounting) for holding up to 14 adapter cards.



System/88 processors and other hardware

System/88 offers multiple processor models that are compatible:

- 4578 Processor Models 408 and 416
- 4579 Processor Models 408, 416, 508, and 516
- 4576 Processor Models 40, 50, 60, 81, 82, 83, 84, 85, and 86.

The processors differ mainly in design, memory size, and power. The 4576 Models 81-86 have 32-bit processor design, and the Model 86 offers the greatest processing power. Models also differ in the number of I/O features that may be attached.

Features that enhance reliability and performance include fault tolerance through a duplexed configuration, continuous checking of hardware components, and automatic failure detection and isolation. Adding one or more 4577 Expansion Cabinets to the system provides additional I/O attachment capability. The System/88 supports a wide range of device attachments, including printers, terminals, personal computers, and non-IBM devices.

IBM processor 4578

IBM 4578 Processor Models 408 and 416

- System/88 entry-range processor; 16-bit processor design; 36-inch-high cabinet
- I/O processor subsystem for attaching communication and I/O devices, providing entry-range configuration flexibility
- Data integrity, distributed processing, and fault-tolerant processing that is transparent to users
- Connectibility for ease of horizontal growth
- Ten central electronic complex (CEC) slots for memory, main processor, I/O processor, and optional (Model 408) Link controller boards
- Four logical main processors that can simultaneously process up to four instruction streams
- Rack space for up to four 4583 Disk Drives, one 1/4-inch cartridge tape unit, one I/O adapter chassis (which houses up to 14 intelligent I/O adapter cards), and Link connectors
- Support for 8 and 16 megabytes (Mb) of duplexed memory; a maximum of 1.56 gigabytes of duplexed, direct access storage; and a maximum of 40 communication ports
- CEC boards, I/O adapter cards, and disk drives (4583 Models 001 and 002) – replaceable by the customer, providing lower maintenance cost
- Continuous hardware component checking
- Remote/automatic service
- Hot pluggability for removing and replacing many parts without interrupting normal operations
- Self-contained power supplies with battery backup for storage retention during short external power failures.

The two models differ in the amount of memory supported:

- Model 408: 8 Mb of duplexed memory
- Model 416: 16 Mb of duplexed memory

Model 408 can be upgraded to a Model 416.

Standard

The standard configuration for the 4578 includes the following:

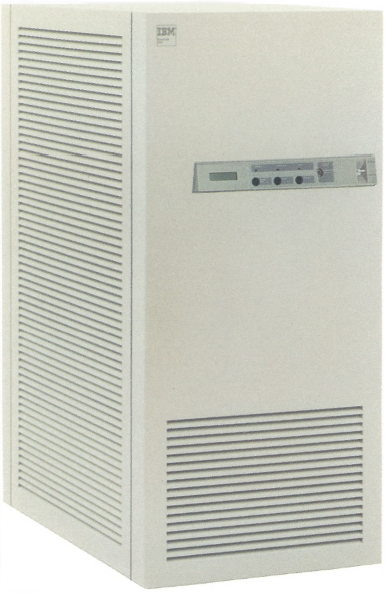
- I/O processor subsystem design
- 8 or 16 Mb of duplexed memory
- Duplexed main processor boards
- Duplexed I/O processor boards
- One 1/4-inch tape unit
- One I/O adapter chassis for housing up to 14 adapter cards
- One 1/4-inch tape unit adapter card
- One 2-port Remote Support Network and system console adapter card
- Duplexed 4583 DASD adapter cards.

Optional

- Memory expansion to 16 Mb
- Up to 1.56 gigabytes of duplexed DASD (four 4583 disk units) and the corresponding DASD adapter cards
- Communication adapter cards*
  - 4-port, full modem
  - 4-port, direct connect
  - 2-port, programmable RS422/232C
  - 2-port, programmable RS423/232C
  - 2-port, programmable V.35/RS232C
- Line printer adapter cards for 4245 or 5262
- Duplexed Link controller boards (Model 408 only).

*The online debugging of code to be used in the programmable adapters cannot be accomplished on the 4578 because the process requires two pairs of I/O processors.

IBM 4579 Processor Models 408, 416, 508 and 516



- System/88 entry-range processor; 16-bit processor design; standard-size cabinet
- I/O processor subsystem for attaching communication and I/O devices, providing configuration flexibility
- Data integrity, distributed processing, and fault-tolerant processing that is transparent to users
- Connectibility for ease of horizontal growth and flexibility for ease of vertical growth
- Ten central electronic complex (CEC) slots for memory, main processor, I/O processor, and optional (except Model 416) Link and magnetic tape controller boards
- Four logical main processors that can simultaneously process up to four instruction streams
- Rack space for up to six 4583 Disk Drives and one I/O adapter chassis (which houses up to fourteen I/O adapter cards); or up to four 4583 Disk Drives, one 4968 tape unit or 1/4-inch tape unit, and one I/O adapter chassis; and Link connectors
- Support for a second I/O adapter chassis (except Model 416) that can be mounted in an attached 4577 Expansion Cabinet Model 21
- Support for 8 and 16 megabytes (Mb) of duplexed memory; a maximum of 2.34 gigabytes of duplexed, direct access storage; and a maximum of 96 communication ports
- CEC boards, I/O adapter cards, and disk drives (4583 Models 001 and 002) – replaceable by the customer, providing lower maintenance cost
- Continuous hardware component checking
- Remote/automatic service
- Hot pluggability for removing and replacing CEC boards without interrupting normal operations
- Self-contained power supplies with battery backup for storage retention during short external power failures.

The 4579 is offered in four models. Models 508 and 516 have higher-speed processors with on-chip cache memory.

- Models 408, 508: 8 Mb of duplexed memory
- Models 416, 516: 16 Mb of duplexed memory

Models 408, 416, and 508 can be upgraded to a higher 4579 model.

Standard

The standard configuration for the 4579 includes the following:

- I/O processor subsystem design
- 8 or 16 Mb of duplexed memory
- Duplexed main processor boards
- Duplexed I/O processor boards
- One I/O adapter chassis for housing up to 14 adapter cards
- One 2-port Remote Support Network and system console adapter card
- Duplexed 4583 DASD adapter cards.

Optional (all models)

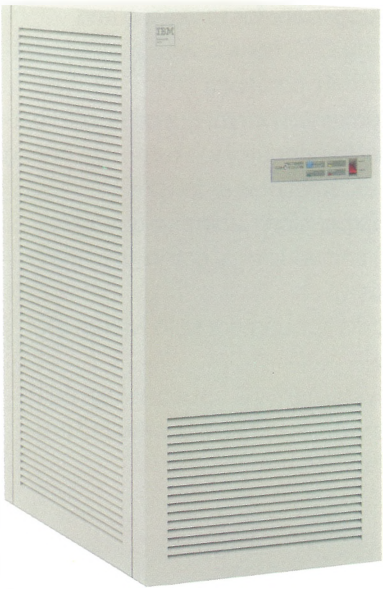
- Memory expansion up to 16 Mb
- Up to 2.34 gigabytes of duplexed DASD (six 4583 disk units) and the corresponding DASD adapter cards
- Up to two 1/4-inch cartridge tape units and the corresponding 1/4-inch tape adapter cards
- Communication adapter cards*
  - 4-port, full modem
  - 4-port, direct connect
  - 2-port, programmable RS422/232C
  - 2-port, programmable RS423/232C
  - 2-port, programmable V.35/RS232C
- Line printer adapter cards for 4245, 5262, or 6262.

Optional (except Model 416)

- Magnetic tape controller board for 4585 or 4968
- Duplexed Link controller boards
- Second I/O adapter chassis that houses up to 14 adapter cards (mounted in a 4577 Model 21) and the corresponding duplexed I/O processor boards mounted in a 4579).

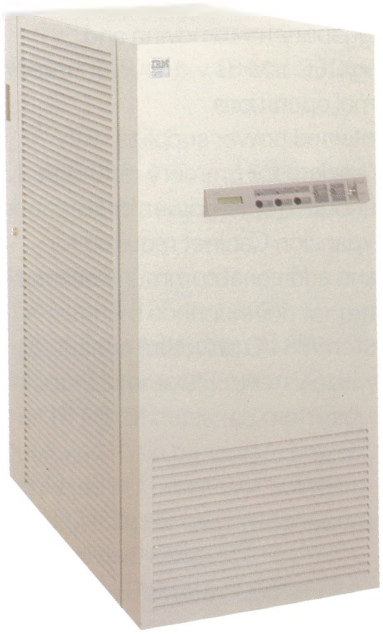
*The online debugging of code to be used in the programmable adapters requires two pairs of I/O processors.

IBM 4576 Processor Model 40



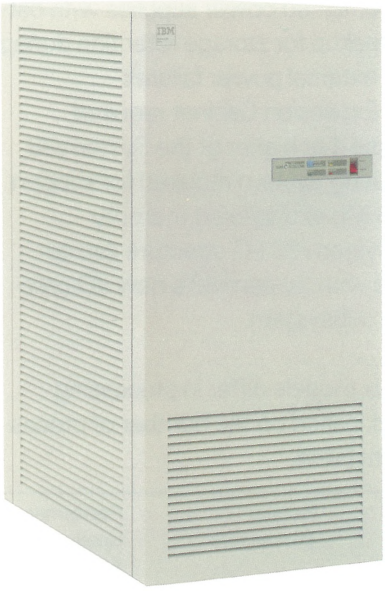
- 16-bit processor and data/address bus
- Data integrity
- Distributed processing
- Connectibility for ease of horizontal growth
- 36 central electronic complex (CEC) slots for memory, main processor, I/O processor, and controller boards
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) and Link connectors; additional rack space available in the attached 4577
- Support for up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards) mounted in 4577 Models 21 and 22
- Support for 4 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports
- Four sets of main processors that share the workload in a non-hierarchical fashion
- Continuous hardware component checking
- Remote/automatic service
- Hot pluggability for removing and replacing CEC boards without interrupting normal operations
- Self-contained power supplies with battery backup for memory retention during short external power failures
- 4577 Expansion Cabinet required for DASD and additional communications chassis
- The System/88 I/O structure can coreside with System/88's new I/O processor subsystem.

IBM 4576 Processor Model 50



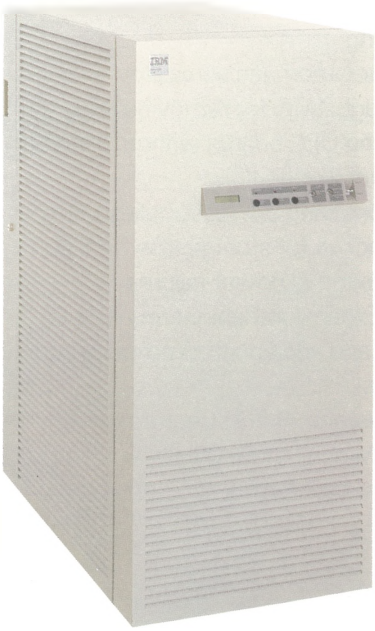
- System/88 intermediate-range processor
- 16-bit processor and 16-bit data/address bus
- Data integrity, distributed processing, and fault-tolerant processing that is transparent to users
- Connectibility for ease of horizontal growth
- 36 central electronic complex (CEC) slots for memory, main processor, I/O processor, and controller boards
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) or up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards), and Link connectors
- Support for 8 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports
- Four sets of main processors that share the workload in a non-hierarchical fashion
- Up to 90% performance relative to the Model 60 (individual customer results variable)
- Continuous hardware component checking
- Expanded-function control panel
- Remote/automatic service
- Hot pluggability for removing and replacing CEC boards without interrupting normal operations
- Self-contained power supplies with battery backup for storage retention during short external power failures
- 4577 Expansion Cabinet required for DASD and additional communication chassis
- Capability for upgrading to Model 8X family
- The System/88 I/O structure can co-reside with System/88's new I/O processor subsystem.

IBM 4576 Processor Model 60



- System/88 intermediate-range processor
- Data integrity
- Distributed processing
- Connectibility for ease of horizontal growth
- 40 central electronic complex (CEC) slots for memory, main processor, I/O processor, and controller boards
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) and Link connectors; additional rack space available in the attached 4577
- Support for up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards) mounted in 4577 Models 21 and 22
- Support for 8 to 64 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports
- Six sets of main processors that share the workload in a non-hierarchical fashion
- 48 Kb of high-speed cache memory integrated into the processor unit
- Arithmetic assist for both floating-point and packed decimal arithmetic functions
- Continuous hardware component checking
- Remote/automatic service
- Hot pluggability for removing and replacing CEC boards without interrupting normal operations
- Self-contained power supplies with battery backup for storage retention during short external power failures
- 4577 Expansion Cabinet required for DASD and additional communications chassis
- The System/88 I/O structure can coreside with System/88's new I/O processor subsystem.

IBM 4576 Processor Models 81–86



- Full capability 32-bit design, high-performance processors that support high volumes of transactions
- Up to six sets of high-speed processors that simultaneously process up to six independent instruction streams
- 16K by 32 bits of high-speed cache memory and 64 by 32 bits of instruction cache integrated into each processor board
- Floating-point co-processor on each processor board that provides high-performance arithmetic capabilities
- Data transfer of 32 or 64 bits per cycle
- Data integrity, distributed processing, and fault-tolerant processing that is transparent to users
- Continuous hardware component checking
- Connectibility for ease of horizontal growth
- Flexibility for ease of vertical growth
- 32 central electronic complex (CEC) slots for memory, main processor, I/O processor, and controller boards
- Rack space for up to four communications adapter chassis (each housing up to eight line adapter cards) or up to two I/O adapter chassis (each housing up to fourteen I/O adapter cards) and Link connectors
- Support for 8 to 96 Mb of duplexed memory; a maximum of 23.4 gigabytes of duplexed, direct access storage; and a maximum of 256 communication ports
- Expanded-function control panel
- Remote/automatic service
- Hot pluggability for removing and replacing CEC boards without interrupting normal operations
- Self-contained power supplies with battery backup for storage retention during short external power failures
- 4577 Expansion Cabinet required
- Release 4 or higher of the System/88 Operating System required for support for 96 Mb of duplexed memory
- The System/88 I/O structure can co-reside with System/88's new I/O processor subsystem.

The six models differ in processing speed, based on the number of processors installed.

Model	Sets of processors	Performance relative to Model 81[1]
81	1	up to 1.0
82	2	up to 1.9
83	3	up to 2.75
84	4	up to 3.5
85	5	up to 4.2
86	6	up to 5.0

Upgrading to a Model 84 from a Model 81–83, and to a Model 86 from a Model 85, can be done by the customer, while the system is running.

[1] Individual customer results may vary.

IBM 4577 Expansion Cabinet Model 001

- For the 4576 Processor, the 4577 Model 001 provides additional power distribution and rack space for disks, magnetic tape units, and other features, such as communications adapter chassis.
- One 4585 or 4968 tape unit per 4577 can be mounted in the first and second 4577s from the processor on either side. For usability, they are located at the top of the rack.
- Up to four 4581 or eight 4584 Disk Drives can be mounted in a single 4577.
- Up to 12 communications adapter chassis are mounted in the 4577s adjacent to the processor. Link connectors can be mounted in place of communications adapter chassis.
- Combinations of disk drives, magnetic tape units, communications adapter chassis, and Link connectors can be installed in a 4577. Maximums for each unit are based on the combination of units installed.
- Multiple 4577 Expansion Cabinets Model 001 (up to a maximum of eight) can be attached to a 4576 Processor.

The 4577 attaches through an air plenum to the 4576 Processor or to another 4577 Expansion Cabinet.

Note: See also the 4577 Expansion Cabinet Models 21 and 22.

IBM 4577 Expansion Cabinet Models 21 and 22

- For the 4576 and 4579 Processors, the 4577 Models 21 and 22 provide rack-mount space for I/O adapter chassis and their supporting power modules. (The I/O adapter chassis are features of the 4577s.)
- One power module is installed for each I/O adapter chassis, and one module is installed in each cabinet to provide backup should a power module fail. One power control module is installed to distribute the duplexed power to each I/O adapter chassis.

For the 4576 Processor

The 4577 Models 21 and 22 provide rack-mount space for one and two (respectively) I/O adapter chassis and their supporting power modules.

- The Model 21 can also hold up to four 4584 Disk Drives; or two 4584s and one 4585 or 4968 tape unit; and Link connectors.
- The Model 22 can also hold up to two 4584s, one 1/4-inch tape unit, and Link connectors.

For the 4579 Processor (except Model 416)

- The 4577 Model 21 provides rack-mount space for the system's second I/O adapter chassis and its supporting power modules.
- The Model 21 can also hold one 4585 or 4968 tape unit and Link connectors.

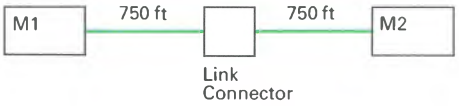
The 4577 attaches through an air plenum to the 4576 or 4579 Processor or, for a 4576, to another 4577 Expansion Cabinet.

Note: See also the 4577 Expansion Cabinet Model 001.

System/88 Link and communication hardware

System/88 Link

Multiple System/88 processor modules can be interconnected by the System/88 Link while maintaining a single-system image to the end user.



- The continuous aggregate bandwidth approaches 2.8 Mb per second for a pair of Link controllers.
- System/88 processor modules can be located up to 457.5 meters (1500 feet) apart, using Link cable. The distance between two modules can be extended up to 3 miles through the use of 4591 Link Extenders.

  Multiple modules can be linked up to approximately 10 miles maximum between all modules on a system, using 4591 Link Extenders.
- The linking is transparent, giving the end user and application developer a single-system view.

Communication hardware

The IBM System/88 provides fault-tolerant hardware for communication. Duplexed intelligent communication controllers support communications adapter chassis and line adapter cards through an I/O controller subsystem. Duplexed I/O processors and intelligent I/O adapter cards support communication lines in the I/O processor subsystem.

Communication hardware for the I/O controller subsystem

- All terminals and communication lines remain operational even if one communication controller fails; no physical switching is required.
- Multiple microprocessors distribute communication functions to the line adapters and the communication controller, freeing the System/88 to work on applications functions.

- The communication controller handles all data transfers directly from its own main memory to storage.
- Duplexed communication controllers can support up to 16 line adapter cards. Adapters are available to support asynchronous, binary synchronous, Synchronous Data Link Control (SDLC), and X.25 lines.
- Multiple communication controllers may be attached to a System/88 processor.
- Asynchronous line adapters each support two asynchronous lines of up to 19.2 kilobits (Kbits) per second.
- Synchronous line adapters each support a single binary synchronous, SDLC, or X.25 line of up to 56 Kbits per second.
- The printers, display stations, and PCs connect directly to the System/88 through communication ports. By attaching a 3270 controller to a communication port and using System/88 3270 Terminal Support, 3270 devices can be attached to the System/88. This allows many 3270 devices to be attached through a single communication port, greatly increasing the number of terminals that can be attached to the System/88.
- RS422 devices can be attached, using the high-performance synchronous line adapter.

Communication hardware for the I/O processor subsystem

- All terminals and communication lines remain operational even if one I/O processor fails; no physical switching is required.
- The I/O processor handles the processing and transferring of data.
- A dual bus structure between the I/O processor and all attached I/O adapters provides an increased level of fault tolerance.
- A duplexed I/O processor supports a mix of up to fourteen I/O adapter cards. Communication adapters are available to support asynchronous, binary synchronous, SDLC, and X.25 lines.
- Multiple I/O processors may be attached to a System/88 processor.
- A four-port, full-modem adapter supports four RS232C synchronous or asynchronous lines. The maximum transmit rate is 9.6 Kbits per second for synchronous lines and 19.2 Kbits per second for asynchronous lines.
- A four-port, direct-connect adapter supports four RS232C asynchronous lines of up to 19.2 Kbits per second.
- A two-port, programmable adapter provides support for unique or standard protocol requirements. This adapter is available in three types.

  One type supports RS232C and/or RS422 synchronous or asynchronous lines. The second type supports RS232C and/or RS423 synchronous or asynchronous lines. The third type supports RS232C and/or V.35 synchronous or asynchronous lines.

  The maximum transmit rate for the RS232C port is 19.2 Kbits per second per port; the maximum transmit rate for the RS422, RS423, and V.35 is 64 Kbits per second per port.
- A two-port adapter attaches the system console and the Remote Support Network. This adapter also provides a system clock and calendar facility.
- Printers, 4583 disks, and the 1/4-inch cartridge tape unit connect through their respective intelligent I/O adapter cards.

IBM 4581 Disk Drive Model 001

- Direct access storage device (DASD) for the 4576 Processor
- Storage capacity of 448 megabytes (Mb)
- Data transfer rate of 1.8 Mb/second
- Average access time of 25.5 milliseconds (ms)
- Extensive error-checking and recovery procedures
- Format of 2048-byte fixed-length sectors that optimize the speed of data handling
- Rack mountable, permitting up to four units to be mounted in a 4577 Expansion Cabinet Model 001
- Hot pluggability, allowing a duplexed drive to be taken offline, serviced, and replaced without affecting system operation
- Self-contained maintenance routines that continually monitor units for operational errors.

The 4581 Disk Drive Model 001 is designed to operate in parallel with a partner 4581. An unrecoverable error on the 4581 causes the unit to be taken out of service automatically. Processing continues with the partner device without interrupting system operations.

A 4581 unit can be repaired or replaced without interrupting System/88 operations. When the system is notified that a 4581 has been brought back into service, system management routines automatically bring the unit up-to-date to make it an exact image of its partner.

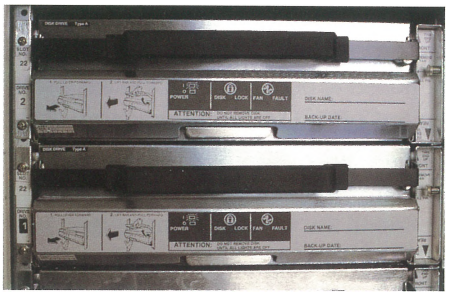
For increased performance, the maximum of 15 duplexed (30) 4581s can be attached to each 4576 Processor, using up to 12 DASD Controllers.

Each 4581 must have a DASD Director, which provides interface control between the DASD Controller and the 4581 Disk Drive.

Operating characteristics

Storage capacity	448 Mb
Cylinders	842
Tracks per cylinder	20
Sectors per cylinder	260
Bytes per sector	2048
Data transfer rate	1.8 Mb/sec
Average seek time	18 ms
Average rotational delay	7.5 ms
Average access time	25.5 ms

IBM 4583 Disk Drive Models 001, 002, and 003



Models 001, 002

- Direct access storage device (DASD) for the 4578 and 4579 Processors
- High-performance disk drives with 151 Mb (Model 001), 320 Mb (Model 002), and 781 Mb (Model 003) capacity
- Data transfer rate of 1.2 Mb/second or 2.5 Mb/second
- Average access time of 28.3 or 24.3 milliseconds (ms)
- Format of 2048-byte fixed-length sectors that optimize the speed of data handling
- Rack mountable, permitting up to four units to be mounted in a 4578 Processor cabinet, and up to six in a 4579 Processor cabinet
- Hot pluggability, allowing a duplexed drive to be replaced without affecting system operation
- Disk unit replaceable by customer (Models 001 and 002).

The 4583 disk unit provides a high-performance disk drive, with Models 001 and 002 being replaceable by the customer. The 4583 is designed to operate in parallel with a partner 4583. An unrecoverable error on the 4583 causes the unit to be taken out of service automatically. Processing continues with the partner device without interrupting system operations.

The 4583 unit can be replaced without interrupting System/88 operations. When the system is notified that a 4583 has been brought back into service, system management routines automatically bring the unit up-to-date to make it an exact image of its partner.

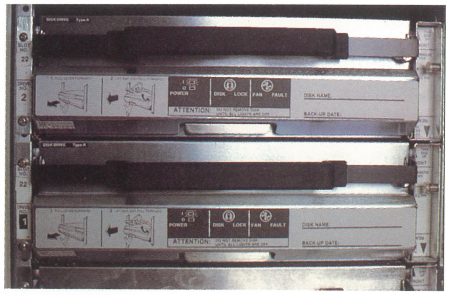
A maximum of 3 duplexed (6) 4583s (mounted in the 4579 Processor cabinet) can be supported by each 4579 Processor. A maximum of 2 duplexed (4) 4583s (mounted in the 4578 Processor cabinet) can be supported by each 4578 Processor.

Each 4583 requires a DASD adapter card and attaches through an I/O adapter chassis.

Operating characteristics

	Model 001	Model 002	Model 003
Storage capacity	151 Mb	320 Mb	781 Mb
Cylinders	823	823	745
Tracks per cylinder	10	10	27
Sectors per track	9	19	19
Bytes per sector	2048	2048	2048
Data transfer rate	1.2 Mb/sec	2.5 Mb/sec	2.5 Mb/sec
Average seek time	20 ms	20 ms	16 ms
Average rotational delay	8.3 ms	8.3 ms	8.3 ms
Average access time	28.3 ms	28.3 ms	24.3 ms

IBM 4584 Disk Drive Models 001, 002, and 003



Models 001, 002

- Direct access storage device (DASD) for the 4576 Processor
- High-performance disk drives with 151 Mb (Model 001), 320 Mb (Model 002), and 781 Mb (Model 003) capacity
- Data transfer rate of 1.2 Mb/second or 2.5 Mb/second
- Average access time of 28.3 or 24.3 milliseconds (ms)
- Format of 2048-byte fixed-length sectors that optimize the speed of data handling
- Rack mountable, permitting up to eight units to be mounted in a single 4577 Expansion Cabinet Model 001; up to four in a 4577 Model 21; and up to two in a 4577 Model 22 – actual maximums based on the combination of disks and tape units installed
- Hot pluggability, allowing a duplexed drive to be replaced without affecting system operation
- Disk unit replaceable by customer (Models 001 and 002).

The 4584 disk unit provides a high-performance disk drive, with Models 001 and 002 being replaceable by the customer. The 4584 is designed to operate in parallel with a partner 4584. An unrecoverable error on the 4584 causes the unit to be taken out of service automatically. Processing continues with the partner device without interrupting system operations.

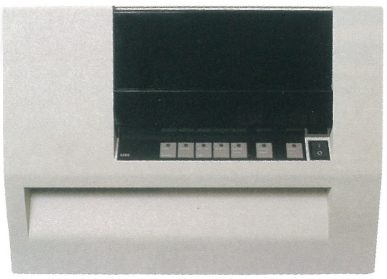
The 4584 unit can be replaced without interrupting System/88 operations. When the system is notified that a 4584 has been brought back into service, system management routines automatically bring the unit up-to-date to make it an exact image of its partner.

A maximum of 30 duplexed (60) 4584s can be attached to each 4576 Processor. Each 4584 requires a 4581/4584 DASD Director, which provides interface control between the 4581/4584 DASD Controller and the 4584 Disk Drive. A DASD Controller can control up to 8 DASD Directors.

Operating characteristics

	Model 001	Model 002	Model 003
Storage capacity	151 Mb	320 Mb	781 Mb
Cylinders	823	823	745
Tracks per cylinder	10	10	27
Sectors per track	9	19	19
Bytes per sector	2048	2048	2048
Data transfer rate	1.2 Mb/sec	2.5 Mb/sec	2.5 Mb/sec
Average seek time	20 ms	20 ms	16 ms
Average rotational delay	8.3 ms	8.3 ms	8.3 ms
Average access time	28.3 ms	28.3 ms	24.3 ms

IBM 4585 Autoload Streaming Magnetic Tape Unit



- Convenient save/restore tape unit for the 4576 and 4579 Processors
- Autoload convenience for standard tape reels
- Multiple density: 1600, 3200, and 6250 bits per inch (bpi)
- Tape formats: ANSI-compatible 1600 bpi Phase Encoded (PE), ANSI-compatible 6250 bpi Group Code Recording (GCR), and 3200 bpi PE
- Tape speeds of 100 inches per second (ips) (1600 bpi), 70 ips (6250 bpi), and 50 ips (3200 bpi)
- Reel capacity (2400-foot, unformatted): approximately 40 megabytes (Mb) at 1600 bpi, 80 Mb at 3200 bpi, and 170 Mb at 6250 bpi
- Automatic read/write retry
- Self-checking controller board.

Up to four units can be supported by the 4576; one unit by the 4579. For the 4576, up to four units can be mounted in 4577s Model 001 or Model 21 (one per 4577). For the 4579, one unit can be mounted in a 4577 Model 21.

The primary purposes of the 4585 Autoload Streaming Magnetic Tape Unit are to load new releases of the operating system and to provide convenient save/restore functions for System/88 data files. It also offers start/stop processing.

The 4585 Magnetic Tape Unit attaches to the System/88 through the Streaming Tape Controller (Feature 1110) and requires the System/88 Operating System Release 2 or higher.

Note: The controller is available as a simplex controller only; it does not provide duplexed tape operation. Additional drives and controllers are recommended for environments where tape is critical.

Operating characteristics

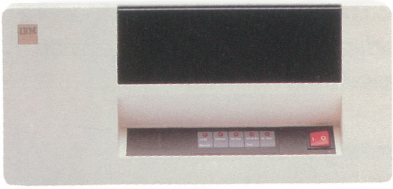
Normal tape speeds:
2540 mm/sec (100 ips) at 1600 bpi
1778 mm/sec (70 ips) at 6250 bpi
1270 mm/sec (50 ips) at 3200 bpi

Normal rewind time:
2.5 minutes (2400-foot reel)

Normal read/write data density and recording mode:
1600 and 3200 PE
6520 GCR (1600 bpi and 6250 bpi ANSI-compatible)

Head:	Multiple gap
Number of tracks:	9
Cache storage:	256 kilobytes

IBM 4968 Autoload Streaming Magnetic Tape Unit



- Convenient save/restore tape unit for the 4576 and 4579 Processors
- Autoload convenience for standard tape reels
- Dual density: 1600 and 3200 bits per inch (bpi)
- Streaming operation of 160 Kb per second at 100 inches per second (ips) (1600 bpi ANSI standard) or 50 ips (3200 bpi)
- Compatible with IBM 3420 at 1600 bpi
- Reel capacity (2400-foot): up to 80 Mb at 3200 bpi
- Start/stop at up to 25 ips (1600 bpi) for limited applications
- Self-checking controller board.

Up to four units can be supported by the 4576; one unit by the 4579.

For the 4576, up to four units can be mounted in 4577s Model 001 (one per 4577); one unit can be mounted in a Model 21. For the 4579, one unit can be mounted in the 4579 Processor cabinet or a 4577 Model 21.

The 4968 Autoload Streaming Magnetic Tape Units are designed for mounting in 4579 Processor cabinets and 4577 Expansion Cabinets.

The primary purposes of the 4968 Autoload Streaming Magnetic Tape Unit are to load new releases of the operating system and to provide convenient save/restore functions for System/88 data files. Autoloading plus large per-reel tape capacity makes operator convenience a 4968 highlight.

The 4968 Magnetic Tape Unit attaches to the System/88 through the Streaming Tape Controller (Feature 1100).

Note: The controller is available as a simplex controller only; it does not provide duplexed tape operation. Additional drives and controllers are recommended for environments where tape is critical.

Operating characteristics

Normal tape speeds:
635 mm/sec (25 ips)
1270 mm/sec (50 ips)
2540 mm/sec (100 ips)

Normal rewind time:
2.6 minutes (2400-foot reel)

Normal read/write data density and recording mode:
1600 and 3200 PE
(1600 bpi is IBM/ANSI-compatible)

Head:	Dual gap
Number of tracks:	9

IBM 1/4-Inch Cartridge Streaming Tape Unit (Feature 1425)

- Economical save/restore tape unit for the 4576, 4578, and 4579 Processors
- Tape density of 8000 bits per inch (bpi)
- Formatted capacity of 60 Mb
- 1/4-inch cassette format
- Tape speeds of 90 inches per second (ips)
- Data transfer rate of 90 Kb per second
- 64 Kb buffer for faster response.

One 1/4-Inch Cartridge Tape Unit (Feature 1425) can be mounted in a 4578 or 4579 Processor cabinet; one tape unit can be mounted in a 4577 Expansion Cabinet Model 22 for attaching to a 4576.

The primary purposes of the Cartridge Tape Unit are to load new releases of the operating system and to provide economical save/restore functions via streaming tape for System/88 data files.

The 1/4-Inch Cartridge Tape Unit holds up to 60 Mb of data. A two-byte character is used to ensure data integrity. Parity checking is done on the bus and in a 64 Kb buffer.

The tape unit attaches to the System/88 through the 1/4-Inch Tape I/O Adapter (Feature 1627), which plugs into an I/O adapter chassis (Feature 1610). The tape unit requires Release 5 of the System/88 Operating System.

Note: The adapter is available as a simplex adapter only; it does not provide duplexed tape operation.

Operating characteristics

Format	Quarter-inch committee (QIC-24)
Tracks	9
Capacity	60 Mb (formatted)
Tape speed	90 ips
Data transfer	90 Kb per second
Tape density	8000 bpi
Buffer	64 Kb

IBM Personal Computers and Personal System/2

Model 60

IBM Personal Computers

- High-performance, high-speed microprocessor
- Typewriterlike keyboard with the following features:
  - Tactile and audio feedback to help reduce typing errors and enhance productivity
  - Typing angle that can be adjusted to suit working position
- Green phosphor characters on an 11-1/2 inch (diagonal measurement), anti-glare screen
- Up to 25 lines of text with 80 characters per line
- Brightness and contrast controls for viewing comfort.

The IBM Personal Computers are tabletop units that can communicate with the System/88 as a terminal or as a system console. The Personal Computer can be operated either directly connected or remotely connected through a modem. The models of the IBM PC supported include the IBM Personal Computer, IBM Personal Computer XT, IBM Personal Computer AT, and IBM Personal Computer Convertible.

The IBM Personal Computers require IBM PC Terminal Support (5732-019) software.

IBM Personal System/2

In addition to the Personal Computer highlights, the IBM Personal System/2 also offers:

- Higher-performance, higher-speed microprocessor
- Compact design
- The enhanced keyboard.

The models of the IBM Personal System/2 supported include Models 25, 30, 50, and 60.

IBM Personal System/2 requires IBM PC Terminal Support (5732-019) Release 3.1 or higher and Release 3.1 or higher of the System/88 Operating System; Model 25 requires Release 4 or higher of the System/88 Operating System, Release 4 or higher of IBM PC Terminal Support, and the Enhanced PC Keyboard.

IBM 3151 ASCII Display Station Models 310 and 410

Model 310

Model 410

The IBM 3151 ASCII Display Station Models 310 and 410 features and functions supported by System/88 include the following. (Note that other functions that are available for the 3151 are not currently supported by the System/88.)

- Compact design with two major elements: display unit and keyboard
- 14-inch, flat, anti-smudge and anti-glare display screen
- Screen format of 24 lines of 80 characters each (1920 characters)
- Tilt display with optional tilt/swivel stand
- Field and character attributes for blinking, intensifying, reverse video, underlining, and non-display
- Windowing for displaying data from multiple sources
- Bi-directional, smooth and jump scroll
- Low-profile, tactile-touch keyboard with dedicated editing keys
- User-definable function keys
- RS232C compatible for remote attachment.

Models 310 and 410 are functionally identical; only the colors of the display screens are different.

- Green display screen (Model 310)
- Amber-gold display screen (Model 410).

The 3151 display stations are tabletop units. Each can communicate with the System/88 as an end-user terminal or as a system console.

The 3151 provides space-saving ergonomics; the display screen and logic are integrated into one element.

The 3151 operates through asynchronous communication interface. As an end-user terminal, the 3151 can be attached to the System/88 through the Direct Connect Adapter Card (Feature 1202 or 1206), which plugs into a communications adapter chassis. As a system console, the 3151 must be attached to the System/88 through Feature 1202.

System/88 support for the 3151 requires System/88 Operating System Release 3.1 or higher.

IBM 3161, 3162, and 3163 ASCII Display Stations

IBM 3161 ASCII Display Station

IBM 3163 ASCII Display Station

The IBM 3161, 3162, and 3163 ASCII Display Stations features and functions supported by System/88 allows the end user to do the following. (Note that other functions that are available for the 316X series are not currently supported by the System/88.)

- Adjust brightness and contrast for viewing comfort
- Adjust tilt and swivel for viewing angle
- Adjust keyboard angle
- Determine the host and display status
- Define function keys
- Change keyboard functions (3163 only)
- Use field, character, and line attributes for highlighting displayed characters and editing keyboard entries
- Use windowing for displaying data from multiple sources
- Use paging for displaying data from multiple sources (3163 only).

The models supported are: 3161 and 3163 Models 11, 12, 21, and 22; 3162 Models 11 and 12.

The 3161, 3162, and 3163 are tabletop units. Each can communicate with the System/88 as an end-user terminal or as a system console. Highlights include:

- RS232C compatible for remote attachment
- Screen format of 24 lines of 80 characters each (1920 characters).
- For the 3161 and 3163: 12-inch monochrome monitor
- For the 3162: 14-inch monochrome monitor

The 3161, 3162, and 3163 operate through asynchronous communication interface. As an end-user terminal, any of the 316X series can be attached to the System/88 through an RS232C interface; each has a port for attaching an RS232C ASCII printer. As a system console, any of the 316X series must be attached to the System/88 through the Direct Connect Adapter Card (Feature 1202).

System/88 support for the 316X series requires System/88 Operating System Release 1.1 or higher; operation as a system console requires Release 3.1 or higher.

IBM 3164 ASCII Color Display Station Models 11 and 12

The IBM 3164 ASCII Color Display Station features and functions supported by the System/88 allows the end user to do the following. (Note that other functions that are available for the 3164 are not currently supported by the System/88.)

- Adjust brightness and contrast for viewing comfort
- Adjust tilt and swivel for viewing angle
- Adjust keyboard angle
- Determine the host and display status
- Define function keys
- Change keyboard functions
- Use field, character, and line attributes for highlighting displayed characters and editing keyboard entries
- Use paging and windowing for displaying data from multiple sources.

The 3164 is a tabletop unit that can communicate with the System/88 as an end-user terminal or as a system console. Highlights include:

- RS232C compatible for remote attachment
- A high-quality, 14-inch color display screen.

While the 3164 has color attributes of red, green, blue, yellow, magenta, and white, the support for color by the System/88 Operating System allows four color attributes to be set, in the device Terminal Type Parameter (TTP), for all 3164 devices attached to the system. The colors cannot be changed without redefining the TTP.

The 3164 operates through an asynchronous communication interface. As an end-user terminal, the 3164 can be attached to the System/88 through an RS232C interface and has a port for attaching an RS232C ASCII printer. As a system console, the 3164 must be attached to the System/88 through the Direct Connect Adapter Card (Feature 1202).

System/88 support for the 3164 requires System/88 Operating System Release 1.2 or higher; operation as a system console requires Release 3.1 or higher.

IBM 3812 Page Printer

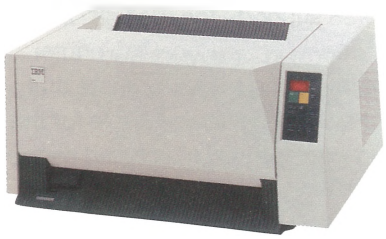
System/88 supports the IBM 3812 Page Printer only as a local line printer with the following features. (Note that other functions that are available for the 3812 are not currently supported by the System/88.)

- A character resolution of 240 x 240 picture elements per square inch
- The capability to print on cut-sheet paper and on special-use materials, such as preprinted paper, colored paper, transparencies, and adhesive labels
- The convenience of tabletop size
- Ease of setup, operation, and maintenance
- A printing speed of up to 12 pages per minute
- An audible alarm.

The 3812 is a tabletop unit for printing output from the System/88.

The 3812 attaches to the System/88 by means of the Full-Modem Asynchronous Line Adapter Card (Feature 1201), which plugs into a communications chassis.

IBM 4224 Printer Models 301 and 302



The IBM 4224 Printer features and functions supported by System/88 include the following. (Note that other functions that are available for the 4224 are not currently supported by the System/88.)

- Wire-matrix, serial printer
- Internal controller/processor
- Easy-to-use operator panel
- Print head and ribbon cartridge replaceable by customer
- Model 301: 200 characters per second (cps)
- Model 302: 400 cps
- Three print modes: Data Processing, Data Processing Text, and Near-Letter Quality
- A selection of three forms devices:
  –Continuous-forms device
  –Document-on-demand forms device
  –Document insertion forms device
- Printing paper: multipart continuous forms, preprinted continuous forms, and cut forms
- Character set selection (through the operator panel)
- Operator problem determination
- Automatic self-test during power-on
- Audible alarm.

The 4224 is a desktop/tabletop matrix printer. It is a customer setup unit for early printer availability and ease of relocation. An operator does not need special training to use the 4224.

The 4224 attaches to the System/88 by means of the Direct Connect Adapter Card (Feature 1202 or 1206), which plugs into a communications adapter chassis. This printer requires the System/88 Operating System Release 2 or higher.

IBM 4245 Printer Model T20

The IBM 4245 Printer features and functions supported by System/88 include the following. (Note that other functions that are available for the 4245 are not currently supported by the System/88.)

- 2000 lines per minute, using a 48-character print band
- 132-character print line, at 10 characters per inch
- Spacing: six or eight lines per inch
- Interchangeable print bands
- Print-band image data, resident in the printer and loaded automatically
- Operator panel for operation control and status information
- Power-assisted, self-controllable stacker unit
- Automatic switching to idle mode, two minutes after printing stops
- Built-in vacuum cleaning system, for continuously cleaning ribbon lint, paper dust, and chads from the print-band area while printing
- Local attachment up to 914 meters (3000 feet).

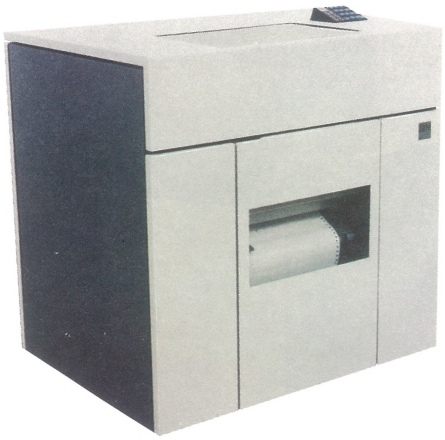
The 4245 is a floor-standing line printer that provides output at very high speed on continuous forms paper.

The 4245 uses interchangeable print bands. Several duplicates of all characters are contained on the print band with a greater number of high-usage characters placed more frequently, to improve print throughput.

The print band is located in the front unit. As the band rotates, it is continuously cleaned by a vacuum cleaning system to reduce the accumulation of ribbon lint, paper dust, and chads.

The 4245 attaches to the System/88 by means of the Direct Connect Printer Adapter Card (Feature 1203), which plugs into a communications adapter chassis. This printer requires the System/88 Operating System Release 2 or higher.

IBM 5262 Printer



The IBM 5262 Printer features and functions supported by System/88 include the following. (Note that other functions that are available for the 5262 are not currently supported by the System/88.)

- 650-line-per-minute output, using a 48-character print band
- 132-character print line, at 10 characters per inch
- Spacing: six or eight lines per inch
- Printing up to six-part forms
- Easy front loading
- Horizontal vernier adjustment
- Interchangeable print bands
- Fully enclosed paper path (to reduce noise)
- Ribbon spools (for easy changing)
- Audible alarm
- Local attachment up to 914 meters (3000 feet).

The 5262 is a floor-standing line printer that provides high-speed output on continuous forms paper.

A continuously rotating steel band with 288 etched characters travels in front of the print hammers, form, and ribbon. As the print band moves, every character passes in front of every hammer position. Timing marks on the print band synchronize the printer electronics and mechanics. When the desired character is in the correct position, the hammer strikes the form against that character. Print bands of various styles and character sets are available. Bands are easily changed by the operator.

Forms are fed by the carriage drive from the forms supply compartment, up between the hammers and the ribbon, through the tractors, and down into the stacker compartment in the rear of the printer. The carriage advances the forms at increments of either six or eight lines per inch, at a maximum skipping rate of 508 mm (20 in.) per second.

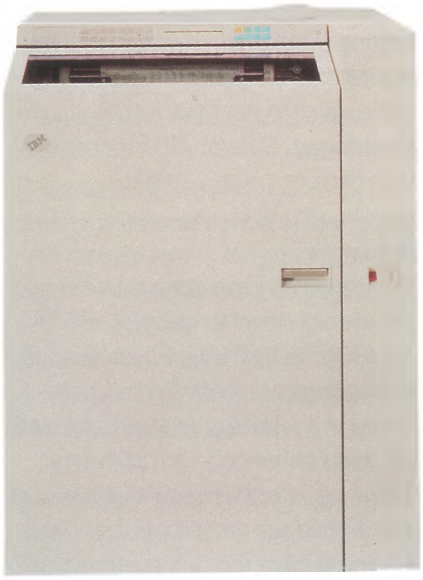
Only pin-fed continuous forms can be used. The printer handles card stock and up to six-part forms.

Printer controls enable the operator to load forms, change the print band and/or ribbon, start and stop the print operation, set up the print job, feed and align the form, recover from error or abnormal conditions, print the error log, and do various diagnostic tests.

The 5262 meets the need for a system printer or a workstation printer. It is a customer setup unit, which allows the user to easily install or relocate the printer.

The 5262 attaches to the System/88 by means of the Direct Connect Printer Adapter Card (Feature 1203), which plugs into a communications adapter chassis.

IBM 6262 Printer Models T12 and T14



The IBM 6262 Printer features and functions supported by System/88 include the following. (Note that other functions that are available for the 6262 are not currently supported by the System/88.)

- Engraved band technology
- 1200 lines per minute (Model T12) and 1400 lines per minute (Model T14)
- 132-character print line, at 10 characters per inch
- Three, four, six, or eight lines per inch
- Power stacker (Model T14)
- Four forms feed tractors
- First-line viewing and swing gate
- Quiet operation
- Enhanced operator convenience.

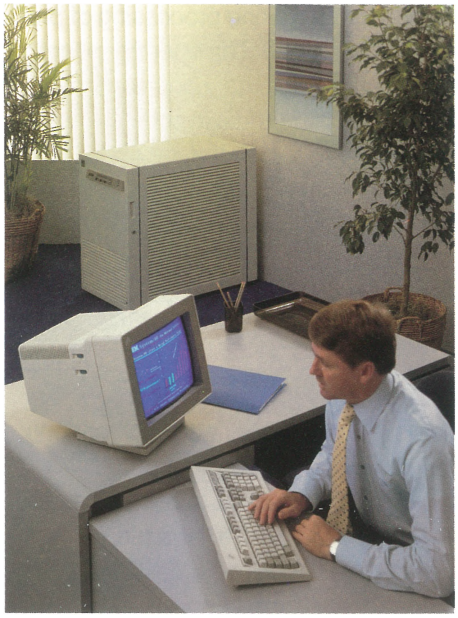
The 6262 is a high-quality printer that combines increased user flexibility with the proven advantages of engraved band technology. It offers exceptional capabilities for forms handling, including six-part "no-carbon-required" forms and those with carbon interleaves.

Offering new levels of operating simplicity and use, the 6262's swing gate allows operators to load forms faster and more easily. And its four forms feed tractors, which can be adjusted individually or simultaneously with a single knob, permit routine processing of prenumbered forms. The operator panel read-out gives printer conditions in plain language, rather than in code numbers. Also, operators can change print contrast, page length, and vertical spacing offline.

With the 6262 you get a number of sophisticated diagnostic capabilities. These include the plain language diagnostic and test message display – and dual processors to help reduce paper jams, decrease operator interventions, and maintain high throughput.

The 6262 attaches to the System/88 by means of a twin axial cable.

System/88 software



The System/88 software provides a convenient environment for online interactive and batch processing.

System/88 Operating System (5732-001)

The IBM System/88 Operating System – a virtual storage operating system designed for multiprogramming, multiple processors, and high availability in a fault-tolerant environment – provides the support for a fault-tolerant data processing system. Highlights include:

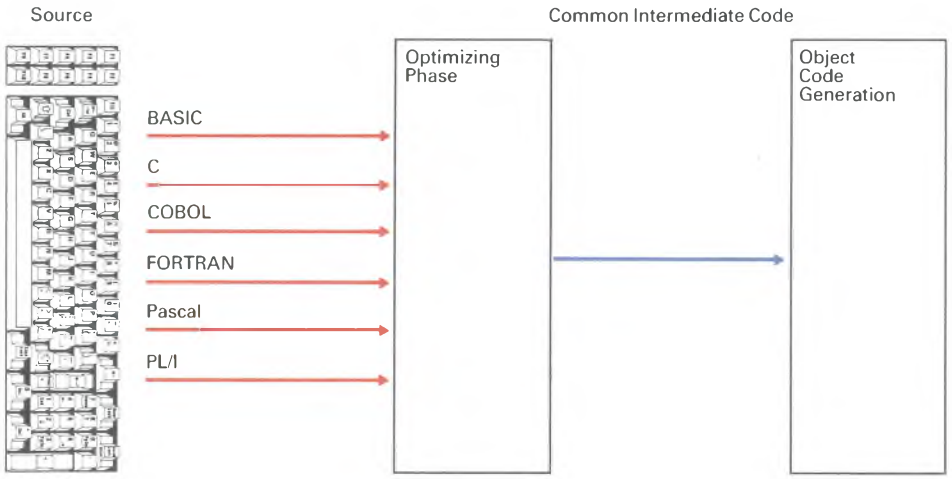
- Dynamic allocation of system resources to each user as needed
- Concurrent system usage, including transaction processing, interactive processing, networking, batch processing, and online program development
- Automatic sharing of resources among users
- Hierarchical file system for sequential, relative, or fixed file organization
- Multikey indexed file access
- Output spooling
- Security controls for system access and authority
- Friendly, powerful command language
- Diagnostic subsystem for problem analysis
- Maintenance software for logging and reporting problems
- Optional data encryption capabilities.

Dependency: System/88 Processor.

Languages

The System/88 Operating System supports six high-level languages: BASIC, C, COBOL, FORTRAN, Pascal, and PL/I. The languages (except C) are implemented in an ANSI standard form, and have been enhanced with powerful extensions. Programs written in any of these languages and processed on a System/88 have the automatic advantage of fault-tolerant operation. The language compilers generate fast, compact code, using a common optimizer and code generator.

- IBM System/88 BASIC (5732-012) exceeds BASIC Level 1 as defined in ANSI X3.60 1978.
- IBM System/88 C (5732-023) is a general purpose language used for structured programming. System/88 supports the full C language, as defined by Kernighan and Ritchie (1978).
- IBM System/88 COBOL (5732-011)



conforms to the COBOL 74 (ANSI X3.23) standard.

- IBM System/88 FORTRAN (5732-014) conforms to the ANSI X3.9 1978 standard.
- IBM System/88 Pascal (5732-015) is a complete implementation of standard Pascal and conforms fully with the draft standard defined by the joint ANSI/IEEE Pascal Committee.
- IBM System/88 PL/I (5732-013) conforms to the ANSI PL/I (ANSI X3.74 1981) subset standard.

Dependency: System/88 Operating System.

Symbolic Debugging Aid (5732-017)

The IBM System/88 Symbolic Debugging Aid provides a powerful debugging facility for programs written in any of the System/88 languages. Using System/88 Symbolic Debugging Aid, breakpoints can be set in a program. When a breakpoint is reached during program execution, the program is stopped, program variables can be examined and modified, and processing can continue. Portions of source code of the program being processed can be displayed at any time during a debugging session.

Dependency: System/88 Operating System.

Text Editor (5732-016)

The IBM System/88 Text Editor provides an interactive full-screen editor for entry and modification of text data and application programs using video display terminals. The Text Editor is menu-driven and includes basic edit functions, such as tab setting; character, line, and block moving; copying and deleting; pattern matching; and searching forward and backward.

Dependency: System/88 Operating System.

Programming Editor (5732-033)

The IBM System/88 Programming Editor provides an interactive full-screen editor for entry and modification of text data and application programs using video display terminals. The Programming Editor is command-driven and includes edit functions, such as tab setting; character, line, and block moving; copying and deleting; pattern matching; and global search and replacement.

The Programming Editor provides multiple-language support – including French, German, Italian, Spanish, Japanese (SBCS Katakana only), U.K. English, and U.S. English.

This editor also provides a keystroke file capability for backup/recovery functions.

The Programming Editor supports the following asynchronous terminals:

- Personal System/2 Models 25, 30, 50, and 60
- Personal Computer Convertible
- 3151 ASCII Display Station Models 310 and 410
- 3161 and 3163 ASCII Display Station Models 11, 12, 21, and 22
- 3162 and 3164 ASCII Display Station Models 11 and 12.

Dependency: System/88 Operating System Release 4 or higher.

Transaction Processing Services (5732-006)

The IBM System/88 Transaction Processing Services provide tools and structures that assist in developing online transaction processing applications. Features include:

- Control for multiple terminals from a single user program
- Support of multiple terminal types
- Access to multiple applications from the same terminal
- Distribution of workload across multiple System/88 processors
- Distributed processing in a network of System/88 processors
- Commands that enhance file integrity if a transaction fails to be completed
- Priority control of key transactions
- Facilities to support split-screen processing
- Flexibility of application design due to a large virtual storage program space.

Dependency: System/88 Operating System.

Forms Management System (5732-007)

The IBM System/88 Forms Management System is designed to simplify the creation and modification of video display formats with these features:

- Interactively creates and maintains video display formats
- Assists users with little or no programming experience in designing video display formats
- Generates source code for System/88 BASIC, C, COBOL, FORTRAN, Pascal, and PL/I languages
- Separates forms definition from the application code for ease of maintenance
- Provides support for Systems Network Architecture (SNA) terminals.

Dependencies: System/88 Text Editor (5732-016) or Programming Editor (5732-033). Support for SNA terminals requires System/88 Primary SNA (5732-028) and Release 3.1 or higher of the System/88 Operating System.

SQL/88 SQL Server (5732-036) and SQL/88 Data Workbench[1] (5732-037)
SQL/88 is an SQL-based relational data base management system designed for an online transaction processing (OLTP) environment. SQL/88 provides a multithreaded server architecture. SQL/88 consists of two major components: the SQL/88 SQL Server and the SQL/88 Data Workbench.[1]

The SQL/88 SQL Server handles data management functions for all SQL/88 users and includes the following:

- Provides a multithreaded architecture designed for multiple users
- Provides improved machine throughput and response times in a multi-user, high-volume transaction environment
- Supports extensions to SQL that include specifying control of flow, declaring temporary variables, the ability to begin/commit/roll back transactions, sending a message to requesters, and initiating an action after a defined time delay via the SQL/88's programmable SQL, TRANSACT-SQL[1] facility
- Maintains enforced data base integrity and consistency independent of applications
- Supports high availability by enabling applications to continue running during data base maintenance activities such as backup, recovery, data base design changes (for example, adding a column to a table), performance tuning, and diagnostics
- Manages all communications between any front end tool and the back end SQL/88 SQL Server using the SQL/88 DB-LIBRARY.[1]
- Contains data base descriptions, integrity definitions, and precompiled, stored procedures via an active data dictionary
- Provides read-only access to Operating System files.

The SQL/88 Data Workbench is a separately priced product that consists of a set of visually based tools for application development, data base management, and decision support. It includes the following tools:

- Interactive query facility – Visual Query Language (VQL[1]) – allows all users to compose and run complex SQL queries using a "point and pick" interface.
- Data entry provides a default data input screen with a prompt and data entry space for each field in the specified table.
- Report writer provides a visual tool for defining, saving, and running reports. Data can be extracted from Operating System files or SQL/88 data bases for reporting.
- Utilities and tools provide several other means through the Data Workbench to aid in application development and maintenance.

Dependency: System/88 Operating System.

System/88 ORACLE (5732-024)
This is a relational data base management system that provides the high-level Structured Query Language (SQL) for accessing a shared data base, from either a terminal or an application program. The primary advantage of a relational data base management system is that it is easy to learn and easy to use.

It provides powerful tools for developing applications. SQL is a natural English-like language that provides for data query, manipulation, definition, and security.

Dependency: System/88 Operating System.

IBM PC Terminal Support (5732-019)
The IBM System/88 PC Terminal Support program executes in an IBM Personal Computer or Personal System/2 connected to a System/88 and allows the PC to appear as an ASCII terminal to the System/88 application. Highlights include:

- File transfer support
- Pop-up function menu
- Multiple-language support: French, German, Italian, Spanish, U.K. English, and U.S. English.

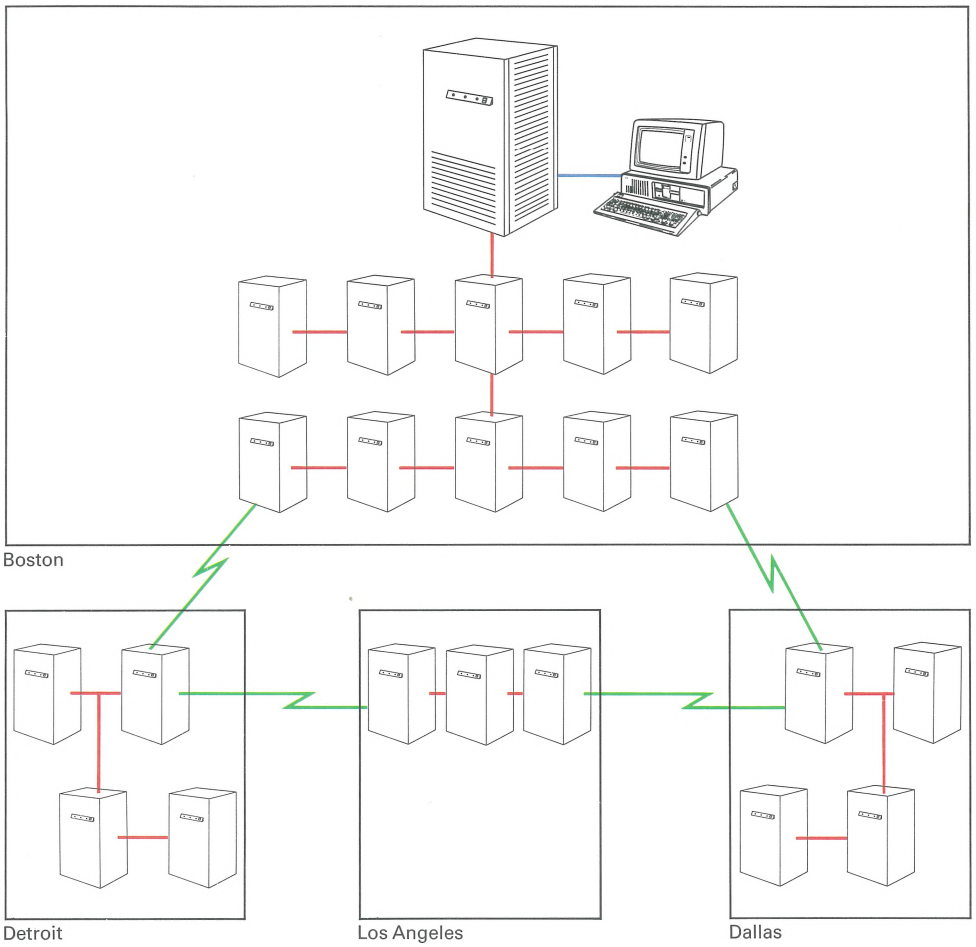
The models of the IBM PC supported include the IBM Personal Computer; Personal Computer XT; Personal Computer AT; Personal Computer Convertible; and the Personal System/2 Models 25, 30, 50, and 60.

Dependencies: System/88 Operating System; IBM Personal Computer, Personal Computer XT, Personal Computer AT, Personal Computer Convertible, or Personal System/2; IBM PC DOS 2.1 or 3.1, or IBM DOS 3.3.

The Personal Computer AT requires PC Terminal Support Release 2 or higher; the Personal Computer Convertible and the Personal System/2 require PC Terminal Support Release 3.1 or higher; Personal System/2 requires IBM DOS 3.3; Personal System/2 Model 25 requires PC Terminal Support Release 4 or higher and the Enhanced PC Keyboard.

[1]Data Workbench, TRANSACT-SQL, DB-LIBRARY, and VQL are trademarks of Sybase Corporation.

A typical network



System/88 communication software products offer a range of function, including networking, device emulation, and terminal connectivity. The System/88 supports ASCII terminals and printers, the IBM Personal Computer or Personal System/2, IBM binary synchronous 3270s, X.25, and X.29. Attachment to other IBM systems through Remote Job Entry (RJE), 3270 emulation, X.25 networking, and SNA is also supported.

Network (5732-002)

The IBM System/88 Network program provides easy access to other System/88 processor modules connected through a telecommunications network. Features include:

- Single-system image of the network, regardless of the number of systems within it
- Security for system access and authority
- Adaptive routing
- Global connection through X.25.

Dependency: System/88 X.25 Networking Facility (5732-008).

Remote Job Entry (5732-003)
The IBM System/88 Remote Job Entry (RJE) program allows binary synchronous data transfer between System/88 processor modules and other IBM processors by emulating a 2780, 3780, or HASP multileaving remote workstation.

Dependency: System/88 Operating System with High-Speed Synchronous Line Adapter.

3270 Terminal Support (5732-004)
The IBM System/88 3270 Terminal Support program enables application programs to read and write to 3270 binary synchronous devices without concern for terminal type or communication protocol. The 3270 devices are supported as standard application devices or as log-on devices.

Dependency: System/88 Operating System with High-Speed Synchronous Line Adapter.

3270 Emulator Support (5732-005)
The IBM System/88 3270 Emulator Support program enables System/88 application programs to communicate with other IBM hosts. Using this program, the System/88 appears to the host as a 3271, 3274, or 3276 Control Unit using binary synchronous protocols.

Dependency: System/88 Operating System with High-Speed Synchronous Line Adapter.

X.25 Networking Facility (5732-008)
The IBM System/88 X.25 Networking Facility provides for full duplex communication between remote application programs.

- Provides program-to-program communication through one of the following:
  - Public packet-switched network
  - Private point-to-point links
- Conforms to CCITT X.25 Level 3 standard for computer-to-computer communication.

Dependency: System/88 Operating System with High-Speed Synchronous Line Adapter.

X.29 Networking Facility (5732-009)
The IBM System/88 X.29 Networking Facility provides communication between remote terminals and the System/88 through a packet-switched network.

Dependency: System/88 X.25 Networking Facility (5732-008).

SDLC Protocol Support (5732-010)
The IBM System/88 Synchronous Data Link Control (SDLC) Protocol Support provides bit-synchronous communication software corresponding to the IBM SNA Link layer and can be used to transmit data over communication lines using SDLC protocol.

Dependency: System/88 Operating System with High-Speed Synchronous Line Adapter.

Distributed System Services (5732-030)
The IBM Distributed System Services program allows the System/88 to communicate with the Distributed Systems Executive (DSX) program executing in a host IBM System/370. (The DSX program provides central libraries, record keeping, session scheduling, and controlled transmission. DSX can report on data and software assignments, schedules, and transmission.)

Highlights of the Distributed System Services program, in conjunction with DSX in the host, include the following:

- The program can be activated by an operator command or when the system is powered on.
- An operator at the host may:
  - Send programs, files, panels, and command macros to the System/88
  - Retrieve System/88 programs, files, panels, storage dumps, and command macros
  - Delete System/88 programs, files, panels, storage dumps, and command macros
  - Process a command macro in the System/88.
- An operator, using DSX, may specify a time and sequence for each operation or use the defaults.
- System/88 supports logical session pass-through, enabling host DSX to establish sessions with logical units in downstream processors (including System/88s) and controllers.

Dependencies: Transaction Processing Services (5732-006), Communications & System Management (5732-026), and Primary SNA (5732-028) for pass-through support. The IBM host requires the DSX (5668-915) Version 3.1 or higher.

System/88 Systems Network Architecture (SNA)

The IBM System/88 Systems Network Architecture (SNA) consists of two families of products that greatly enhance the System/88 communication networking capabilities. These products provide functionally rich communication facilities and a high-level application program interface.

The first family of System/88 SNA products has great versatility, as shown in the illustration below. The products are:

- SNA Network Interface Support (5732-027)
- Primary SNA (5732-028)
- Secondary SNA (5732-029)
- Advanced Program-to-Program Communications (APPC) (5732-025)
- Communications & System Management (C&SM) (5732-026).

The second family of System/88 SNA products may satisfy certain limited requirements. The products are:

- SNA Cluster Controller (5732-021)
- SNA 3270 Terminal Emulation (5732-020).

Note that the products in the first family do not function with those in the second family, but they may coexist in the same system.

System/88 SNA Network Interface Support (5732-027)

This System/88 SNA product provides networking services and is a prerequisite for:

- Primary SNA (5732-028)
- Secondary SNA (5732-029)
- Advanced Program-to-Program Communications (APPC) (5732-025)
- Communications & System Management (C&SM) (5732-026).

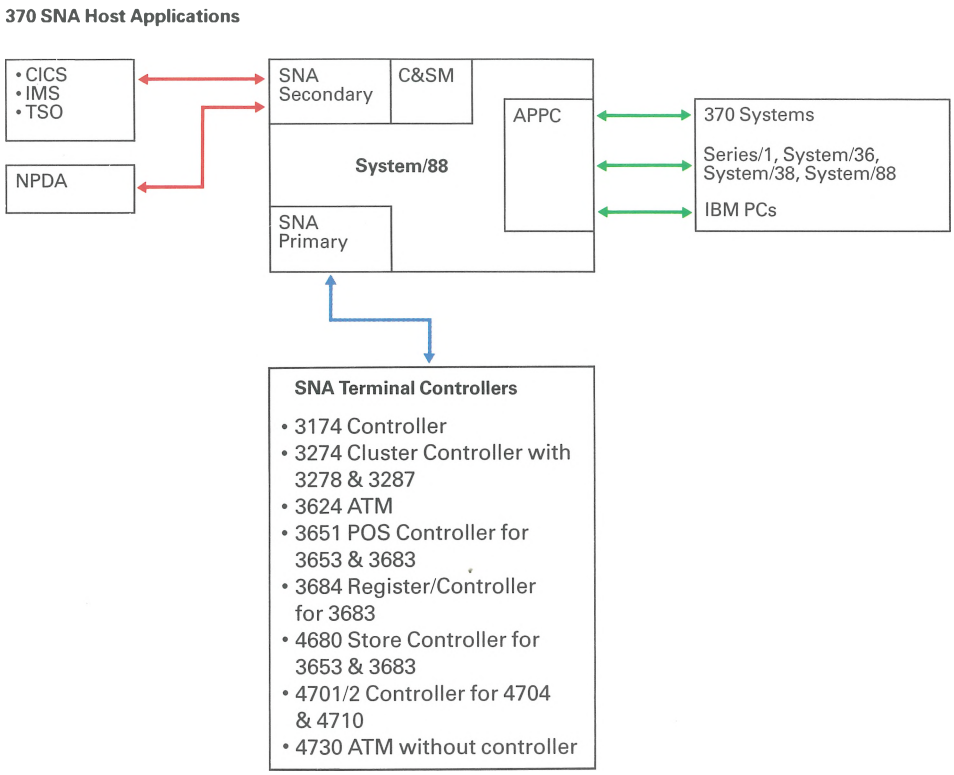
The IBM System/88 SNA Network Interface Support is used in conjunction with one or more of the above products to provide various levels of SNA functions for the application programmer.

The main purpose of this product is to interface between the SNA products and one or more transmission facilities that provide the link between upstream or downstream processors and devices. It enables processors and terminals to be interconnected in a traditional SNA subarea network and in a new *peer* type of SNA network. The point-to-point connectivity of SNA Network Interface Support allows both upstream connections to SNA host systems, and downstream connections to SNA controllers and control units.

This product provides a set of System/88 command verbs that an operator can use to control the network or obtain and modify configuration information. It also provides the following:

- Dynamic add/change/delete related resource definitions
- Activate/deactivate local resources
- Primary, secondary, APPC, and C&SM interface
- Error log and display facility for all SNA errors
- Message log and display facility for operator messages
- Session level segmentation and segmentation assembly
- Programming interface for all operator functions
- Support for point-to-point, multipoint, and switched SDLC links.

Dependencies: System/88 Operating System, System/88 SDLC Protocol Support (5732-010), Duplexed Communication Controllers (Feature 1200), Communication Chassis (Feature 1220 or 1220/1230), High-Speed Synchronous Line Adapter.



Systems Network Architecture connectivity

System/88 Primary SNA (5732-028)

IBM System/88 Primary SNA provides support to allow System/88 applications to exchange data with a variety of control units and communication controllers. Primary SNA:

- Enables the IBM System/88 to function as an SNA host – Physical Unit (PU) Type 5 – node in a network with secondary SNA control units
- Provides the application programmer with an interface for Logical Unit (LU) Types 0, 1, 2, and 3
- Provides support to allow IBM System/88 applications to exchange data with the following SNA control units and SNA communication controllers:
  - 3274 Display Control Unit
  - 3624 Consumer Transaction Facility
  - 3651 Store Controller
  - 3684 Point-of-Sale Controller/Register Model 2
  - 4680 Store System Controller
  - 4701 and 4702 Finance Communications Controllers
  - 4730 Personal Banking Machine
  - System/88 Secondary SNA applications
- Enables the IBM System/88 to provide session pass-through on an LU basis from SNA secondary units.

Enhancements for Primary SNA

Primary SNA enhancements include:

- 3174 Controller support, enabling applications to communicate with LUs residing in an IBM 3174 Subsystem Control Unit Model 1R, 51R, or 81R
- 3278 or 3279 log-in terminal support, enabling an IBM 3178, 3179, 3180, 3278, or 3279 Display Station that is connected to an IBM 3174 or 3274 Controller to be used as a log-in terminal for the System/88
- Forms Management System (FMS) (5732-007) support:
  - As a log-in device, SNA terminals can function with the FMS in 3278 Model 2 mode.
  - Any FMS application that is written to the 3270 binary synchronous restriction can function with the SNA terminals without modification.
  - Using the FMS, most applications can display a form on an SNA terminal, accept operator-entered data, process the data, and display another form using one of several high-level language application program interfaces.

Dependencies: System/88 SNA Network Interface Support (5732-027). Enhancements require Release 3.1 or higher of the System/88 Operating System.

System/88 Secondary SNA (5732-029)

IBM System/88 Secondary SNA allows the System/88 to be connected to SNA networks as a PU Type 2 cluster controller. Support is provided to allow selected System/88 peripherals to appear to upstream hosts as SNA terminals and printers. Secondary SNA:

- Allows the System/88 to operate as an SNA PU Type 2 node connected to an SNA host
- Provides an application program interface, which supports LU Types 0, 1, 2, and 3
- Provides support that allows IBM PCs, 3151s, 3161s, 3162s, 3163s, 3164s, and other System/88-supported ASCII terminals connected to the System/88 to appear as 3278 Display Stations to upstream hosts
- Provides support that allows System/88 printers to appear as emulated SNA LU Type 1 and Type 3 printers
- Provides pass-through support for System/88 Primary SNA.

Enhancements for Secondary SNA

Secondary SNA has been enhanced to provide support for the System/370 Host Command Facility (HCF) licensed program (5668-985). HCF is part of the System/370 and 4300 distributed systems host support. In conjunction with Release 4 or higher of System/88 Secondary SNA, HCF permits a 3270 terminal attached to a System/370 or 4300 to function as though the 3270 were directly connected to a System/88 in an SNA network.

The System/88 support for HCF allows a System/370 terminal operator to access and control a System/88 attached to a System/370 host in an SNA network. The user can log in to the System/88 from a System/370 SNA or non-SNA terminal and perform System/88 functions that do not require direct human intervention.

In general, the enhanced Secondary SNA gives a System/370 terminal user the added capability to:

- Interactively control System/88 operations within an SNA network
- Use the operation and service facilities of the System/88
- Execute and debug System/88 application programs.

Dependencies: System/88 SNA Network Interface Support (5732-027). Enhancement requires Release 4 or higher of the System/88 Operating System.

System/88 Advanced Program-to-Program Communications (5732-025)

IBM System/88 Advanced Program-to-Program Communications (APPC), as represented by LU Type 6.2, provides a single, converged solution to the communication requirements of a variety of IBM products. It provides enhanced SNA support for distributed processing. All mandatory APPC base sets and several option sets have been implemented in System/88 APPC.

APPC enables processors and terminals to be interconnected in a traditional SNA subarea network. When attached to a System/370 host, the System/88 appears as a PU Type 2 node. Attachment capability is provided by the System/88 Network Interface Support.

APPC provides a program interface through a set of verbs, allowing transaction programs to communicate at a conversational level with no session awareness.

This product allows two types of connections with other SNA nodes:

- Peripheral node – connecting to a Type 4 node that provides boundary function support
- Direct – connecting to other Type 2.1 nodes.

Dependency: System/88 SNA Network Interface Support (5732-027).

System/88 Communications & System Management (5732-026)

IBM System/88 Communications & System Management (C&SM) supports an IBM standard host C&SM tool – Network Problem Determination Application (NPDA) Release 3, Version 3 – and sends permanent IBM hardware alerts, as well as alerts from downstream SNA processors. It provides:

- Alert support for IBM System/88 hardware failures
- Alert pass-through for downstream SNA physical units attached to the IBM System/88 and controlled by the IBM System/88 Primary SNA licensed program
- For user-requested alerts to be sent to the host from an application program
- A central logging facility for the SNA network controlled by the System/88
- Operator messages
- Programmed operator control interface.

Dependency: System/88 Secondary SNA (5732-029).

System/88 SNA Cluster Controller (5732-021)

The System/88 SNA Cluster Controller allows the System/88 to support SNA communication using SDLC protocols in an SNA network over SDLC lines by emulating SNA 3274/3276 Cluster Controllers. Highlights include:

- Support for SNA communication using SDLC protocols
- Support that makes the System/88 appear to SNA hosts as 3274 or 3276 Cluster Controllers with attached 3278 Model 2 Displays and 3287 or 3289 Printers with data stream compatibility
- Support by an application programming interface for all System/88 high-level languages
- Access to host application software in an SNA network
- Gathering of PU and LU status information by way of SNA commands or user-written application software.

Dependency: System/88 SDLC Protocol Support (5732-010).

System/88 SNA 3270 Terminal Emulation (5732-020)

The System/88 SNA 3270 Terminal Emulation support used in conjunction with the System/88 SNA Cluster Controller allows the System/88 to support SNA communication by enabling System/88 asynchronous terminals and printers to communicate in an SNA network using SDLC. Highlights include:

- System/88 ASCII terminals permitted to emulate SNA 3278 Display Stations and 3289 Printers
- ASCII data converted to and from EBCDIC data
- Printer emulation that takes full advantage of the System/88 Operating System print spooler and queue control to provide efficient use of printer.

Both the terminal and printer emulation are transparent to an IBM SNA host and the distributed data processing applications.

Dependency: System/88 SNA Cluster Controller (5732-021).

System/88 support services

Maintenance

System/88 support underlines IBM's commitment to customer service. System/88 provides the security of high availability through:

- Power-up checking
- Continuous checking
- Error detection, isolation, and reporting
- Online replacement
- Remote/automatic service.

Power-up checking
An extensive set of diagnostic routines runs automatically before a unit is put online.

Continuous checking
The system monitors itself continuously. If an error occurs, automatic self-diagnosis is initiated, and the maintenance action required to fix a faulty component is begun.

Error detection, isolation, and reporting
Because of System/88's comprehensive and continuous self-checking, errors are rapidly detected, and failed components are taken off line before they can affect other system components. The System/88 Support Center will be automatically notified of the problem (except for tape unit and I/O device failures). The Support Center will further diagnose the problem. If parts are needed, they can be automatically ordered.

Online replacement
A duplexed component can be removed or replaced while the System/88 continues operation. This means that no processing time is lost while a failed component is being replaced and the system restored to operation.

Remote/automatic service
Every System/88 has the capability of remote service. Off-site IBM personnel can help determine the cause of failure, provide software fixes, and identify hardware corrective actions. The customer benefits from speedy repairs and low maintenance costs.

Support Centers

IBM System/88 Support Center

The IBM System/88 Support Center implements, through the IBM Remote Support Network, the remote/automatic service for hardware and software failure. In addition to benefiting from the automatic service, customers can send information electronically to the System/88 Support Center at any time.

IBM System/88 Customer Assistance Center

The IBM System/88 Customer Assistance Center provides six months of technical support, at no charge, to customers who obtain System/88s from IBM. Customers can elect to begin the support any time during the first month following the installation date. The Center answers customers' questions about the function, implementation, or operation of the System/88. Customers communicate with the Customer Assistance Center by electronic mail.

Other System/88 customer support

In addition to the support provided through the System/88 Support Center and Customer Assistance Center, System/88 technical support teams provide product support through such activities as performance analysis, capacity planning, and snapshot modeling.

System/88 field support teams support IBM account teams at customer installations. In addition, an online data base is accessible to IBM Systems Engineers to enable them to provide faster, more efficient service.

Education

Courses currently available through the IBM Advanced Education Center are described below. Contact your IBM Marketing Representative for additional course information. For scheduling and enrollment information, call IBM Direct, Education, toll-free at 1-800-426-2468.

System/88 Basic Usage course

The IBM System/88 Basic Usage course is designed for personnel who will be using the system. With a combination of lectures and demonstrations, students are prepared for hands-on exercises. This course meets the prerequisites for the System Administrator course and the Application Programmer course.

Prerequisites

The student must have a general knowledge of computer systems (giving commands, using an editor, and so on). Some knowledge of programming will be useful.

Objectives

At the end of the Basic Usage course, the student should be able to:

- Describe the system software and hardware
- Use commands
- Use the editor to create and modify files
- Understand the System/88 Directory Structure
- Understand the System/88 Access Control Mechanism
- Develop abbreviations
- Develop command macros.

System/88 System Administrator course

The IBM System/88 System Administrator course is designed for personnel who will be administering the System/88. Along with attending a combination of lectures and demonstrations, students use hands-on experience to perform administrator functions.

Prerequisite

IBM System/88 Basic Usage course

Objectives

At the end of the System Administrator course, the student should be able to:

- Register new users and establish their access rights
- Change the system configuration
- Start up and shut down the system
- Perform a backup of the system
- Monitor the use of the system
- Administer the batch and spooler subsystems
- Install a new release of the operating system
- Implement load control on the system
- Interpret system error information
- Interface with the IBM System/88 Support Center.

System/88 Application Programmer course

The IBM System/88 Application Programmer course is designed for programmers who will be writing application programs on a System/88. Along with attending a combination of lectures and demonstrations, students use hands-on terminal experience to actually develop and execute sample programs during the class. The course assumes that the student can already write programs in one of the languages that System/88 offers. It does not teach students how to program.

Prerequisites

Ability to write programs in BASIC, C, COBOL, FORTRAN, Pascal, or PL/I, in an interactive environment. Completion of IBM System/88 Basic Usage course.

Objectives
At the end of the Application Programmer course, the student should be able to:
- Describe the system software and hardware
- Use commands for program development
- Use the editor to create and modify source programs
- Use Utilities to compile and load a program
- Use the debugger to debug programs at the source level
- Develop abbreviations and command macros
- Use the Service Subroutines in a program
- Use the Forms Management System (FMS) to implement formatted screen handling from an application program
- Use the Transaction Processing Services to implement transaction processing (including queue operations, multitasking, and transaction protection) from an application program.

System/88 ORACLE Facilities course
The System/88 ORACLE Facilities course is designed for data base administrators, application programmers, and those who advise personnel in the development of data base queries. This course covers in detail the relational data base management system and its components. Along with attending a combination of lectures and demonstrations, students use hands-on experience to develop queries, define and load data, generate reports, and use the Data Dictionary.

Prerequisites
Familiarity with using online terminals, full-screen editors, and interactive systems.

Objectives
At the end of the ORACLE Facilities course, the student should be able to:
- Log on to ORACLE, using the User Friendly Interface (UFI), and set the characteristics of the UFI terminal session
- Write Structured Query Language (SQL) statements to query, define, maintain, and control data in the data base
- Use UFI options to customize the terminal session, format data, and print reports
- Use the Report Writer to produce reports
- Use the Data Dictionary
- Design and create relational tables
- Run an application, using the Interactive Application Processor
- Use Utilities to load and unload data
- Define the access authority for System/88 ORACLE tables.

System/88 SNA Advanced Program-to-Program Communications (APPC) course
The IBM System/88 SNA APPC course is recommended for system administrators and application programmers who will be implementing SNA distributed applications. Along with attending a combination of lectures and demonstrations, students use hands-on experience in learning how to install, maintain, and use the SNA APPC capabilities of the System/88.

Prerequisites
System/88 system administration and/or application programming skills

Objectives
At the end of the SNA APPC course, the student should be able to:
- Understand SNA APPC concepts, terms, functions, and processes
- Display the status of SNA APPC resources
- Start SNA APPC resources and initialize sessions
- Code transaction programs that use SNA APPC operational and conversational verbs
- Code transaction programs that use System/88 subroutine calls to invoke SNA APPC functions and processes
- Define and change the status of SNA APPC resources
- Understand the purpose of logs, traces, and other SNA problem determination aids.

System/88 Primary and Secondary SNA (PSSNA) course
The IBM System/88 PSSNA course is designed for system administrators who will be implementing SNA Primary and/or Secondary functions. Along with attending a combination of lectures and demonstrations, students use hands-on experience in learning how to install, maintain, and use the PSSNA capabilities of the System/88.

Prerequisite
IBM System/88 System Administrator course or the equivalent

Objectives
At the end of the PSSNA course, the student should be able to:
- Understand PSSNA concepts, terms, functions, and processes
- Display the status of PSSNA resources
- Start PSSNA resources and initialize sessions
- Define and change the status of PSSNA resources
- Understand the purpose of logs, traces, and other SNA problem determination aids.

A full range of publications is available with the System/88 to help you learn, plan, program, and operate System/88. These publications include the following.

Note: This list does not include some publications that are shipped with specific devices.

Overview publications

System/88 Advantage, G520-6073
System/88 Brochure, G520-6520
System/88 Communication Advantage, GX34-1000
System/88 Software Solutions: A Catalog of Non-IBM Applications, G520-6519

Hardware publications

System/88 1/4-Inch Cartridge Tape Unit Guide, SX34-1004
System/88 Control Panel Guide, SX34-0190
System/88 Control Panel Guide–4576, SX34-1002
System/88 Control Panel Guide–4578/4579, SX34-1003
System/88 5150/5160 PC Keyboard Aid, SX34-0169
System/88 5170 PC Keyboard Aid, SX34-0195
System/88 Site Planning Guide, SA34-0302
System/88 4585 Tape Unit Guide, SX34-1001
System/88 4968 Tape Unit Guide, SX34-0191
System/88 User's Maintenance Guide, SY34-0356

Note: Additional I/O publications not listed are shipped with specific I/O devices.

Software publications

Communication

Asynchronous Communications Guide, SC34-0926
Binary Synchronous Communications Guide, SC34-0679
Generic Communications Software Reference, SC34-0951
Introduction to Communications, SC34-0677
Remote Job Entry Facility Guide, SC34-0680
Synchronous Data Link Control Guide, SC34-0775
System/88 Advanced Program-to-Program Communication: Planning and Operations Guide, SC34-0759
System/88 Advanced Program-to-Program Communication: Programming Guide and Reference, SC34-0760
System/88 Communications and System Management User's Guide, SL23-0156
System/88 Distributed System Services User's Guide, SL23-0182
System/88 Network Configurator User's Guide, SC34-0976
System/88 Primary and Secondary Systems Network Architecture Planning and Operations Guide, SC34-0757
System/88 Primary and Secondary Systems Network Architecture Programming Guide and Reference, SC34-0758
System/88 Systems Network Architecture Guide, SC34-0727
System/88 Systems Network Architecture Keyboard Aid, SX34-0172
User Programmable Communications Adapter Reference, SC34-0971
X.25 and Network Administration Guide, SC34-0949
X.25/X.29 Networking Facility Guide, SC34-0792
3270 Keyboard Aid, SX34-0176
3270 Support and 3270 Emulation Guide, SC34-0678

Forms Management

Forms Management System BASIC Guide and Reference, SC34-0684
Forms Management System C Guide and Reference, SC34-0748
Forms Management System COBOL Guide and Reference, SC34-0675
Forms Management System FORTRAN Guide and Reference, SC34-0688
Forms Management System Pascal Guide and Reference, SC34-0692
Forms Management System PL/I Guide and Reference, SC34-0671

General

The Analyze System Facility Guide, SC34-0694
Device Configuration Guide, SC34-0979
National Language Support Reference, SC34-0947
System Administrator's Guide, SC34-0667
Tape Processing Facility User's Guide, SC34-0950
Terminal Type Definition Guide, SC34-0975

Languages

BASIC Forms Management System Guide and Reference, SC34-0684
BASIC Language Reference, SC34-0681
BASIC Subroutines Reference, SC34-0682
BASIC Transaction Processing Services Supplement, SC34-0683

C Forms Management System Guide and Reference, SC34-0748
C Language Reference, SC34-0746

C Subroutines Reference, SC34-0819
C Transaction Processing Services Supplement, SC34-0747

COBOL Forms Management System Guide and Reference, SC34-0675
COBOL Language Reference, SC34-0672
COBOL Subroutines Reference, SC34-0673
COBOL Transaction Processing Services Supplement, SC34-0674
System/88 ORACLE COBOL Call Interface Reference, SC34-0735

FORTRAN Forms Management System Guide and Reference, SC34-0688
FORTRAN Language Reference, SC34-0685
FORTRAN Subroutines Reference, SC34-0686
FORTRAN Transaction Processing Services Supplement, SC34-0687

Pascal Forms Management System Guide and Reference, SC34-0692
Pascal Language Reference, SC34-0689
Pascal Subroutines Reference, SC34-0690
Pascal Transaction Processing Services Supplement, SC34-0691

PL/I Forms Management System Guide and Reference, SC34-0671
PL/I Language Reference, SC34-0668
PL/I Subroutines Reference, SC34-0669
PL/I Transaction Processing Services Supplement, SC34-0670
System/88 ORACLE PL/I Call Interface Reference, SC34-0745

Operating System
Introduction to the Operating System, SC34-0664
Operating System Commands, SC34-0666
Operating System Commands User's Guide, SC34-0972

ORACLE
Introduction to System/88 ORACLE, SC34-0736
System/88 ORACLE COBOL Call Interface Reference, SC34-0735
System/88 ORACLE Data Base Administrator's Guide, SC34-0734
System/88 ORACLE Error Messages and Codes, SC34-0744
System/88 ORACLE Interactive Application Facility Application Designer's Guide, SC34-0738
System/88 ORACLE Interactive Application Facility Application Designer's Reference, SC34-0739
System/88 ORACLE Interactive Application Facility Terminal Operator's Guide, SC34-0740
System/88 ORACLE Interactive Application Facility Terminal Operator's Reference, SC34-0741
System/88 ORACLE Keyboard Aid, SX34-0175
System/88 ORACLE PL/I Call Interface Reference, SC34-0745
System/88 ORACLE Precompiler Interface Reference, SC34-0862
System/88 ORACLE Report Generator, SC34-0742
System/88 ORACLE Report Text Formatter, SC34-0743
System/88 ORACLE User-Friendly Interface Reference, SC34-0737
System/88 ORACLE User-Friendly Interface Terminal User's Guide, SC34-0733

PC Terminal Support
IBM Personal Computer Terminal Support, SX34-0173
System/88 5150/5160 PC Keyboard Aid, SX34-0169
System/88 5170 PC Keyboard Aid, SX34-0195

SQL/88
System/88 SQL/88 C DB-LIBRARY Reference, SC34-0980
System/88 SQL/88 COBOL DB-LIBRARY Reference, SC34-0983
System/88 SQL/88 Commands Reference, SC34-0988
System/88 SQL/88 Data Base Administrator's Guide, SC34-0987
System/88 SQL/88 Data Workbench Overview, SC34-0981
System/88 SQL/88 Data Workbench User's Guide, SC34-0985
System/88 SQL/88 Installation Guide, SC34-0989
System/88 SQL/88 PL/I DB-LIBRARY Reference, SC34-0984
System/88 SQL/88 Reference Supplement, SC34-0998
System/88 SQL/88 SQL Server Overview, SC34-0982
System/88 SQL/88 TRANSACT-SQL User's Guide, SC34-0986

Symbolic Debugging Aid
Symbolic Debugging Aid User's Guide, SC34-0948

Text Editors
Programming Editor User's Guide, SC34-0969
Text Editor Reference, SC34-0697
Text Editor User's Guide, SC34-0693

Transaction Processing Services
Transaction Processing Services BASIC Supplement, SC34-0683
Transaction Processing Services C Supplement, SC34-0747
Transaction Processing Services COBOL Supplement, SC34-0674
Transaction Processing Services FORTRAN Supplement, SC34-0687
Transaction Processing Services Guide and Reference, SC34-0855
Transaction Processing Services Pascal Supplement, SC34-0691
Transaction Processing Services PL/I Supplement, SC34-0670

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IBM System/88
Digest

G520-6518-00

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