IBM®

V51

The Evolution of IBM Mainframes and VM

Jim Elliott

zSeries® EXPO
FEATURING Z/OS, Z/VM, Z/VSE
AND LINUX ON ZSERIES

September 19 - 23, 2005   **San Francisco, CA**

2005-09-19

IBM

History and Evolution of IBM Mainframes

Jim Elliott

Advocate – Infrastructure Solutions
Manager – IBM System z9 and zSeries Operating Systems
IBM Canada Ltd.   ibm.com/vm/devpages/jelliott

History and Evolution of IBM Mainframes

- IBM mainframes have evolved for over 50 years. This presentation will cover the history of IBM mainframes from the IBM 701 through IBM S/360 to IBM eServer zSeries and the new IBM System z9. The evolution of CP/67 to z/VM will also be covered (with honorable mention of OS/360 to z/OS, DOS/360 to z/VSE and ACP to z/TCP).

- The speaker has worked for IBM for over 32 years including stints as an MVT, VM/370 and DOS/VS systems programmer, IMS application developer and product manager for VM, VSE and Linux for IBM Americas. Today Jim is responsible for all the System z9 and zSeries operating systems in addition to being the Advocate for Infrastructure Solutions for IBM Canada. As a result, he has 'hands-on' experience with most of IBM's mainframes over that period.

Reports of the death of the mainframe were premature

- **"I predict that the last mainframe will be unplugged on March 15, 1996."**
  – Stewart Alsop, March 1991

- **"It's clear that corporate customers still like to have centrally controlled, very predictable, reliable computing systems – exactly the kind of systems that IBM specializes in."**
  – Stewart Alsop, February 2002

Source: IBM Annual Report 2001
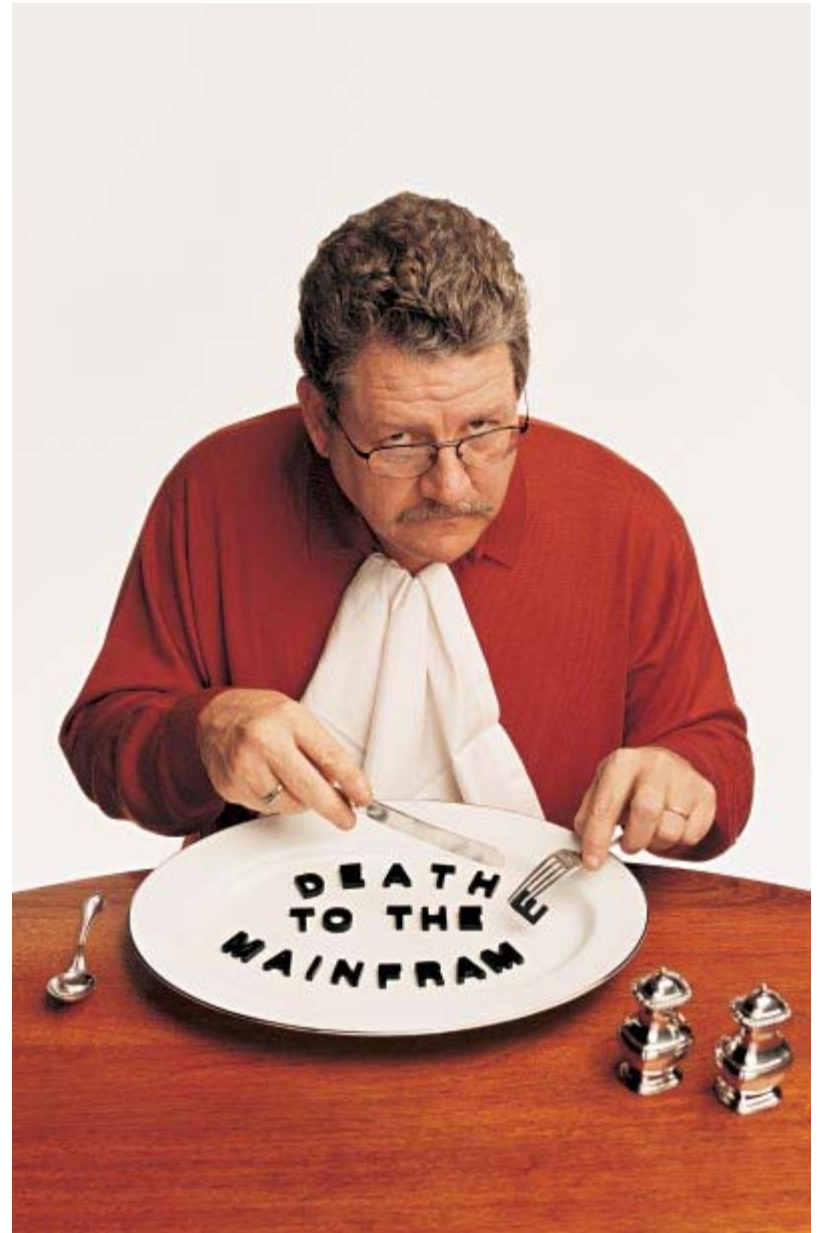
IBM

In the Beginning – The First Two Generations

The family tree – 1952 to 1964

- **Several mainframe families announced, designed for different applications**
- **Every family had a different, incompatible architecture**
- **Within families, moving from one generation to the next was a migration**
  - Common compilers made migration easier – COBOL and FORTRAN
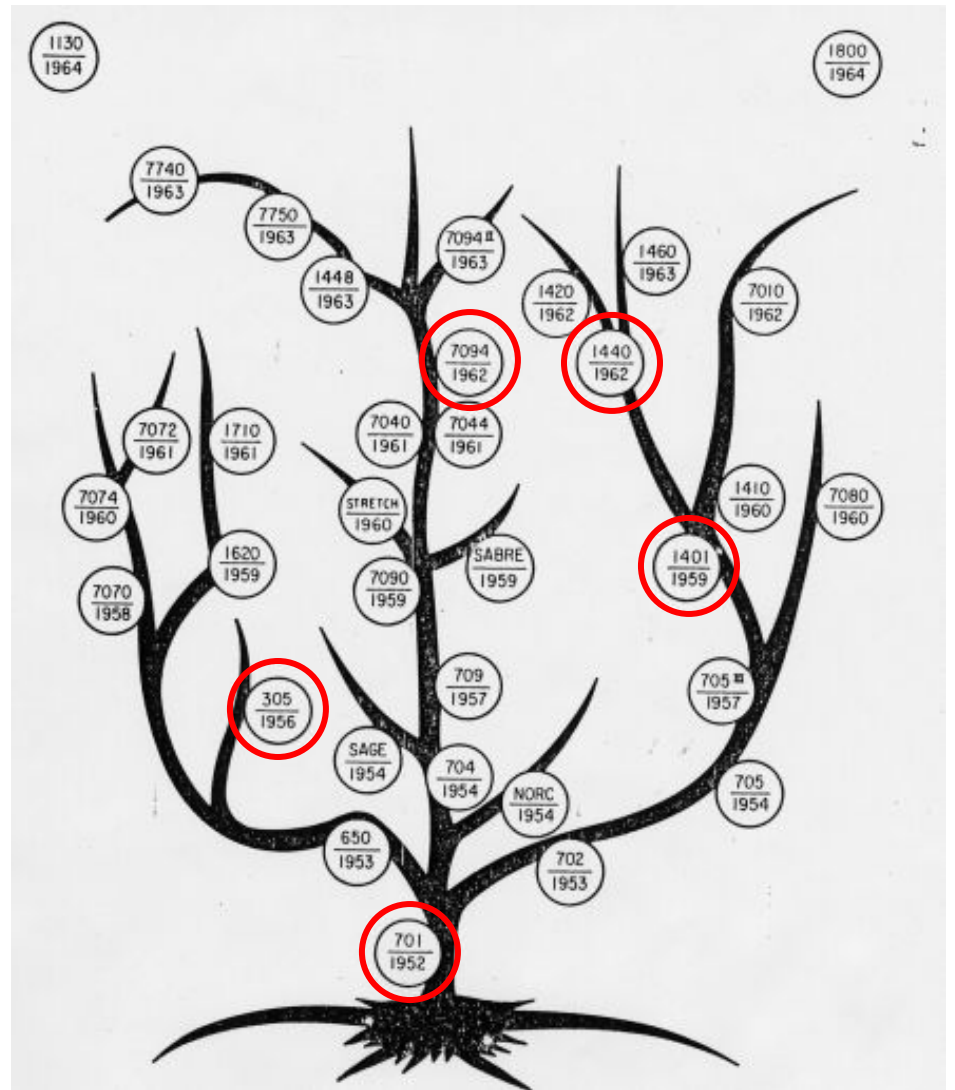
IBM 701 – 1952
1st generation

- **The first IBM large-scale electronic computer manufactured in quantity**

- **IBM's first commercially available scientific computer**

- **The first IBM machine in which programs were stored in an internal, addressable, electronic memory**

- **The first of the pioneering line of IBM 700 series computers, including the 702, 704, 705 and 709**

701

IBM 305 RAMAC – 1956
1st generation

- **The first computer to include a disk drive (named the IBM 350 Disk File)**

- **Prior to this magnetic computer storage had consisted of core memory, tape, and drums**

- **The 350 Disk File consisted of a stack of fifty 24" discs**

- **The capacity of the entire disk file was 5 million 7-bit characters, which works out to about 4.4 MB in modern parlance**


350 Disk
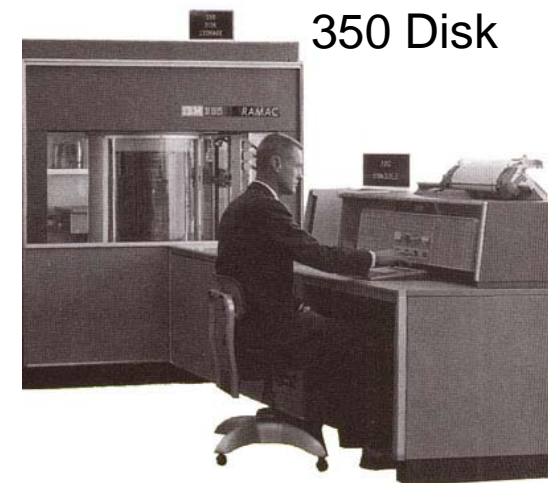
IBM 1401 – 1959
2nd generation

- **The all-transistorized IBM 1401 Data Processing System placed the features found in electronic data processing systems at the disposal of smaller businesses, previously limited to the use of conventional punched card equipment**

- **These features included: high speed card punching and reading, magnetic tape input and output, high speed printing, stored program, and arithmetic and logical ability**

1402   1401   1403   729
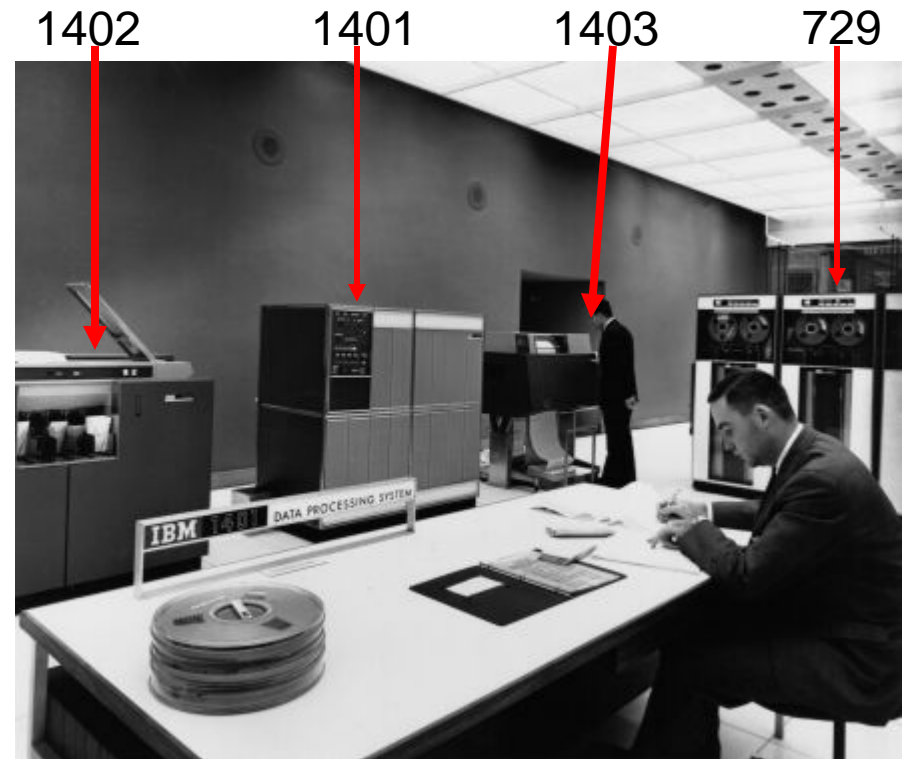
IBM 1440 – 1962
2nd generation

- **Low-cost system specifically designed to solve the increasing data handling problems of smaller volume businesses**

- **The 1440 met the need for a complete accounting system and offered the benefits of a business information system**

- **With a variety of models and special features available for the 1440, a system could be tailored to meet immediate data processing requirements and expanded to absorb increased demands**

1443   1441   1311
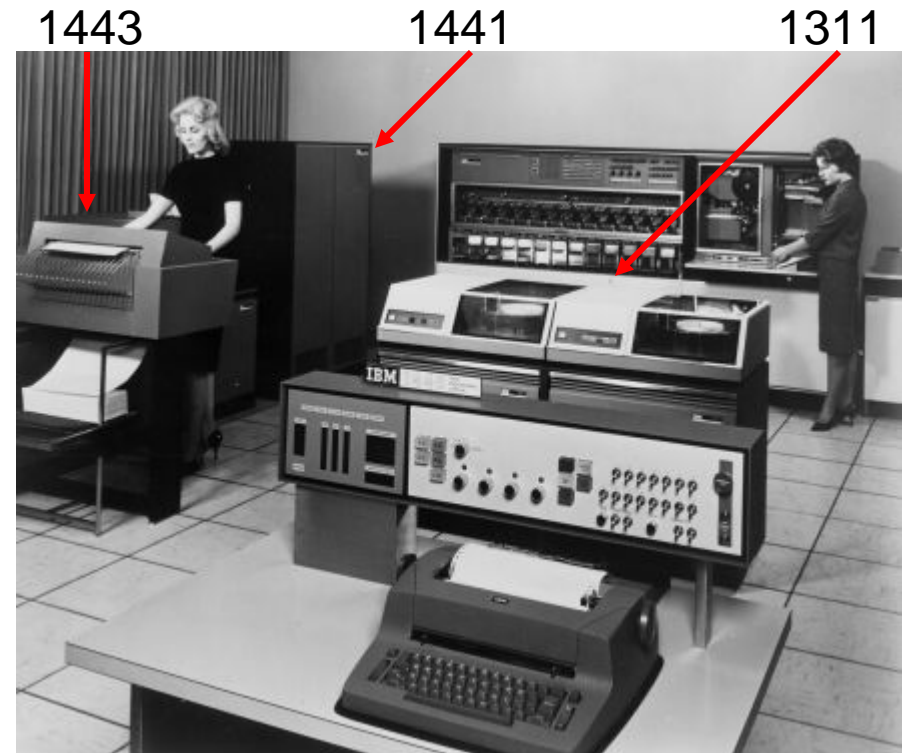
IBM 7094 – 1962
2nd generation

- **Built for large-scale scientific computing**

- **Compatible with the IBM 7090, the advanced solid-state IBM 7094 offered substantial increases in internal operating speeds and functional capacities**

- **New expanded functions provided with the IBM 7094 were: double-precision floating-point operations and seven index registers**

7094

The April 1964 Revolution – *3rd generation*

TECHNICAL CONFERENCES

During the 1950s, Data Processing came of age

- **Data Processing machines existed – sorters, collators, tabulators**
- **"Computers" were devoted almost entirely to the processing of computationally intensive tasks**
- **Demand for computers, as data processing machines, boomed and new machines were built to meet this demand**
- **Customers were getting very frustrated with migration costs that came with processor upgrades**

"[System/360] was the biggest, riskiest decision I ever made, and I agonized about it for weeks, but deep down I believed there was nothing IBM couldn't do."

Father, Son & Co. 1990
Tom Watson, Jr.
IBM President 1952
IBM President and CEO 1956
IBM Chairman and CEO 1961-1971

System/360 – Announced April 7, 1964

- **IBM decided to implement a wholly new architecture specifically designed both for data processing and to be compatible across a wide range of performance levels**

- **IBM invested $5B to develop a family of five increasingly powerful computers that run the same operating systems and can use the same 44 peripheral devices with the same architecture**

  - Architecture published in the S/360 Principles of Operation
  - 24-bit addressing (32-bit architecture)
  - Solid logic circuit cards

S/360-75

2401

2311
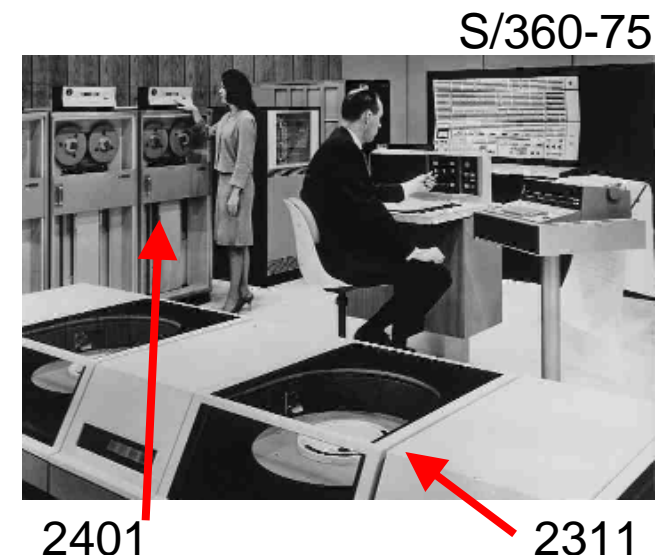
System/360 – a child is born

- **Hardware**
  - One main storage, maximum size is 16MB
  - One or two Central Processing Units (CPUs)
  - One to seven Channels
    - Selector or Byte Multiplexor
    - Block Multiplexor
  - Control Units (which connect to Channels)
  - Devices (which connect to Control Units)
- **Family of operating systems**
  - Operating System/360 (OS/360)
  - Disk Operating System/360 (DOS/360)
  - TOS, BPS, …
  - ACP

S/360 Model 65 Console
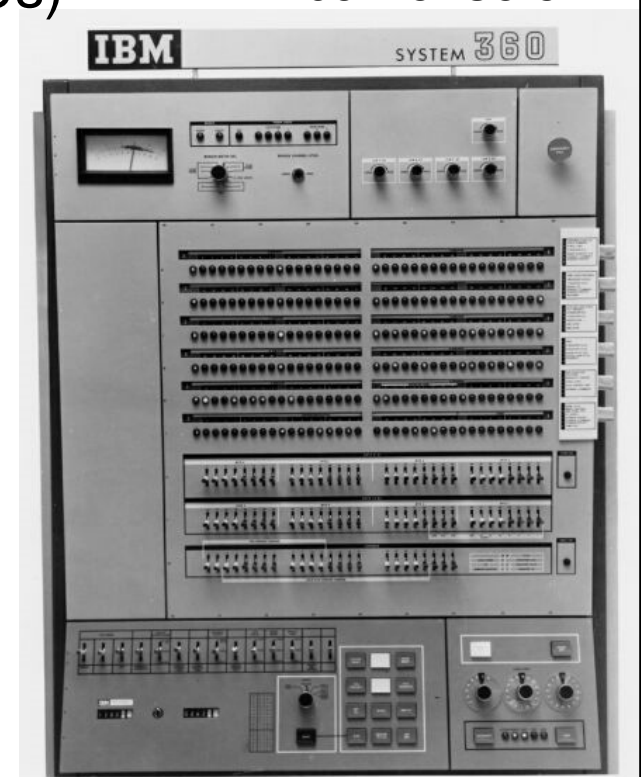
Core Memory

S/360 family

Model	Announced	First Shipped	
30	April 7, 1964	June, 1965	
40	April 7, 1964	April, 1965	
50	April 7, 1964	August, 1965	
20*	November 18, 1964	April, 1966	
65	April 22, 1965	November, 1965	
75	April 22, 1965	January, 1966	
44	August 16, 1965	June, 1966	
67	August 16, 1965	May, 1966	Virtual storage
91	January 18, 1966	October, 1967	
25	January 3, 1968	October, 1968	
85	January 30, 1968	December, 1969	High speed cache
195	August 20, 1969	March, 1971	

System/360 Model 20
1966

- Special purpose "entry level" S/360
- 24K of core memory
- Half the registers of other models
- Instruction set that was not binary-compatible with the rest of the S/360 family
- Popular as an RJE workstation

System/360 Model 67

- **First IBM system with virtual storage capabilities**
  - S/360 Model 65 with addition of the Dynamic Address Translation facility

- **Operating systems**
  - Time Sharing System – The "official" operating system from IBM Data Systems Division
  - Control Program/67 with the Cambridge Monitor System – The "unofficial" operating system from the IBM Cambridge Scientific Center

S/360-67

"DAT box"

University of Newcastle Upon Tyne

System/370 – Announced June 30, 1970

- **Compatible upgrade from S/360**
- **370 Model 145 is the first computer with fully integrated monolithic memory (circuits in which all of the same elements – resistors, capacitors and diodes – are fabricated on a single slice of silicon) and 128-bit bi-polar chips**
- **New peripherals**
  - 3330/3340/3350 disk
  - 3211 printer

> **"We are confident that the performance of System/370, its compatibility, its engineering and its programming will make it stand out as the landmark for the 1970s that System/360 was for the Sixties."**
>
> **Tom Watson, Jr.**
> **IBM Chairman and CEO**
> **1961-1971**

System/370 with Virtual Storage – Announced August 2, 1972

- **Compatible upgrade from S/370 with virtual storage**

- **First multiprocessor models (158MP, 168MP)**

- **Family of operating systems**
  - OS/360 ➔ OS/VS
  - DOS/360 ➔ DOS/VS
  - CP/67 ➔ VM/370

3850　　　　S/370-148　　　3705　　　3350

3505　　　　　3203　　　　　3525　　　3270
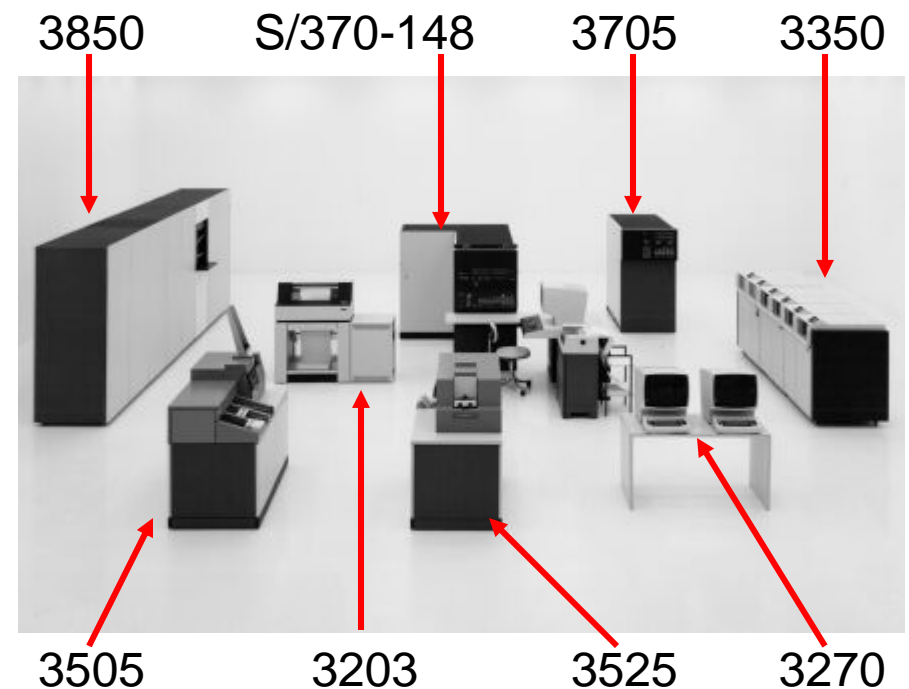
S/370 – the architecture matures

- **Virtual storage**
  - 2KB or 4KB pages of memory
  - 64KB or 1MB segment sizes
  - Translation of virtual addresses to real addresses using Dynamic Address Translation (DAT) logic
  - Segment tables point to page locations
- **Channel architecture**
  - 256 channels
- **CPU changes**
  - Extended MP support via CPU address

3033

3031

S/370 family

Model	Announced	First Shipped	Replacement
155	June 30, 1970	January, 1971	158
165	June 30, 1970	April, 1971	168
195	June 30, 1970	August, 1973	
145	September 23, 1970	June, 1971	148
135	March 8, 1971	April, 1972	138
158	August 2, 1972	April, 1973	3031
168	August 2, 1972	May, 1973	3033
125	October 4, 1972	April, 1973	4331/4361
115	March 13, 1973	March, 1974	4331/4361
138	June 30, 1976	November, 1976	4341/4381
148	June 30, 1976	January, 1977	4341/4381

Virtual storage capable models

System/370 with Extended Architecture

- **Evolution of S/370**

3083

- **3081 introduced Thermal Conduction Modules**

- **New peripherals**
  - 3800 printer
  - 3370/3380 disk
  - 3480 tape

- **Family of operating systems**
  - OS/VS ➔ MVS/SP ➔ MVS/XA
  - DOS/VS ➔ VSE/SP
  - VM/370 ➔ VM/SP, VM/SP HPO
  - VM/370 ➔ VM/XA MA ➔ VM/XA SF ➔ VM/XA SP

370-XA – radical surgery for the architecture

- **Extended storage addressing**
  - 24-bit or 31-bit addressing
  - 4KB pages in 1MB segments
- **Interpretive execution facility**
  - Start Interpretive Execution (SIE) instruction
  - SIE runs until interception condition raised
  - Used by VM/XA
  - Multiple High Performance Guest Support Facility (MHPGSF) to support V=F guests on VM/XA SP
    - Rename Processor Resource/Systems Manager (PR/SM) when Logical Partitions (LPAR) announced
- **370-XA channel design**
  - CHPIDs
  - Subchannels

System/370 with Enterprise Systems Architecture

- **Extension of 370-XA**
  - Expanded Storage
  - Multiple 31-bit address spaces
- **Common set of peripheral devices**
  - 3390 disk
  - 3490 tape
- **Family of operating systems**
  - MVS/XA ➔ MVS/ESA
  - VSE/SP ➔ VSE/ESA
  - VM/XA SP ➔ VM/ESA

3090

9672-G5

System/390 with Enterprise Systems Architecture – Announced September 1990

- **Evolution of ESA/370**
- **1994 – S/390 Parallel Transaction Server**
  - Family of CMOS processors
- **1998 – System/390 Generation 5 server – more than 1,000 MIPS**
- **1999 – System/390 Generation 6 server – copper chip technology**
- **Common set of peripheral devices**
  - RAMAC, Enterprise Storage Subsystem disk
  - 3590 Magstar tape
- **Family of operating systems**
  - MVS/ESA ➜ OS/390
  - VSE/ESA
  - VM/ESA
  - Linux for S/390 (December 1999)

ES/9000

S/370 to ES/9000

115/125	138/148	158/168
▼	▼	▼
4331 ➜ 4321	4341	3031/3032/3033
▼	▼	▼
4361	4381	3081/3083/3084
▼	▼ upgrade	▼
9370	4381-E	3090
▼ upgrade	▼	▼ upgrade
9221	9121	9021

Parallel Transaction Server to G6

1994-04-06	9672-Enn, 9672-Pnn	Parallel Transaction Server
1994-09-13	9672-Rn1	Parallel Enterprise Server
1995-06-12	9672-Rn2, 9672-Rn3	
1996-09-10	9672-Rn4	G3
1996-09-10	2003	Multiprise 2000
1997-06-09	9672-Rn5	G4
1998-06-23	9672-nn6	G5
1999-09-20	7060	Multiprise 3000
1999-05-03	9672-nn7	G6

zSeries with z/Architecture – Announced October 2000

zSeries 900

- **Evolution of ESA-390**
  - 24-bit, 31-bit, and 64-bit addressing supported concurrently
  - z900 – up to 16 processors
  - z800 – up to 4 processors
    - Linux-only model in January 2002
    - General purpose model in February 2002
      - Integrated Facility for Linux on z900/z890
- **Family of operating systems**
  - OS/390 ➜ z/OS
  - VSE/ESA ➜ z/VSE
  - VM/ESA ➜ z/VM
  - TPF ➜ z/TPF
  - Linux for S/390 ➜ Linux for zSeries

zSeries Enhanced

- **May 2003**
  - z990 – up to 32 processors – configurable as CPs, IFLs, SAPs
  - Up to 256GB memory

- **October 2003**
  - The Mainframe Charter

- **April 2004**
  - z890 – up to 4 configurable processors
  - zSeries Application Assist Processor

- **October 2004**
  - Crypto Express 2

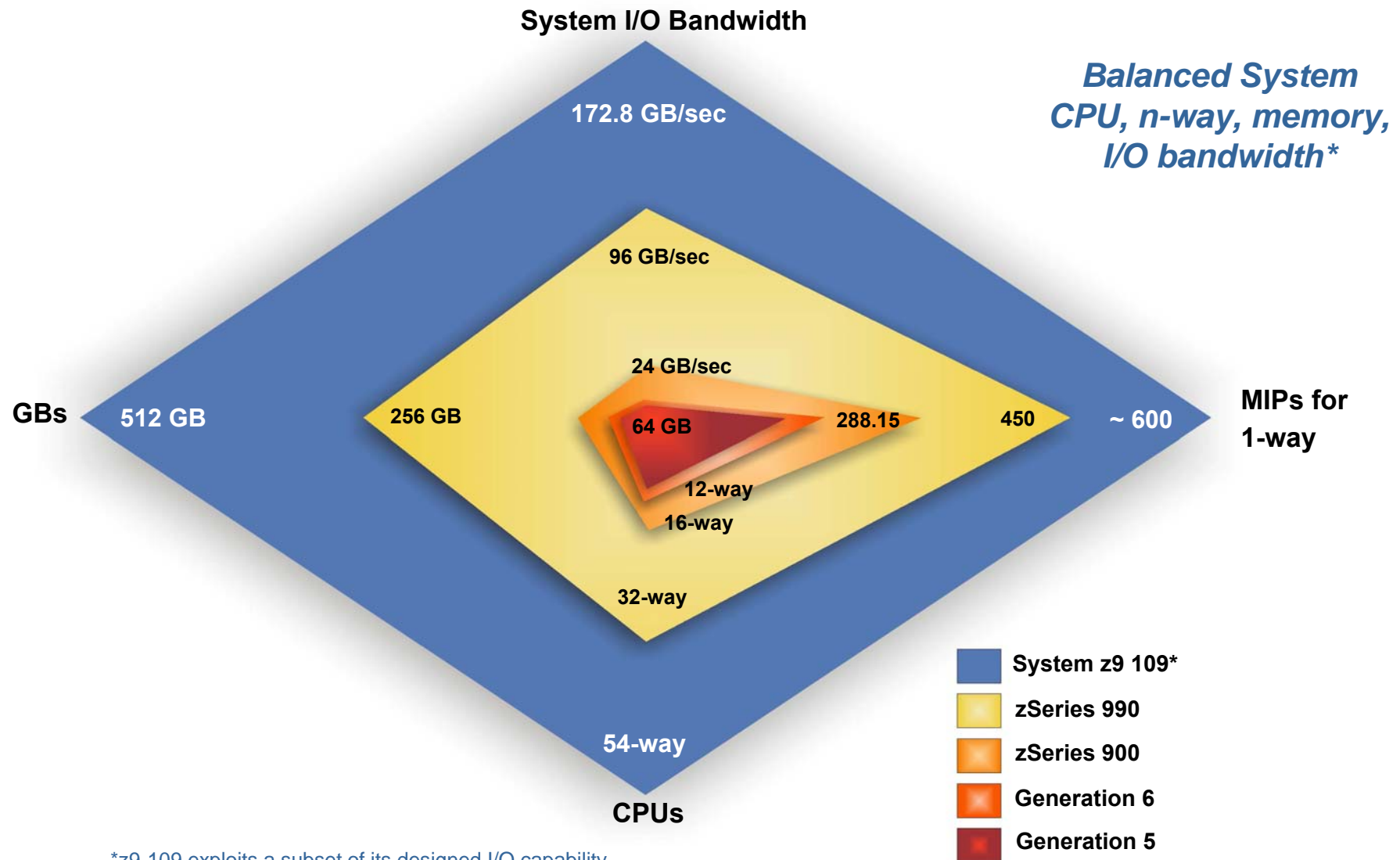- **January 2005**
  - FICON Express 2

zSeries 990

System z9 – Announced July 26, 2005

- **IBM System z9 109 (z9-109) delivers excellence in large scale enterprise computing and is designed and optimized as the hub of the on demand enterprise**
- **Built on more than 40 years as an industry-acknowledged leader and taking that leadership to new levels**
  - Scalability
  - Availability and security
  - Balanced system design
  - Virtualization technology
- **Breaking new ground**
  - Designed to minimize outages to help your business stay always on
  - Greater scalability and performance to grow with your business
  - Flexibility to enable efficient response to your business needs

System z9 and zSeries: Balanced System Design

System I/O Bandwidth

*Balanced System
CPU, n-way, memory,
I/O bandwidth**

172.8 GB/sec

96 GB/sec

24 GB/sec

GBs

512 GB

256 GB

64 GB   288.15   450   ~ 600

**MIPs for
1-way**

12-way

16-way

32-way

54-way

CPUs

	System z9 109*
	zSeries 990
	zSeries 900
	Generation 6
	Generation 5

*z9-109 exploits a subset of its designed I/O capability

9672-G5 to eServer zSeries to System z9

1998-06-23   9672-nn6   G5

1999-05-03   9672-nn7   G6

2000-10-03   2064-1nn   z900

2002-04-30   2064-2Cn   z900 *Turbo*

2002-02-19   2066   z800
                          (Linux only model 2002-01-29)

2003-05-13   2084   z990

2004-04-07   2086   z890

2005-07-26   2094   System z9 109

CP/67 to z/VM Version 5 – The Evolution of Mainframe Virtualization Technology

CP-67

- **CP/CMS conceived in 1964 as a 2nd generation time-sharing system for S/360**
- **Influenced by Compatible Time-Sharing System (CTSS) from MIT on a modified 7094**
- **Key concept was that resource management (CP) and user support (CMS) were split**
- **Internal as CP-40 on a modified S/360-40 in 1966**
- **External as CP-67 on the S/360-67 later in 1966**
  - "Type III" product – no charge

VM/370

- **Announced August 2, 1972 to assist customers in migration from OS/360 to OS/VS**
  - System Control Programming (no-charge product)
  - Six releases through 1979
- **Basic System Extensions (BSEPP) and System Extensions (SEPP) products available for VM/370 R5 and R6**
  - Major functional enhancements were now chargeable

IBM

Data Processing Division **Program Announcement**

VM/370 PROVIDES VIRTUAL MACHINE, VIRTUAL STORAGE, AND TIME SHARING SUPPORT FOR SIX SYSTEM/370 MODELS

SCP 5749-010

Virtual Machine Facility/370 (VM/370) is System Control Programming for System/370 Models 135, 145, 155 II, 158, 165 II and 168.

Its major functions are:

- Multiple concurrent virtual machines with virtual storage support.
- Time sharing support provided by a conversational subsystem.

Role in Advanced Function Announcement

VM/370 is complementary to OS/VS2, OS/VS1 and DOS/VS, offering our customers extended capabilities and additional virtual storage-based functions.

Oriented to the on-line environment, VM/370 can be a significant assist in the development and installation of new applications, and can help justify additional equipment through satellite systems, additional storage and I/O, and CPU upgrades. Use it to help move your customers to virtual storage systems, and to help them grow when they get there.

VM/370 Highlights

- Virtual machine, virtual storage, and time sharing support.
- The execution of multiple concurrent operating systems, including DOS, DOS/VS, OS/MFT, MVT, VS1.and VS2, and VM/370 itself.
- Virtual storage facilities for operating systems which do not support Dynamic Address Translation, such as OS/MFT.
- A general-purpose time sharing system suitable for both problem solving and program development, available to customers beginning with a 240K byte Model 135.
- Capability of running many types of batch problem-solving applications from a remote terminal with no change in the batch program.
- Up to 16 million bytes of virtual storage available to each user.
- Capability of performing system generation, maintenance, and system testing concurrent with other work.

- A high degree of security, isolation, and integrity of user systems.
- The ability for many users to test privileged code in their own virtual machines.
- An aid in migrating from one operating system to another.
- Device address independence for all supported operating systems.
- Multiple forms of disk protection, e.g., preventing users from writing and/or accessing specific disks.
- Ability to use virtual machines to provide backup for other systems.
- Options to improve the performance of selected virtual machines.
- Ability to run many System/370 emulators in virtual machines.

Customers who should consider VM/370

- Large, multi-system users: satellite systems for virtual machine applications and on-line program development.
- Customers not yet large enough to utilize TSO and who are interested in on-line program development and/or interactive application programs.
- Universities, colleges, and schools: time sharing applications for students, faculty, research and administration.
- Users of non-IBM systems: VM/370 is a strong new IBM entry with many advanced functional capabilities.
- Customers considering conversion from DOS to OS or OS/VS: VM/370 can assist through its virtual machine function, and can supplement the DOS emulator available with OS systems.
- Mixed systems or mixed release installations, including those using PS/44 or modified back releases of DOS or OS.
- Customers with high security requirements: operating applications in separate virtual machines may provide an extra measure of security.
- Current CP/67 users: the features of the virtual storage-based Control Program 67/Cambridge Monitor System (CP-67/CMS), originally designed and implemented in 1968 for use on the System/360 Model 67, have been refined and improved to form the foundation for VM/370.

Description

VM/370 is a multi-access time shared system with two major elements:

- The Control Program (CP) which provides an environment where multiple concurrent virtual

machines can run different operating systems, such as OS, OS/VS, DOS and DOS/VS, in time-shared mode.
- The Conversational Monitor System (CMS) which provides a general-purpose, time-sharing capability.

Multiple Concurrent Virtual Machines

The control program of VM/370 manages the resources of a System/370 to provide virtual storage support through implementation of virtual machines. Each terminal user appears to have the functional capabilities of a dedicated System/370 computer at his disposal. Multiple virtual machines may be running conversational, batch, or teleprocessing jobs at the same time on the same real computer. A user can define the number and type of I/O devices and storage size required for his virtual machine application provided sufficient resources are available with the real machine's configuration.

A customer can concurrently run many versions, levels, or copies of IBM operating systems under VM/370, including DOS, DOS/VS, OS, OS/VS, and VM/370 itself. (See sales manual pages for the major restrictions pertaining to the operation of systems in virtual machines.)

The capability of running multiple virtual machines should assist the customer in scheduling multiple operating systems and various mixes of production jobs, tests, program maintenance, and FE diagnostics. It can aid new systems development, reduce the problems of converting from one operating system to another, and provide more economical backup facilities.

Time Sharing

The Conversational Monitor System (CMS) component of the VM/370 system provides a general-purpose, conversational time sharing facility that is suitable for general problem solving and program development, and can serve as a base for interactive applications.

CMS, specifically designed to run under VM/370, provides broad functional capability while maintaining a relatively simple design.

CMS can help programmers become more productive and efficient by reducing unproductive wait time. CMS also allows non-programmers such as scientists, engineers, managers, and secretaries to become more productive via its problem-solving and work-saving capabilities. CMS gives the user a wide range of functional capabilities, such as; creating and maintaining source programs for such operating systems as DOS and OS on CMS disks; compiling and executing many types of OS programs directly under CMS; setting up complete DOS or OS compile, linkedit and execute job streams for running in DOS

or OS virtual machines; and transferring the resultant output from those virtual machines back to CMS for selective analysis and correction from the user's remote terminal.

Service Classification

VM/370 is System Control Programming (SCP).

Note: VM/370 does not alter or affect in any way the current service classification of any IBM operating system, language, program product, or any other type of IBM program while under the control of VM/370.

Language Support for CMS

A VM/370 System Assembler is distributed as a part of the system and is required for installation and maintenance. All necessary macros are provided in CMS libraries.

The following is distributed with VM/370 as a convenience to the customer but is not part of the SCP.

A BASIC language facility consisting of the CALL-OS BASIC (Version 1.1) Compiler and Execution Package adapted for use with CMS. This facility will receive Class A maintenance by the VM/370 Central Programming Service.

The following program products may also be ordered for use with CMS:

OS Full American National Standard COBOL V4 Compiler and Library	5734-CB2
OS Full American National Standard COBOL V4 Library	5734-LM2
OS FORTRAN IV (G1)	5734-FO2
OS FORTRAN IV Library Mod I	5734-LM1
OS Code and Go FORTRAN	5734-FO1
OS FORTRAN IV H Extended	5734-FO3
OS FORTRAN IV Library Mod II	5734-LM3
FORTRAN Interactive Debug	5734-FO5
OS PL/I Optimizing Compiler	5734-PL1
OS PL/I Resident Library	5734-LM4
OS PL/I Transient Library	5734-LM5
OS PL/I Optimizing Compiler and Libraries	5734-PL3

Further details on language support and execution-time limitations appear in the manual *IBM Virtual Machine Facility/370: Introduction*, and in the *Program Product* section of the sales manual.

Availability

VM/370 has a planned availability of November 30, 1972, supporting the Dynamic Address Translation facility on the System/370 Models 135 and 145. Planned support for certain advanced VM/370 facilities, other System/370 machines, and additional I/O devices will be via Independent Component Releases on the dates shown below.

ICR1, planned for April 1973, will support the System/370 Models 155 II, the 158, the Integrated

Release Date: August 2, 1972
Distribution: DP managers, marketing representatives and systems engineers
FE managers and program system representatives

P72-91

File Adapter Feature (4655) for 3330 Model 1 and 3333 Model 1 on the Model 135, and the following additional VM/370 facilities:

. The Virtual=Real and Dedicated Channel performance options.
. The virtual and real Channel-to-Channel Adapter.
. Support of OS/ASP in a VM/370 environment, effective with the availability of ASP Version 3.
. The 3811 Control Unit and the 3211 Printer.

ICR2, planned for August 1973, will support the CMS Batch Facility, the Model 168, and the Integrated Storage Controls (ISCs) for the 158 and 168.

ICR3, planned for December 1973, will support the 165 II.

See the respective program product announcement letters for planned availability of the program products for CMS.

Note: VM/370 requires the system timing facilities (i.e., the Clock Comparator and the CPU Timer).

Maintenance

Maintenance for VM/370 Release 1 will be provided by the VM/370 Central Programming Service until nine months after the next release of VM/370.

Education

See Education Announcement Letter E72-14 for details of VM/370 Introduction (no charge) and additional educational plans.

Publications

IBM Virtual Machine Facility/370: Introduction (GC20-1800), is available from Mechanicsburg. Other manuals to be available at a later date include logic manuals, as well as planning, system generation, command language, system operator, terminal user, and programmer guides. Titles and form numbers will be announced in a future Publications Release Letter (PRL).

Reliability, Availability and Serviceability (RAS)

VM/370 provides facilities which supplement the reliability, availability, and serviceability (RAS) characteristics of the System/370 architecture. See the sales manual or the introduction manual for details.

MINIPERT

VM/370 planning information is available in the MINIPERT Master Library as an aid to selling and installing System/370.

No RPQs will be accepted at this time.

Detailed information on the VM/370 system is in sales manual pages.

W. W. Eggleston
Vice President, Marketing

VM/SP

- **VM/SP R1**
  - Announced 1980/02/11, GA 1980/12/12
  - MP, enhanced AP, CCS, EXEC2, SCIF, IUCV
  - 3278-5, 3279, 3380 data streaming, 3800

- **VM/SP R2**
  - Announced 1981/10/21, GA 1982/09/02
  - Programmable Operator (PROP)
  - SENDFILE, RECEIVE, RDRLIST, FILELIST, EXECIO

- **VM/SP R3**
  - Announced 1983/03/17, GA 1983/11/18
  - REXX, XEDIT, *BLOCKIO, PER, CMSIUCV

SHARE, VM, and the teddy bear

- **The MVS Group had the turkey as their mascot**
  - Changed in the early 1980s to the eagle
- **At SHARE 60 in 1983 the VM Group decided to identify newcomers with yellow stickers and old timers with blue stickers, but no one could remember which was which**
- **Carol Jobusch bought a few hundred teddy bear stickers to identify the "warm, cuddly" old timers, and a mascot was born!**

VM/SP

- **VM/SP R4**
  - Announced 1984/08/22, GA 1985/11/06
  - SNA

- **VM/SP R5**
  - Announced 1985/10/07, GA 1987/06/17
  - APPC/VM, TSAF, CMS Session Services, AFP

- **VM/SP R6**
  - Announced 1987/10/20, GA 1988/12/31
  - Shared File System (SFS), Callable Services Library (CSL)

VM/SP High Performance Option

- **VM/SP HPO R1**
  - VM/SP R1 base, Announced 1981/10/21, GA 1982/03/27
  - Performance enhancements for 3081-D16

- **VM/SP HPO R2**
  - VM/SP R1 base, Announced 1981/10/21, GA 1982/08/18
  - SPMODE support for MVS/SP V=R guests

- **VM/SP HPO R3**
  - VM/SP R2 base, Announced 1981/10/21, GA 1982/05/31
  - 32MB support, 3880-11 paging subsystem

VM/SP High Performance Option

- **VM/SP HPO R3.4**
  - VM/SP R3 base, Announced 1983/09/15, GA 1984/02/23
  - High performance paging subsystem

- **VM/SP HPO R4.2**
  - VM/SP R4 base, Announced 1985/02/12, GA 1986/02/28
  - SNA, Vector

- **VM/SP HPO R5**
  - VM/SP R5 base, Announced 1997/01/26, GA 1987/09/30
  - SPOOL file limit relief, performance enhancements

VM/XA Migration Aid and Systems Facility

- **VM/XA Migration Aid**
  - Tool to assist in migration from MVS/370 to MVS/XA
  - First use of Start Interpretive Execution (SIE)
  - R1 announced 1981-10-21, GA 1984-02-06
  - R2 announced 1984-02-15, GA 1984-10-31

- **VM/XA Systems Facility**
  - Support of CMS and production guest environments
  - Exploitation of SIE Assist for I/O performance
  - R1 announced 1985-02-12, GA 1985-09-30
  - R2 announced 1986-02-11, GA 1987-06-11

VM/XA SP

- **R1 announced 1987-06-11, GA 1988-02-15**
  - Large scale, bimodal CMS (24 and 31-bit)

- **R2 announced 1987-06-11, GA 1988-04-19**
  - SNA, US DoD C2 security evaluation

- **R2.1 announced 1989-10-24, GA 1989-12-29**
  - Support for production use in an LPAR

VM/ESA Version 1

- **V1.1 announced 1990-09-05, GA 1991-03-29**
  - Converged VM/SP, VM/SP HPO, VM/XA SP
- **V1.1.1 announced 1990-09-05, GA 1991-12-27**
  - CMS Pipelines
- **V1.2 announced 1992-06-16, GA 1992-12-18**
  - System configuration
- **V1.2.1 announced 1993-05-20, GA 1993-07-09**
  - Virtual disks
- **V1.2.2 announced 1994-04-06, GA 1994-06-10**
  - SPXTAPE, Minidisk cache, VMLINK, LOGON BY

VM/ESA Version 2

- **V2.1 announced 1994/09/13, GA 1995/10/27**
  - OpenEdition, CMS GUI

- **V2.2 announced 1996/09/10, GA 1996/12/20**
  - Year 2000, OSA/SF

- **V2.3 announced 1998/03/24, GA 1998/03/27**
  - TCP/IP, Java/NetRexx, LE (in base)

- **V2.4 announced 1999/05/24, GA 1999/07/23**
  - Dynamic CP exits

z/VM

- **V3.1 announced 2000-10-03, GA 2001-02-23**
  - Enabling 64-bit guest operating systems
  - Real storage constraint relief
  - Native FlashCopy support for Enterprise Storage Server
  - Connectivity enhancements for TCP/IP
- **V4.1 announced 2001-05-29, GA 2001-07-20**
  - New pricing structure
  - Support for the IBM Integrated Facility for Linux
  - Improved performance for Linux guests
  - "G5" technology and later ONLY

z/VM

- **V4.2 announced 2001-10-04, GA 2001-10-26**
  - HiperSockets high-speed internal TCP/IP network
  - Guest support for FICON CTCA communications
  - Guest LAN support
  - Ease-of-use functions for managing Linux images
- **V4.3 announced 2002-04-30, GA 2002-05-31**
  - Fibre Channel Protocol support
  - Simulation of a QDIO network adapter
  - TCP/IP stack security, performance and configurability
  - z/VM self-management to achieve guest performance goals
  - Better utilization of large real storage

z/VM

- **V4.4 announced 2003-05-13, GA 2003-08-15**
  - High-performance virtual FICON channel-to-channel adapters
  - Virtual LANs (VLANs)
  - External IP connectivity for Guest LANs through virtual switching
  - Improved logical-partitioning scalability due to logical channel subsystems
  - Twice the number of logical partitions (LPARs)
  - Better control, definition and dynamic reconfiguration of hardware I/O
  - Support for the new C/C++ for z/VM compiler

z/VM

- **V5.1 announced 2004-04-07, GA 2004-09-24**
  - New pricing model based on engine-based Value Units
  - Install, IPL, and operate from SCSI FCP disks
  - Install of z/VM from a DVD to SCSI FCP disks and to 3390 DASD
  - PCIX Cryptographic Coprocessor (PCIXCC) support
  - Enhanced virtual switch support
  - Internet Protocol Version 6 (IPv6) support
  - z/Architecture (64-bit) mode zSeries ONLY

z/VM

- **V5.2 announced 2005-08-26, GA 2005-12-16**
  - Constraint relief below the 2G address line
  - Improved performance of SCSI disk I/O
  - Support for OSA-Express2 CDLC connectivity to the IBM Communications Controller for Linux
  - SSL server support for current Red Hat and SUSE Linux distributions
  - Enhanced HiperSockets, FCP, and OSA-Express performance assists for z/VM guests
  - Crypto Express2 supported as an accelerator card for Crypto sharing among Linux and z/OS guests
  - Simplified user administration with the coordination of DirMaint and RACF changes
  - New Performance Toolkit reports

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System/360 and the new world of on demand business

The 360 Revolution
Chuck Boyer

http://ibm.com/eserver/zseries/timeline/
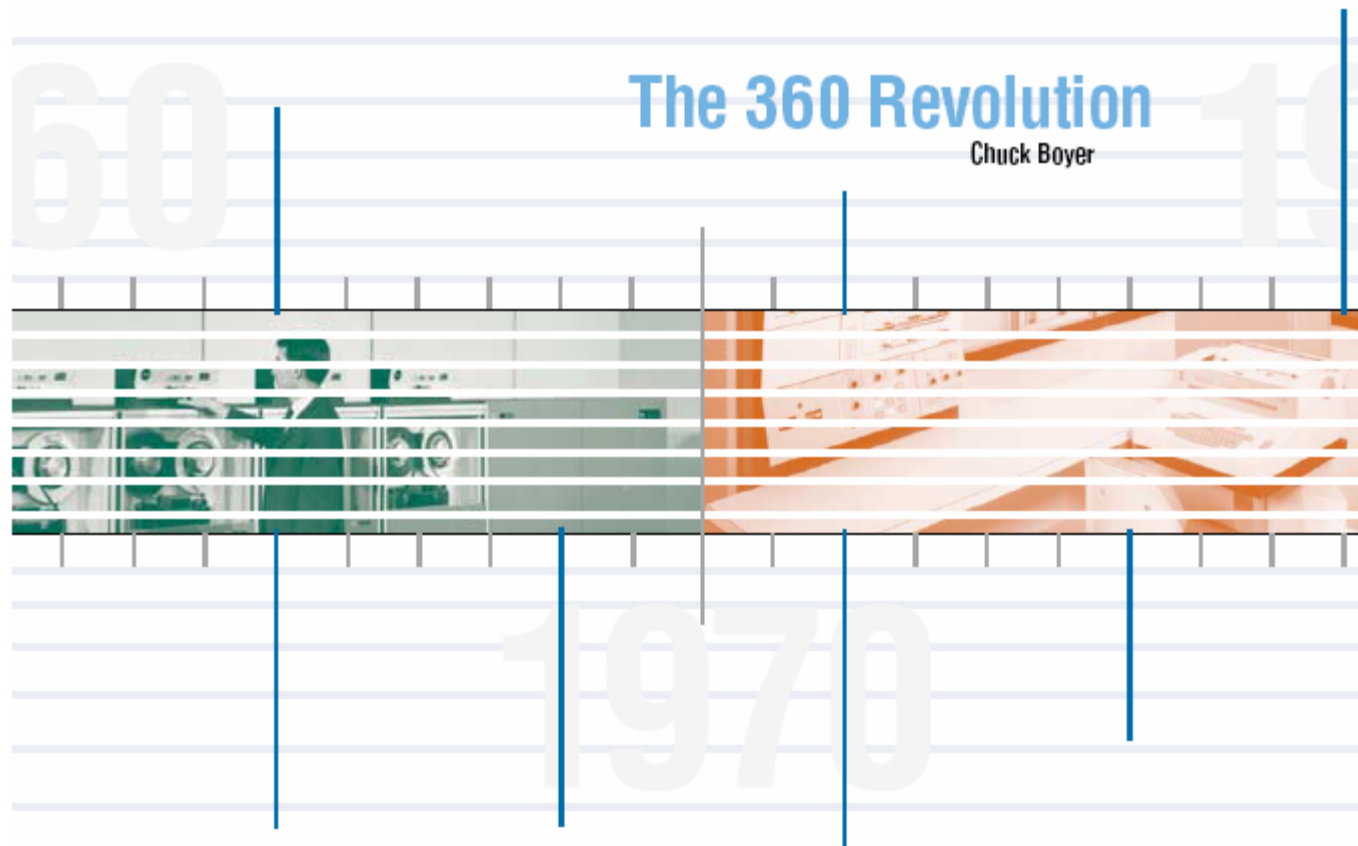
Summary

- **From System/360 in 1964 to today's System z9 and zSeries, we have seen an evolution that has preserved customer investments in a unique way**

- **From OS/360 to MVS to OS/390 to z/OS, we have seen an evolution of the operating system that is core to most corporate IT environments**

- **From CP/67 as a research project and VM/370 as a migration tool, VM has evolved to today's z/VM as the core of IBM's zSeries virtualization technology**
  - Virtualization is now considered "standard" in the industry and all virtualization solutions owe much to the VM family

"Legacy systems are systems that work!"

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Notices