**Siegfried Langer**

**Business Development Manager z/VSE and Linux on System z**

**IBM Germany Research & Development**

# zSY0455
# 50 Years of z/VSE – Still Going Strong

**2015**
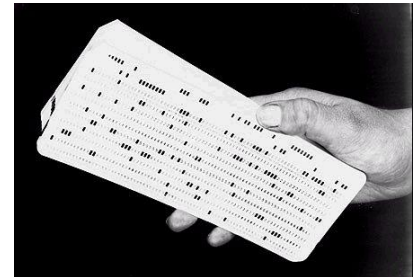IBM z Systems
Technical University
18-22 May | Dublin, Ireland

IBM

# The VSE history – a look into the past 50 years

- **How it began – DOS/360**

- **DOS/VS – added virtual storage capability**

- **DOS/VSE – "extended" version of DOS/VS**

- **SSX/VSE – Small System Executive**

- **VSE/SP – System Product**

- **VSE/ESA – 31-bit VSE version**

- **z/VSE – today's VSE**

# System/360 – Announced April 7, 1964

**In the most important product announcement in company history to date, IBM introduces the IBM System/360 - a new concept in computers which creates a "family" of small to large computers incorporating IBM-designed Solid Logic Technology (SLT) microelectronics and uses the same programming instructions. The concept of a compatible "family" of computers transforms the industry.**

"(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

# IBM System/360 – April 7, 1964
*Now one new computer fills all your data processing needs*

# How it began

- Plan was to deliver a single operating system, OS/360
- OS/360 project was falling behind schedule
- When finally released, a year late, it required at least 64 KB of memory

Source: Wikipedia

**IBM System/360 Model 30**

- Typical arithmetic operations per second:
  - Decimal add (5 + 5 digits)          13,300
  - Fixed point add (32 bits)          34,500
- Memory sizes:
  - 8K, 16K, 32K, 64K

| Model | Announced | First Shipped |
|-------|-----------|---------------|
| 30 | April 7, 1964 | June, 1965 |
| 40 | April 7, 1964 | April, 1965 |
| 50 | April 7, 1964 | August, 1965 |
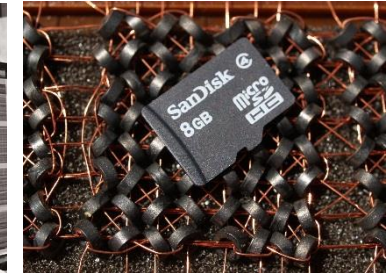
# DOS/360 – the first S/360 operating system

**DOS/360 became available in 1965**

- Designed for use of little memory
- Required approximately 6KB for system residence (supervisor)
- A minimum configuration consisted of
  - Model 30 with 16K memory
  - IBM 1052 printer keyboard
  - Card reader
  - Printer
  - Punch
  - One IBM 2311 disk drive (7.25 MB removable pack)

- User programming in
  - Macro Assembler
  - COBOL
  - Fortran
  - PL/I (designed for 32K systems)
  - RPG (Report Program Generator)
- One partition
  - Up to three with release 3
  - BTAM for telecommunications added with release 3



5

# Things back in 1965

- Relative worth of $ 1.00 from 1965 to 2014 is $ 7.50 (using the Consumer Price Index)
- Dow Jones Industrial Average = 969
- Average cost of new house $ 13,600
- Average income per year $ 6,450
- Gas per gallon 31 Cent
- Average cost of a new car $ 2,650

- The Mary Quant designed Mini Skirt appears in London
- Popular films
  - Mary Poppins
  - The Sound of Music
  - Goldfinger
  - My Fair Lady
  - Cat Ballou

Ladies High Fashion mid 1960's Boots
From $9.77 to $13.70

Sixties Pocket Transistor Radios $14.95

IBM

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# System/370

- **Virtual storage**
  - Translation of virtual to real addresses using Dynamic Address Translation (DAT) logic
- Compatible upgrade from S/360
- Fully integrated monolithic memory
- New I/O devices
  - 3330 Direct Access Storage (100 MB removable disk pack
  - 3420 Magnetic Tape Subsystem
  - 3505 Card Reader & 3525 Card Punch

| Model | Memory size | Announced | First Shipped |
|-------|-------------|-----------|---------------|
| 145 | 112K – 512KB | September 23, 1970 | June, 1971 |
| 135 | 96K – 256KB | March 8, 1971 | April, 1972 |
| 125 | 96K / 128KB | October 4, 1972 | April, 1973 |
| 115 | 64K / 96KB | March 13, 1973 | March 1974 |
| 138 | 512K – 1MB | June 30, 1976 | November 1976 |
| 148 | 1MB – 2 MB | June 30, 1976 | January 1977 |

# DOS/VS - DOS with Virtual Storage support

- Releases 28 → 34
- Up to 16 MB virtual storage
- 5 partitions (up to 7 in release 34)
- Linkage Editor, Relocation Loader for effective multiprogramming
- POWER for I/O spooling (**P**riority **O**utput **W**riters, **E**xecution Processors, and Input **R**eaders)
- New VSAM file system
- 'DBDC' → CICS and DL/I



Processing Jobs A – E Without and With POWER/VS



System/370 DOS/VS     IBM

9
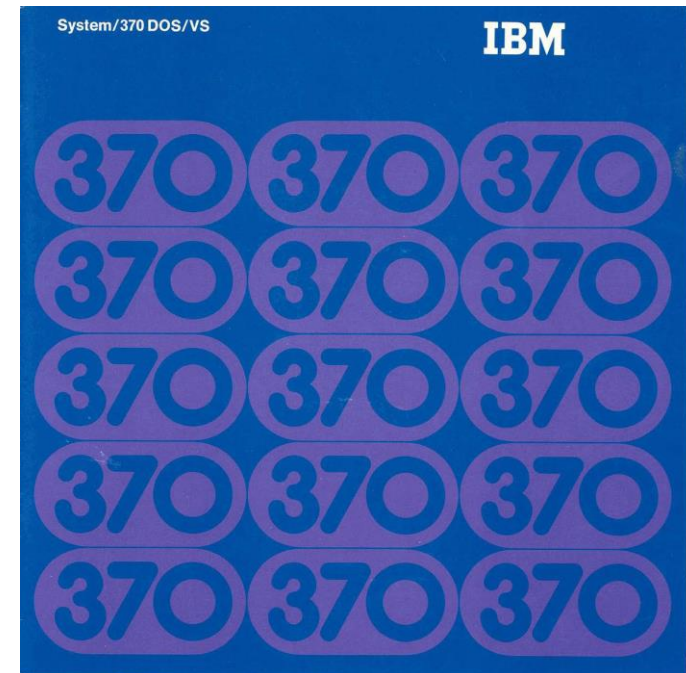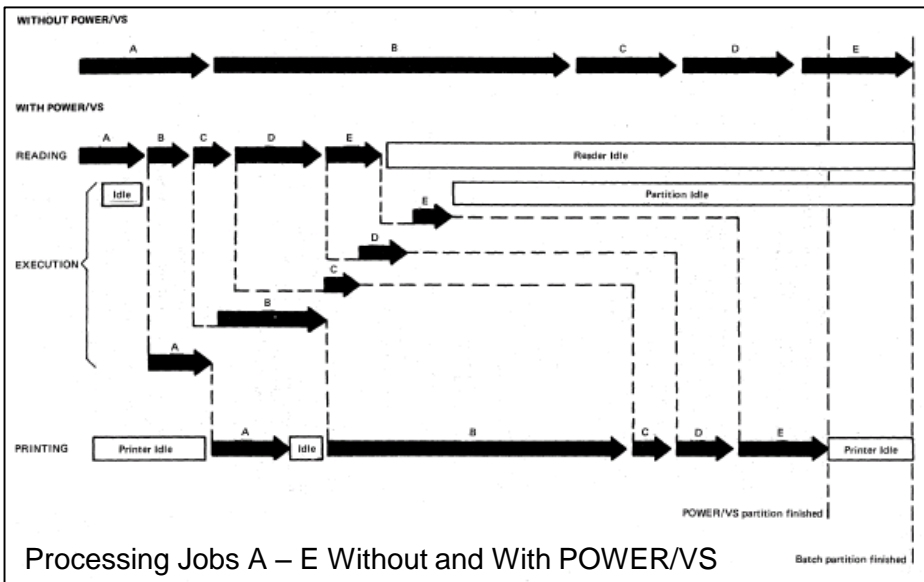
# VSE development mission moved
# from Endicott, NY to Boeblingen, Germany

# My first encounters with VSE

- Joint IBM in 1974 as Customer Engineer in Essen, Germany
- Initially serviced clients with IBM System/370 Model 125 and 115
- DOS/VS Release 29
- Operating system software, support, and 24x7 service was part of the monthly rental charge
- Different transaction monitors used – all moving to CICS later
- Main workload was batch processing
- Punched cards used for job control (JCL statements)
- Several clients still used punched cards for inventory control
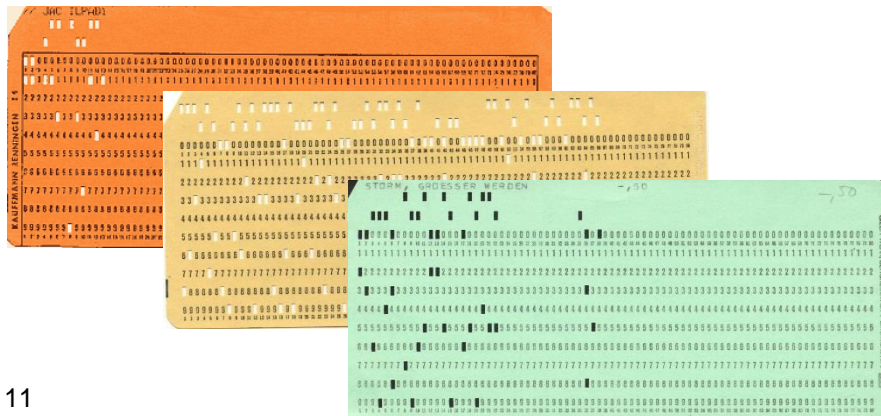
# The VSE history

- **How it began – DOS/360**

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# IBM 4300

- Compact design and significantly reduced power and cooling requirements

- 4331 and 4341
  - High-density logic chips with up to 704 circuits
  - 64,000 bit memory chips
    - 0.5 and 1 MB memory on 4331
    - 2 and 4 MB memory on 4341

- 4361 and 4381
  - Very Large Scale Integration (VLSI) technology
  - Engineering/Scientific features
  - Extended Control Program Support (ECPS) facilities for improved performance
  - 4361: 2 to 12 MB memory
  - 4381: up to 16 MB on Model Group 1 and up to 32 MB with dual processors (Model Group 2&3)

4331

4361

4341

4381
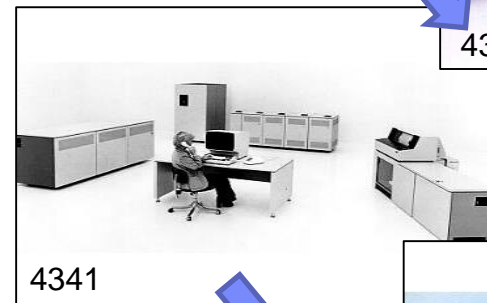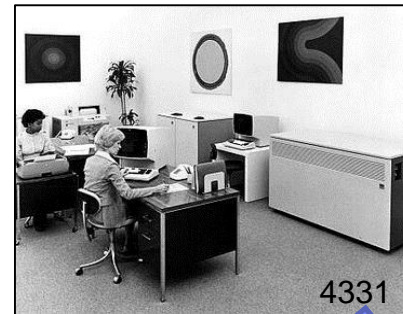
# DOS/VSE – "extended" version of DOS/VS

- Up to 12 partitions
- ICCF - Interactive Interface as an integral part of VSE
- ACF/VTAM became a component of VSE
- Maintain System History Program (MSHP) to install programming packages, APAR/local fixes, and service tapes
- Support of FBA disk devices
- Last free version of DOS

- In 1979, an imaginary DOS/VSE customer might have
  - a 4331 system with 512K bytes main memory
  - 6 IBM 3310 FBA disk drives (65 MB per drive) or
  - 4 IBM 3340 CKD disk drives (35/70 MB removable packs)
  - 2 IBM 8809 reel-to-reel tape drives
  - 1 IBM 3203 line printer

- Use of punched cards began to fade

IBM 3340 disk pack

IBM 3310

14
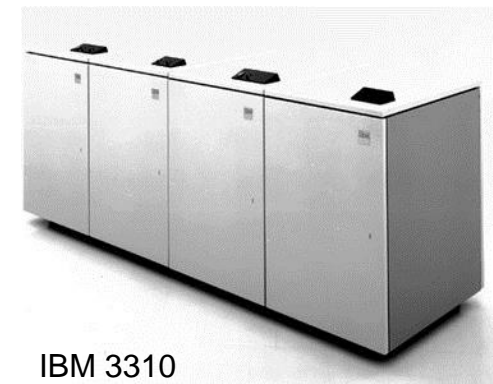
# SSX/VSE - Small System Executive

- A pre-generated, pre-configured VSE operating system for the 4321, 4331, 4341, and 4361 systems
- Designed for ease of installation, operation and use
- SSX/VSE consists of VSE components and unique prompters and aids
- Tested as a single product including
  - Assembler, POWER, CICS/VS, ICCF, IPF, ACF/VTAM, VSE/VSAM, Sort/Merge, DITTO, Fast Copy, OCCF, IPCS, COBOL
  - plus optional products

- SSX integration approach was too rigid for most customers
- VSE/SP refined the concept

# IBM ES/9370

- Designed to operate in an office environment
- Packaged for 19-inch racks
- Main memory ranged from 4 MB to 16 MB
- Different models with 0.5 to 1.4 MIPS
- New rack mounted devices
  - IBM 9332 or 9335 FBA disk
  - IBM 9347 Tape

- In 1987 new CMOS technology based IBM ES/9370 models were announced
  - 0.7 MIPS to 1.3 MIPS
  - Replacing Bi-polar technology with CMOS at the low end
- First CMOS implementation on mainframe



**IBM ES/9370
VLSI PROCESSOR CHIPS**
1 Micron CMOS Technology
Three Layers of Metal

**Processor**
200,000 Transistors
3,500 cm of Wiring
283,000 Layer Connections

**Cache**
800,000 Transistors
1,800 cm of Wiring
500,000 Layer Connections

Laboratory Böblingen

# VSE/SP – System Product

- Integrated, pre-packaged VSE system
- 'SIPO' concept (System Installation Productivity Option)
- Fast Service Upgrade (FSU) made release-to-release migration simpler

VSE/SP V3 (1987):

- Packaging concept of 'Base' and 'Optional' products
  - 'Base' is an integrated package containing key, commonly used products
  - 'Optional' products are coordinated and shipped and serviced with the Base
- 12 partitions
- Virtual Address Extensions (VAE) supporting up to 9 address spaces
- New Librarian
- Interactive User Interface (IUI)
- Conditional JCL
- Capacity based pricing

```
BG 0000 * STEP 0 EXECUTED
BG 0000 * STEP 1 EXECUTED
BG 0000 * STEP 2 EXECUTED
BG 0000 * STEP 1 EXECUTED
BG 0000 * STEP 2 EXECUTED
BG 0000 * STEP 3 EXECUTED
BG 0000 EOJ DPPETE
```

Figure 3: Console Listing Showing the Order of Program Execution

```
CATALOG PROC2.PROC REPLACE=YES DATA=YES
// GOTO &STEP
/. STEP0
* STEP 0 EXECUTED
/. STEP1
* STEP 1 EXECUTED
/. STEP2
* STEP 2 EXECUTED
// IF $RC EQ '0000' THEN
// SETPARM STEP=STEP5
// IF $RC EQ '0000' THEN
// GOTO END
/. STEP3
* STEP 3 EXECUTED
/. END
/+
CATALOG PROC3.PROC REPLACE=YES DATA=YES
// GOTO &STEP
/. STEP4
* STEP 4 EXECUTED
/. STEP5
* STEP 5 EXECUTED
/. STEP6
* STEP 6 EXECUTED
/. END
/+
```

Figure 4: Branch Forward Procedure

IBM

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# VSE and the Cat

- IBM introduced Extended Architecture (XA) to System/370 early 1983
  - 31-bit architecture expanding address range to 2 GB
  - Delivered first with the IBM 3081
  - IBM 4381 supported XA
  - MVS/XA and VM/XA
- VSE/SP was still S/370 mode only (16-bit architecture)
  - Customer concerns: *Is VSE left behind by IBM ?*

- Many "industry experts" ridiculed the mainframe
  - The PC and Client/Server represent the future

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

# 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
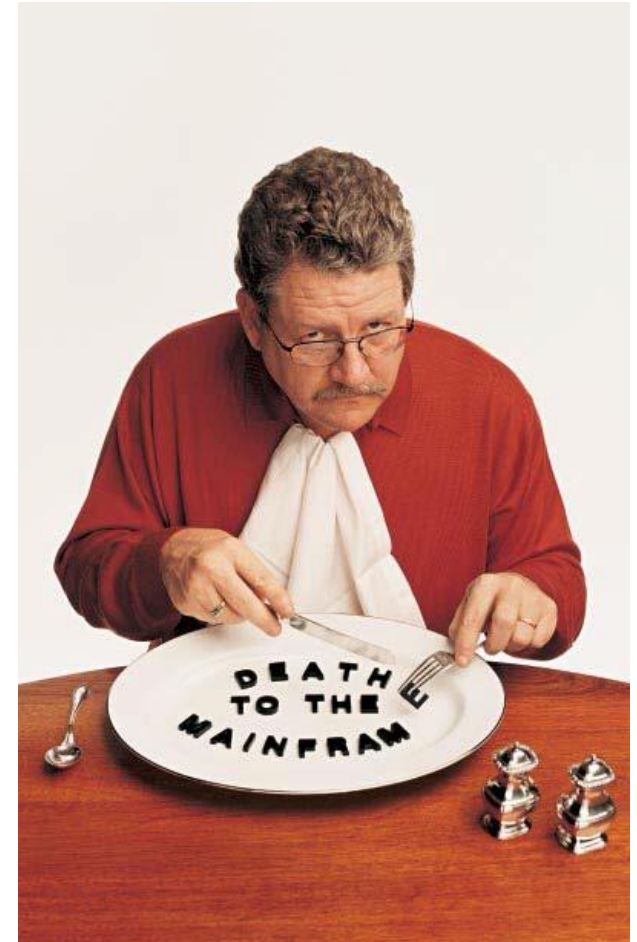
# VSE/ESA Version 1 was introduced with the ES/9000

"Project Blue" announcement in 1990: IBM Enterprise System/9000

- New ES/9000 processor family: ES/9021, ES/9121, ES/9221
    - ESCON channels
- Enterprise Systems Architecture (ESA)
    - MVS/XA → MVS/ESA
    - VM/XA SP → VM/ESA
    - **VSE/SP → VSE/ESA**

# VSE/ESA

- **VSE/ESA V1**
  - 31-bit real memory support, then added 31-bit virtual addressing
  - Dynamic partitions
  - Virtual storage constraint relief (VSCR)
    - Move ACF/VTAM and POWER out of shared partitions
    - Dynamic channels (XA channel subsystem)
    - Up to 1024 devices for added I/O bandwidth
  - ESA exploitation (later releases)
    - ESA data spaces
    - Virtual disk in storage
    - ESA access registers
  - New versions of CICS/VSE, ACF/VTAM, VS COBOL II
    - For greater MVS affinity

- **In 1993, an imaginary VSE/ESA customer might have**
  - a ES/9221-150 system with 128 MB main memory
  - 8 IBM 9336 disk drives (470 MB per actuator in early models)
  - IBM 3490 tape unit

# VSE/ESA

- Focus on
  - Capacity
  - Quality
  - MVS 'affinity'

- Working more closely with ISVs
  - Engaged ISVs prior to GA

- VSE/ESA Version 2
  - N-way support for S/390 Parallel Enterprise Server

- WAVV user group formed in 1995
  - spin-off of GUIDE user group (U.S.)
  - First conference was held in October of 1995 in Winston Salem



VSE/ESA V2.4       1999
- CICS Transaction Server for VSE/ESA
- *e-business*

VSE/ESA V2.3       1997
- TCP/IP

VSE/ESA Version 2       1994
- N-way S/390 Servers
- Investment Protection - Year 2000

VSE/ESA Version 1       1990
- Constraint Relief
- ESA exploitation

Capacity
Quality
zOS Affinity
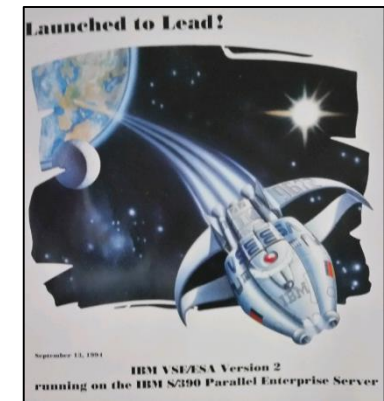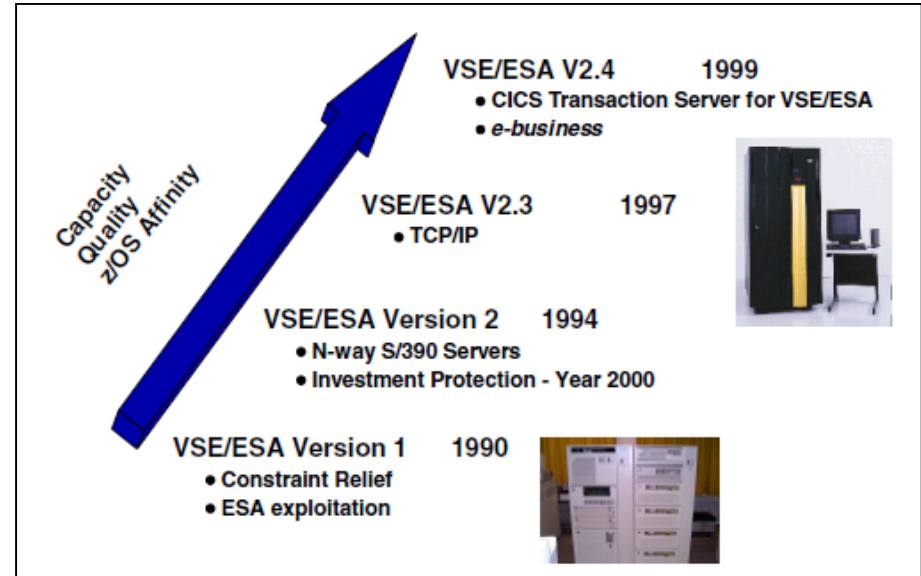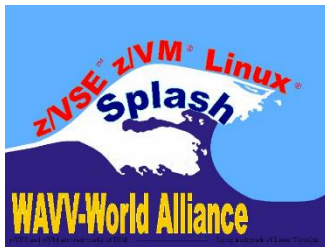
# VSE/ESA Version 2

**VSE/ESA V2.2 (1996)**

- Year 2000 ready

**VSE/ESA V2.3 (1997)**

- optional Turbo dispatcher, support for n-way processors
- VSAM KSDS > 4GB
- TCP/IP for VSE/ESA (native), offered under agreement with CSI
- ACF/VTAM V4.2
- LE and LE-based languages: COBOL, PL/1, C for VSE/ESA

**VSE/ESA V2.4 (1999)**

- CICS Transaction Server (TS)
  - Affinity with OS/390 CICS
  - CICS/VSE still shipped until z/VSE V4.2

**VSE/ESA V2.5 (2000)**

- Connectors (VSE and Java-based components)

# Multiprise 2000 & 3000 Servers

## S/390 Multiprise 2000 Servers (1996)

- Year 2000 ready
- Internal Disk feature
  - Up to 288 GB in 3380/3390 format (ECKD)
- First CMOS Cryptographic Coprocessor (optional feature)
- 1 to 5-way processing units
- 128 MB to 4 GB memory
- Up to 10 LPAR partitions

## S/390 Multiprise 3000 (1999)

- Up to 4 GB memory and 1 or 2 processors
  - Configurable as CP or IFL (integrated Facility for Linux)
- Up to 216 GB internal disk storage (plus 288 GB with expansion unit)
- Up to 15 LPAR partitions

IBM

# Linux on System z - How it began

z/VSE 50



10 YEARS of Enterprise Linux® on System z®
A Simple Idea That Changed The World

"Our Linux initiative and our relationship with the Linux community have had a major impact on the IBM culture... I am convinced that this kind of collaborative culture is required for businesses that want to be innovation leaders in the 21st century."

- Irving Wladawsky-Berger

1999   2000   2001   2002   2003   2004   2005   2006

**SLES 8**   **RHEL 3**

**October 2001** — **Red Hat 7.2 available (implemented on Linux 2.4 kernel)**

**November 2000** — **SuSE Linux 7.0 available**

**August 2000** — **"S/390 Install Fest" with SuSE pre-release**

**July 2000** — **IBM announced Integrated Facility for Linux (IFL)**

**May 17, 2000** — **IBM announced Linux for the enterprise user**

**December 18, 1999** — **Kernel patches (version 2.2.13) available on Marist College web site**

**Spring 1999** — **Linux running under VM/ESA**

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# Introducing the new z/VSE Strategy

z/VSE 50

## Protect existing investments

*Legacy applications and data on z/VSE*
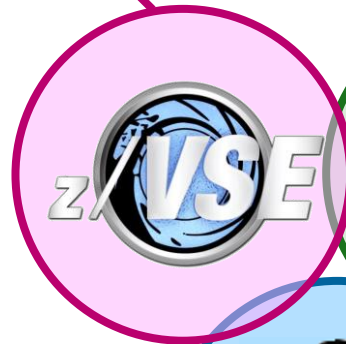
## Integrate with other Systems

*Connect to, and run backend System z applications*

*z/VSE Connectors to Java capable clients*
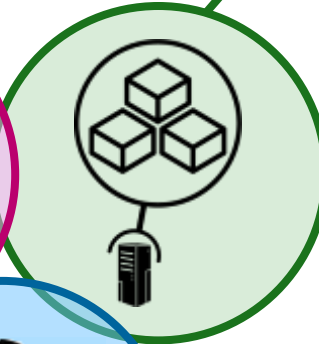
## Extend for new workloads

*Use the combination of Linux on System z and z/VSE*

*The basic z/VSE strategy is as simple as PIE:*

- **P**rotect
- **I**ntegrate
- **E**xtend

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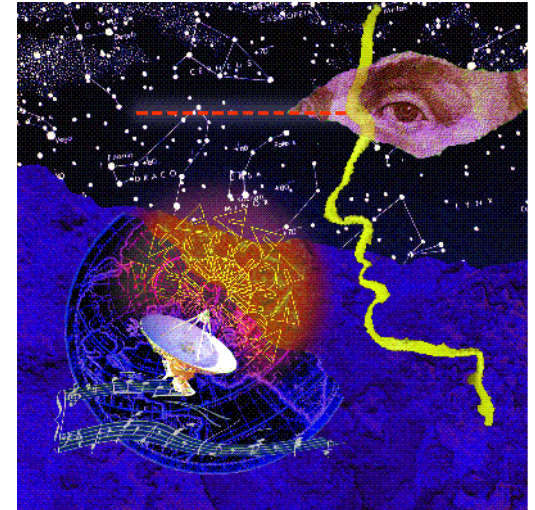
# z/VSE

- **z/VSE V3**
  - 31-bit mode only
    - No z/Architecture, no 64-bit mode
  - FCP-SCSI support

- **z/VSE V4**
  - 64-bit real memory addressing
    - No support of 64-bit virtual memory addressing
  - MWLC pricing
  - Fast Path to Linux on System z

- **z/VSE V5**
  - 64-bit virtual memory addressing

- **z/VSE V6**
  - New CICS

**Z/JOURNAL**

**Virtual Addressing With z/VSE: From 24-Bit to 64-Bit**

By Ingolf Salm

The 64-bit virtual support introduced in z/VSE 5.1, available since November 2011, lifts a boundary and provides more options for growth and new applications. Before we consider how 64-bit virtual is implemented and what it provides, let's examine the evolution of real and virtual addressing in VSE. >

# z/VSE Evolution

**Hardware Support**
**Capacity**
**Quality**
**z/OS Affinity**
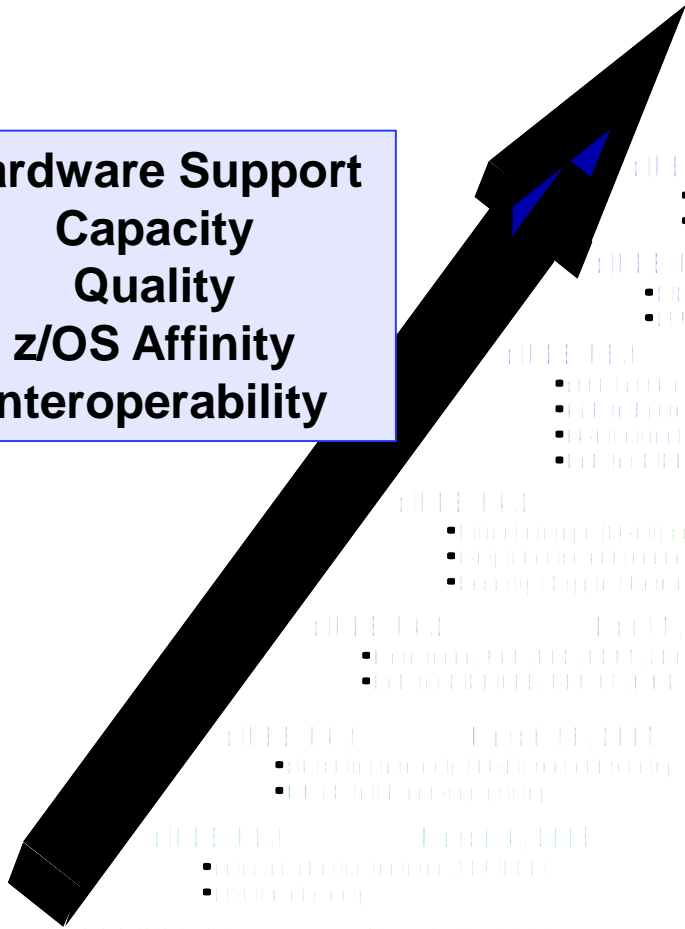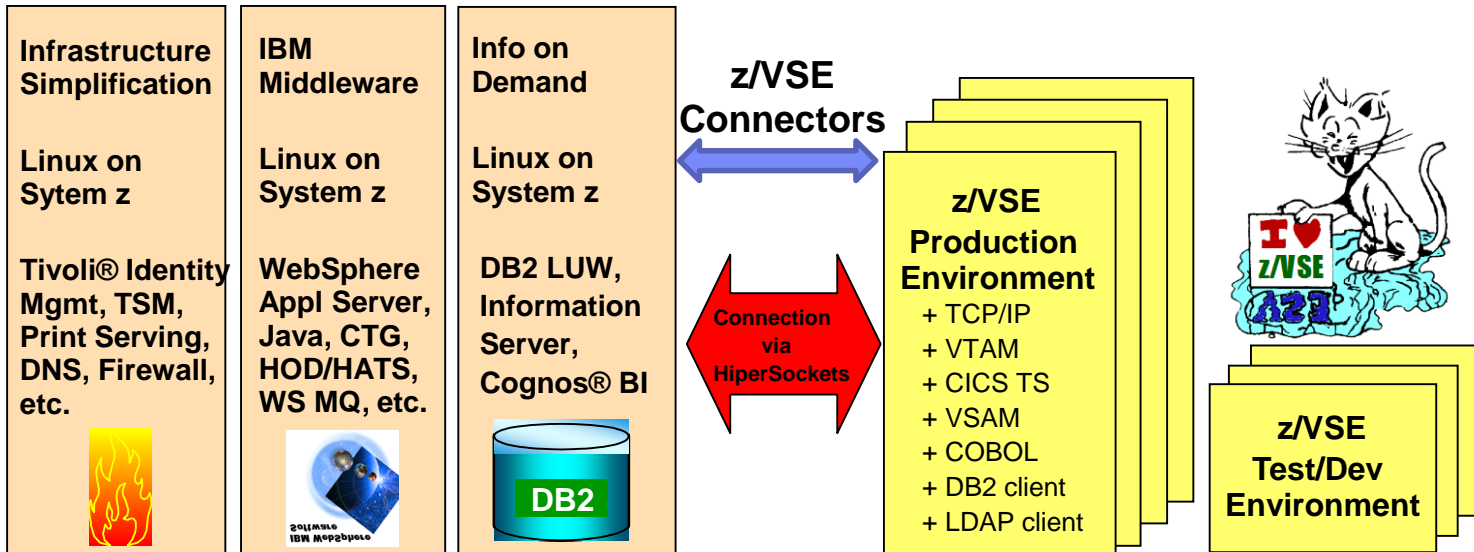**Interoperability**

**IBM**

# z/VSE Strategy with Linux on z Systems

*Hybrid Environment leveraging z/VSE, z/VM, and Linux on System z*

**z/VSE 50**

**P**rotect **existing z/VSE investments**
**I**ntegrate **using middleware and z/VSE connectors**
**E**xtend **with Linux on IBM System z technology & solutions**

| Infrastructure Simplification | IBM Middleware | Info on Demand |
|---|---|---|
| Linux on Sytem z | Linux on System z | Linux on System z |
| Tivoli® Identity Mgmt, TSM, Print Serving, DNS, Firewall, etc. | WebSphere Appl Server, Java, CTG, HOD/HATS, WS MQ, etc. | DB2 LUW, Information Server, Cognos® BI |
| | | DB2 |

**z/VSE Connectors**

**Connection via HiperSockets**

**z/VSE Production Environment**
+ TCP/IP
+ VTAM
+ CICS TS
+ VSAM
+ COBOL
+ DB2 client
+ LDAP client

**z/VSE Test/Dev Environment**

**z/VM-mode LPAR with z/VM**

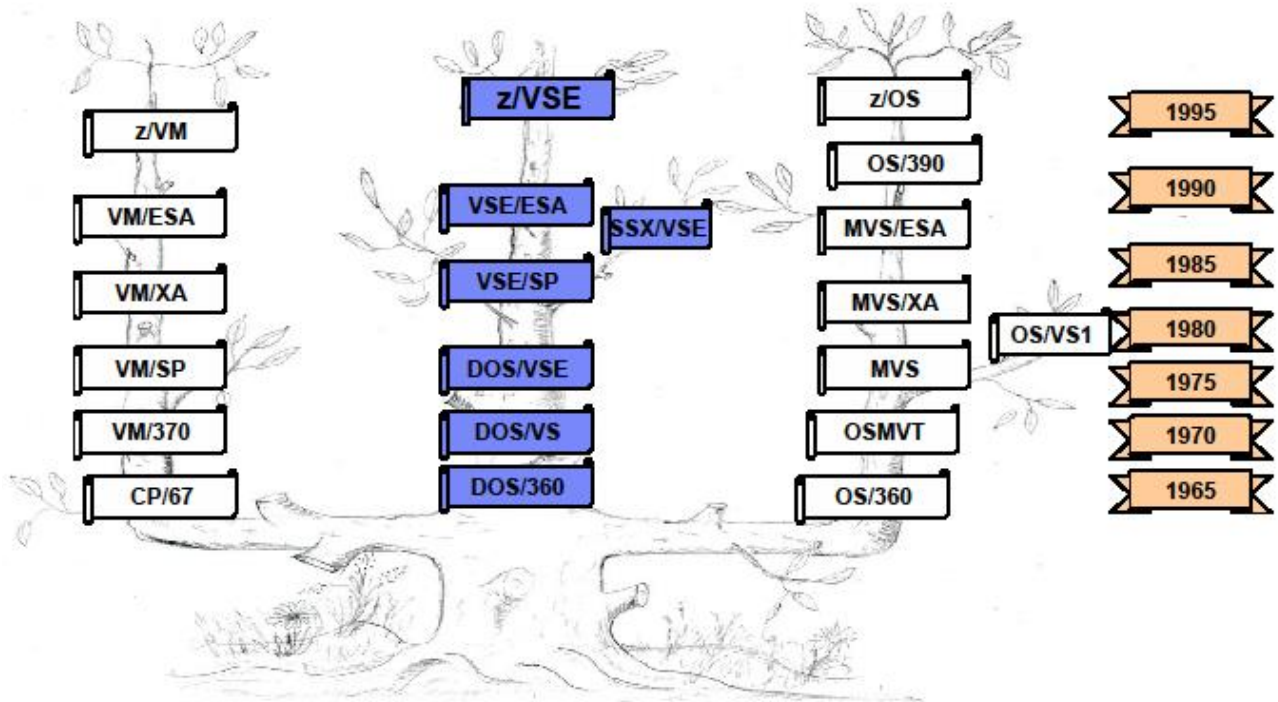| IFL Engine(s) | CP Engine(s) |
|---|---|

**IBM System z10®, IBM zEnterprise: z196, z114, zEC12, zBC12, IBM z Systems: z13**

# z/VSE Evolution

- DOS/360 to z/VSE

- S/360 – S/370 – 4300 – 9370 – 9x21 – MP2000 - MP3000 – Gx – zServer – System z – z Systems

**DOS/360**
**DOS/VS**
**DOS/VSE**
**VSE**
**VSE/SP**
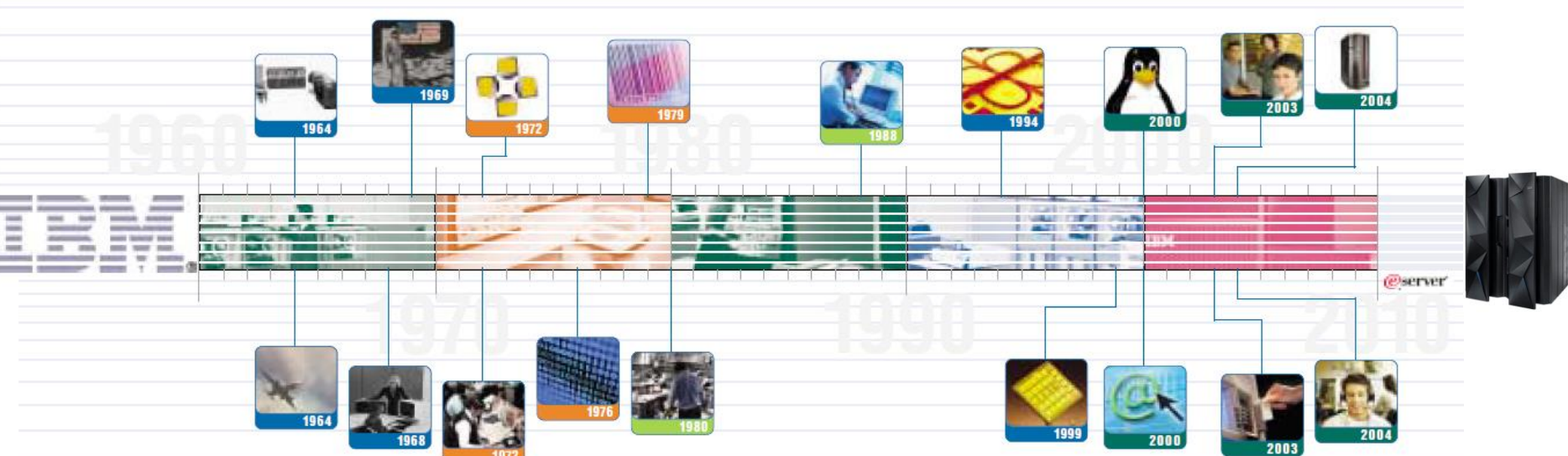**VSE/ESA**
**z/VSE**

*45 years*

# 50 years of innovation

**Fifty years ago IBM changed the worlds of computing
and business — and transformed itself — with the revolutionary
System/360. The spirit of that time thrives today in a new era
of big bets, innovation and on demand business.**

**… and z/VSE is part of this transformation!**

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  - Private training is also available with our Global Training Providers

- Demanding a high standard of quality – **view the paths to success**
  - Browse Training Paths and Certifications to find the course that is right for you

- If you can't find the **training that is right for you** with our Global Training Providers, we can help.
  - Contact IBM Training at dpmc@us.ibm.com

**Global Skills Initiative**