The IBM 3090 — the processor family for computing power and performance

The enhanced IBM 3090s are the base for growth into the 90s. These enhanced processors offer IBM's largest single-system image and, with their optional Vector Facility, comprise the most powerful computing product IBM has ever built. The result is one of the industry's most advanced general-purpose computers.

IBM's 1-megabit memory chip is used in the enhanced 3090 family. When it was introduced in the 3090, it marked a first for large systems in the industry. Today, on the enhanced 3090 models, the original 1-megabit chip is used in expanded storage, and a new, faster, smaller 1-megabit chip is used in central storage.
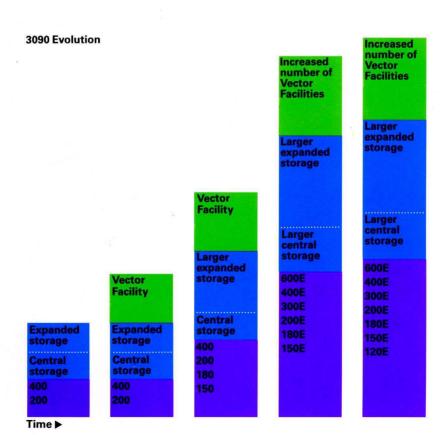
These 3090s include seven processor models that provide a wide range of growth, price/performance, and other benefits for both new and current 3090 users.

For example, these processors offer growth options you can match to your specific information systems requirements. You can obtain up to a tenfold increase in processing power, from 32Mb to 1,280Mb of processor storage, and from 16 to 128 channels. You can also add up to six fully integrated Vector Facilities for handling numerically intensive computing applications. The result is exciting extensions to the technology and design of previously available 3090 models and significant flexibility for you.

The enhanced 3090s provide improved price/performance, too. In fact, these processors' increased granularity, advanced technology, and innovative design extensions can give you price/performance improvements over previously available 3090 processors. That means you can support more users of your current applications at a lower cost per user, while maintaining service levels.

If you already have a 3090 installed, the enhanced 3090s give you a significant opportunity to build on your investment, while achieving powerful growth and price/performance benefits. That's because currently installed 3090 processors can be changed to the enhanced models when you upgrade to meet new growth requirements.

Add expanded connectivity and enriched software offerings, and you have an information system that can provide the function and performance you need to satisfy nearly any information processing requirement.

3090 Evolution

Bar 1:
Expanded storage
Central storage
400
200

Bar 2:
Vector Facility
Expanded storage
Central storage
400
200

Bar 3:
Vector Facility
Larger expanded storage
Central storage
400
200
180
150

Bar 4:
Increased number of Vector Facilities
Larger expanded storage
Larger central storage
600E
400E
300E
200E
180E
150E

Bar 5:
Increased number of Vector Facilities
Larger expanded storage
Larger central storage
600E
400E
300E
200E
180E
150E
120E

Time ▶

The enhanced IBM 3090 processors rely on some of IBM's most powerful technological advances, including leading-edge emitter coupled logic (ECL), an improved Thermal Conduction Module (TCM), and a second generation 1-megabit chip with a faster access time.
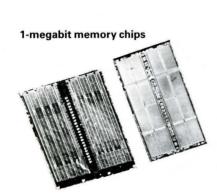
Logic

- Leading edge emitter coupled logic (ECL)
- ECL is a type of bipolar transistor logic that does not allow the transistor to saturate (turn on completely). It is much faster than transistor-to-transistor logic (TTL).
  - IBM was the first to register a patent for ECL technology.
  - The enhanced 3090 with ECL chips has a machine cycle time that is up to 28% faster than the 308X, which uses TTL chips.
  - The 3090's register stack chip can simultaneously write two addresses and read one address during a machine cycle.
- Read-only storage (ROS)
- Double-density chips
- Twice the microcode storage capability of previously available models
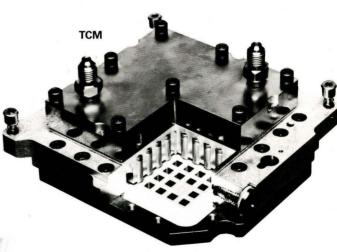
Package

- Improved Thermal Conduction Module (TCM)
- Packaging is denser than the 308X TCM.
- 3090 TCM power capacity is 100% greater than that of the 308X.
- 132 chip site substrate is used in enhanced 3090 models.

Processor Storage

- 1-megabit storage chip
- 3090 uses 1-megabit chips.
- IBM was the first company to begin volume production of 1-megabit memory chips.
- IBM is the first company to include these chips in mainframe computers.
- Is world's densest memory chip in production use for large systems today.
- Is 16 times denser than the chips used in the 308X memory.
- Each 1-megabit chip contains slightly more than 1-million bits (1,048,576 to be exact).
- Each chip can store approximately 100 pages of double-spaced typewritten text; a 250-page paperback novel can be stored on just six of these chips.
- Second generation 1-megabit chips with improved access time are used in central storage in enhanced 3090 models.
- Provides up to 256Mb of high-speed central storage on largest models
- First generation 1-megabit chip is now used in expanded storage.
- Has up to 1,024 Mb of expanded storage on largest models

TCM

1-megabit memory chips

132-chip substrate

IBM Extended Architecture

The IBM 3090 architecture supports such capabilities as integrated vector processing, single-image multiprocessing, and storage management.
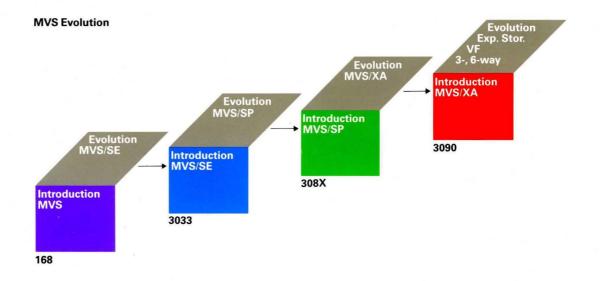
IBM Vector Architecture

- Designed as an integral, basic component of the IBM System/370 and IBM System/370 Extended Architectures
- 171 vector instructions
- 16 vector registers, each able to hold 128 32-bit data elements
- Automatic coupling of even and odd register for 64-bit double-precision arithmetic
- Able to work jointly with general-purpose registers and floating-point registers from scalar processing unit
- Includes compound operations to produce a product and a sum in one instruction
- Exploits contiguous, non-contiguous, and random addressing
- Software support
- VS FORTRAN Version 2
  - Optimizing/vectorizing compiler
  - Intrinsic library, including vector and scalar routines
  - VS FORTRAN Program Multitasking Facility
  - Interactive Debug
  - CPU Sampling Facility
  - Compiler Directives
- Assembler H Version 2
- Engineering and Scientific Subroutine Library (ESSL): 212 subroutines
- Vector Processing Subsystem/Vector Facility (VPSS/VF)
- IBM FORTRAN Language Conversion
- 3090 Vector Facility Simulator
- APL 2
- FORTRAN subroutine calls from PL/I
- Scientific Engineering Application Director (SCENAD)
- Mathematical Programming System Extended/370 (MPSX/370)

Expanded Storage

- Additional level within the storage hierarchy is transparent to subsystems and user programs.
- Designed to improve 3090 capacity by offering a balanced storage subsystem and to provide response time comparable to equal amounts of central storage.
- Permits synchronous movement of a 4K page to and from central storage in approximately 75 microseconds – 400 times faster than an average I/O response time
- Provides the potential to access processor storage well beyond the current 370/XA architecture limitation of 2Gb.
- Up to 1Gb is available on the largest 3090 enhanced models.
- Utilized by Data in Virtual (MVS/SP Release 2.2 or later).
- Can significantly improve the responsiveness of Information Management System (IMS).
- VM/HPO performance is improved by paging into expanded storage (up to 512Mb).
- In conjunction with 3090 processors, expanded storage can provide significant performance improvements...some customer experience:
  - External paging load reduced 50%
  - Response time improved 67%
  - Transaction volume increased 30%

MVS/Extended Architecture (MVS/XA)

- Designed to exploit 3090 design features, such as multiprocessor configurations and expanded storage.
- Single-image mode supported for four-way and six-way models.
- Dispatcher enhancement exploits larger models in single-image mode (MVS/SP 2.1.7, or later).
- Up to six Vector Facilities supported.
- Larger processor storage exploited through Data in Virtual (MVS/SP Release 2.2 or later).
- Software availability features complement processor availability features.
- Software function evolves to meet continuing customer growth requirements.

MVS Evolution

VM/Extended Architecture (VM/XA) System Facility

- Allows multiple guest operating systems to run on one physical processor.
- Using Start Interpretive Execution (SIE) microcode, designed for 370/XA hardware and supported on all 3090 processors, a preferred guest operating system can run at near native performance.
- Includes performance enhancement for VM/HPO and VM/SP guest running under SIE.
- VM/XA SF was designed to fully exploit IBM's Extended Architecture with the ability to use large real and virtual storage and take advantage of the Dynamic Channel Subsystem, while dynamically sharing all system resources.
- Provides full support for all 3090 models, including support for the four-and six-way in both single image and physically partitioned modes.
- 3090 Vector Facility and expanded storage supported.
- Easy migration to other IBM operating systems environment supported, and system testing with powerful trace and debug facilities permitted.
- VM/XA SF supports
- MVS/XA
- OS/VS1 BPE
- VSE/SP
- VM/SP
- MVS/370
- VSE/AF
- VM/SP HPO
- CMS for engineering/scientific (E/S) applications (limited function)

	MVS/XA	VM/XA SF	MVS/370	VM/HPO
3090-150	•	•	•	•
3090-180	•	•	•	•
3090-200	•	•	•	•
3090-400 (SI mode)	•	•		
3090-400 (PP mode)	•	•	•	•
3090-120E	•	•	•	•
3090-150E	•	•	•	•
3090-180E	•	•	•	•
3090-200E	•	•	•	•
3090-300E	•	•		
3090-400E (SI mode)	•	•		
3090-400E (PP mode)	•	•	•	•
3090-600E (SI mode)	•	•		
3090-600E (PP mode)	•	•		

SI = Single image

PP = Physically partitioned

VM Evolution

N-way
support

Expanded
storage
support

Expanded
storage
support

VM/XA
SF

VM/XA
SF

VM/XA
SF

VM/SP
HPO

VM/SP
HPO

VM/SP
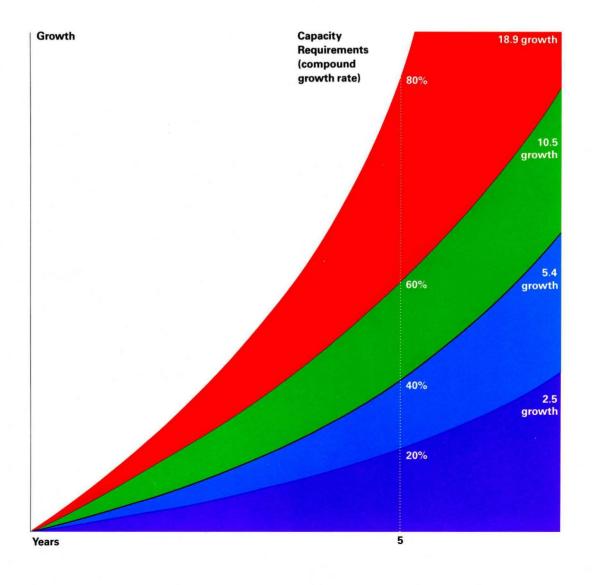HPO

VM/SP
HPO

VM/SP

VM/SP

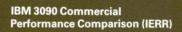VM/SP

VM/SP

VM/SP

Time▶

Growth

One of the 3090's most significant benefits is its increased growth potential. Several options, including the addition of expanded storage and powerful, fully integrated Vector Facilities, are available on each model.

- 3090-600E is the largest single-image system announced by IBM.
- Up to tenfold field-upgradable growth capacity is offered in the 3090 series.
- Up to three times improvement in performance (IERR) is offered over the largest 308X processor.
- IBM is committed to meeting customer growth requirements.
- Seven models provide increased granularity.

Growth

Capacity Requirements (compound growth rate)

18.9 growth

80%

10.5 growth

60%

5.4 growth

40%

2.5 growth

20%
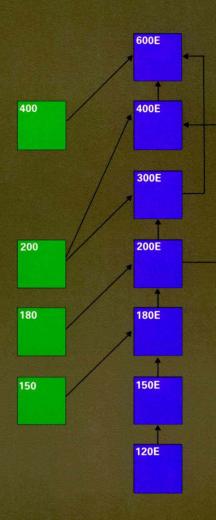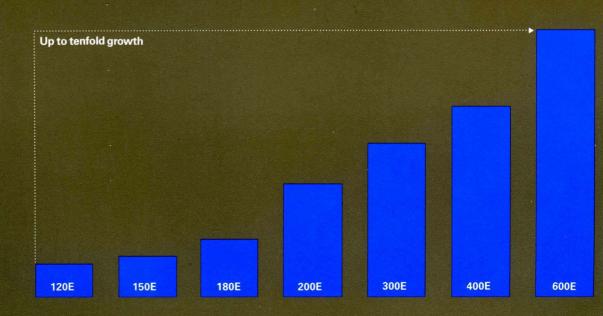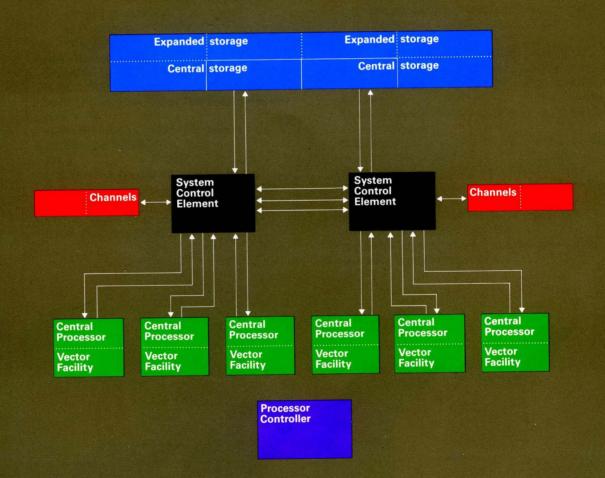
Years   5

Upgradability

- 3090 Models 150, 180, 200, and 400 are upgradable to enhanced models as you upgrade to meet growth requirements.
- Enhanced models establish new base for growth.

**IBM 3090 Commercial
Performance Comparison (IERR)**

From	To	Improvement
150	180E	1.6–1.7
180	200E	2.1–2.2
200	300E	1.6
200	400E	2.0–2.1
400	600E	1.5

600E

400

400E

300E

200

200E

180

180E

150

150E

120E

Up to tenfold growth

| 120E | 150E | 180E | 200E | 300E | 400E | 600E |

Configuration Flexibility

A variety of 3090 configuration features give you the flexibility you need to meet today's demanding operating requirements.

Configuration Features
- 3090 allows the definition of up to 48 control units attached to a channel path. 308X systems are limited to 16 control units.
- 3090 does not require contiguous channel numbers within a channel set, as required on the 308X.
- On the 3090, individual channel processors control the data flow for each channel. 308X system uses one microprocessor for eight channels.
- The 3090 channel subsystem implementation allows individual failing channels to be deconfigured and diagnosed while offline, without impacting the operation of non-failing channels.

Computing Power	Channels	Central storage – Mb	Expanded storage – Mb	Vector Facilities
	0 32 48 64 80 96 128	0 64 128 256	0 128 256 512 1024	0 6
Six-way processor 600E				
Four-way processor 400E				
Triadic processor 300E				
Dyadic processor 200E				
Uniprocessor 180E				
Uniprocessor 150E				
Uniprocessor 120E				

Today, computers are playing an increasingly vital role in the operations of most organizations. As a result, these systems must provide higher levels of availability than ever before. The IBM 3090 includes a range of features designed to meet this need.

Availability

- 3090 is designed to achieve improved availability over the 308X.
- The 3092 Processor Controller monitors the entire 3090 complex
  - Identifies failing field-replaceable units (FRUs).
  - Supports automatic error determination.
  - Includes Remote Support Facility (RSF).
- Dual Processor Controller, dual fault-tolerant, redundant design on the Model 150E and above.
- The IBM 3092 initiates IBM maintenance of the 3090 complex.
- The 3092 also automatically initiates a weekly transfer of microcode maintenance to the processor controller.
- More than 25% of 3090 circuits are for availability.
- Expanded storage with multibit error checking and correction
  - IBM double bit error correction-triple bit error detection code—U.S. Patent No. 4509172 (April 2, 1985)

- Extensive simulation techniques and computer-aided design are used in the development of the 3090.
- Increased error checking and correction code is added for better availability.
- The IBM 3090 allows MVS to dynamically deallocate a failing page in central storage on some double-bit failures. The job is not terminated and continues processing normally. This facility is not available on the 308X.
- The 3090 individual channel microprocessors with single-channel service provide increased 3090 diagnostic capabilities to detect and isolate channel errors for better system availability.
- Maintenance costs on similarly sized performance processors are lower for the 3090 than for the 308X.

The enhanced IBM 3090 processor models give you performance, growth, and availability features, designed to satisfy the requirements of today's competitive environment. At the same time, these processors have much in common with their predecessors, enabling you to build toward the future without sacrificing yesterday's investment.

The result is a high standard for quality and performance in large systems.
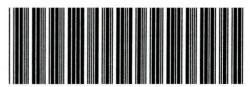
To learn more about the enhanced IBM 3090s and the many ways in which they can help meet the needs of your organization, talk to your local IBM marketing representative today.

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