

```

MMM      MMM      AAAA      IIIIIIII  NNN      NN  FFFFFFFF  RRRRRR      AAAA      MMM      MMM  EEEEEEEEE  SSSSSS
MMMM     MMMM     AAAAAA     IIIIIIII  NNNN     NN  FFFFFFFF  RRRRRR     AAAAAA  MMMM     MMMM  EEEEEEEEE  SSSSSSSS
MM MM    MM MM    AA    AA      II      NN NN    NN  FF      RR  RR    AA    AA    MM MM    MM MM  EE          SS      SS
MM  MM  MM  MM  AA    AA      II      NN  NN    NN  FF      RR  RR    AA    AA    MM  MM  MM  MM  EE          SS
MM  MMMM  MM  AAAAAAAAAA      II      NN  NN    NN  FFFFFFFF  RRRRRR  AAAAAAAAAA  MM  MMMM  MM  EEEEEEEEE  SSSSSSS
MM  MM    MM  AAAAAAAAAA      II      NN  NN    NN  FFFFFFFF  RRRRRR  AAAAAAAAAA  MM  MM    MM  EEEEEEEEE  SSSSSSS
MM      MM  AA      AA      II      NN      NN NN  FF      RR  RR  AA      AA  MM      MM  EE          SS      SS
MM      MM  AA      AA  IIIIIIII  NN      NNNN  FF      RR  RR  AA      AA  MM      MM  EEEEEEEEE  SSSSSSSS
MM      MM  AA      AA  IIIIIIII  NN      NNN  FF      RR  RR  AA      AA  MM      MM  EEEEEEEEE  SSSSSS

```

```

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```

      AA  N  N  DDD      ZZZZ  //  00  SSS
      A  A  NN N  D  D      Z    //  0  0  S
      AAAA  N  NN  D  D      Z    //  0  0  S
      A  A  N  N  DDD      ZZZZ  //  00  SSS

```

```

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=====

```

user=> Kyri Lea

password=> *****

What is a Mainframe?

Historically, the “frame” that held the “main” CPU for a business

Used for bulk data processing and transaction processing

- Credit card transactions, booking flights, making reservations, etc.

Features:

- Redundancy, I/O, backward compatibility, high uptime, security

Enter F1=Help F3=Exit

Device: TESS2024

Logging: ENABLED

History

IBM 701 (1952)

- Vacuum tube memory
- 2200 multiplications/s and 17,000 additions or subtractions/s (very speedy)
- Initially had 8 mil bit tape drive
 - 1956 - RAMAC, first magnetic disk system
- 19 units
- \$16,000 per month



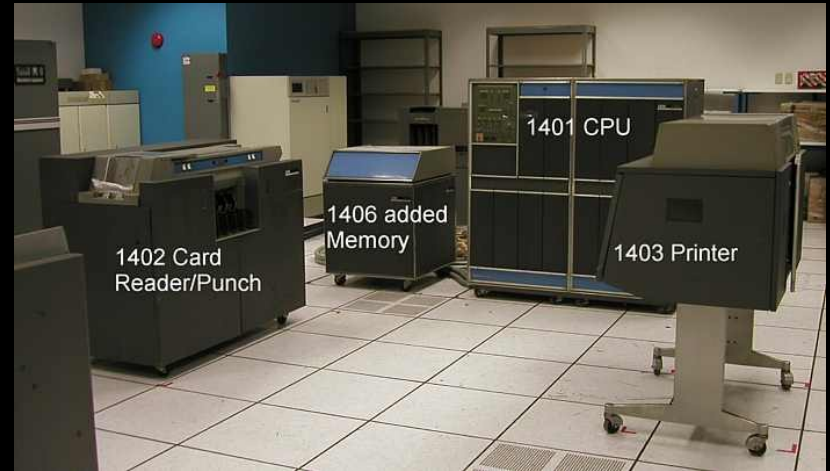
Enter F1=Help F3=Exit

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History

IBM 1401 Data Processing System (1959)

- Core memory
- Lots of software included for free
- Had an improved printer
- \$2500/month, thousands sold



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History

System/360 Series (1974)

- A series of compatible computers
 - Previously all different OSes, software, and hardware
- Beginning of modern architecture
- First scalable system
- Microprogramming



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History

System/370 (1970)

- Looks cool



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History

IBM zSeries (2000)

- The first mainframe to use the modern z/Architecture
 - Backward compatible to 1964
- 12 or 20 processors, 4226 I/O pins
 - Increased with future z models

IBM z16 (2022)

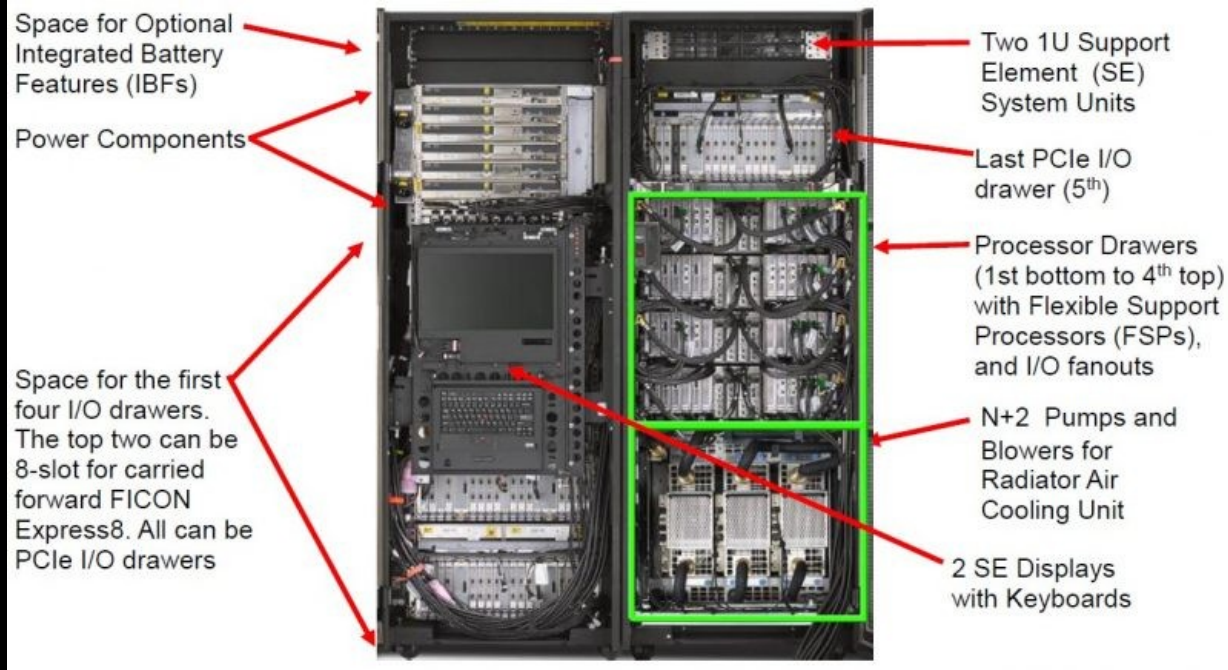
- 1-4 frames
- Telum Processor
- Up to 40TB memory
- Crypto Express adapter with quantum-safe crypto



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Inside a Mainframe



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Processors

CP - central processor

IFL - Integrated Facility for Linux

ICF - Integrated Coupling Facility, for parallel sysplex

zIIP - Integrated Information Processor

- zAAP

SAP - System assistant processors, for moving data around the system

IFP - Integrated Firmware Processor

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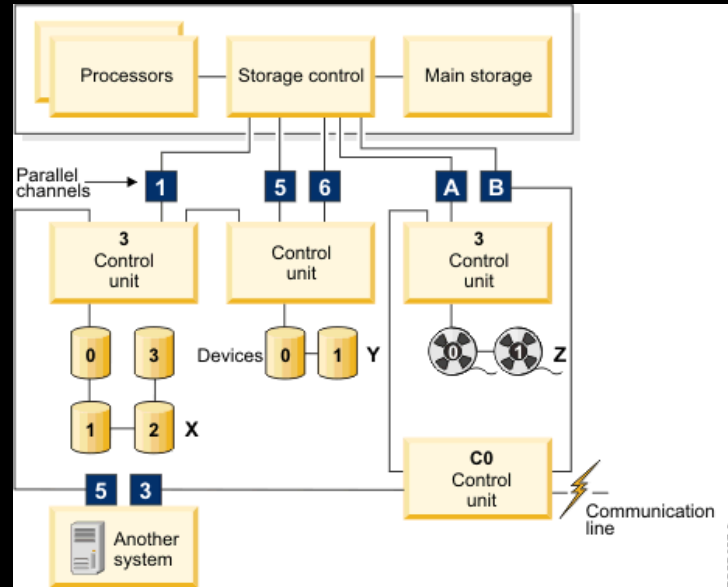
I/O

Storage over FICON, Network connections, Cryptographic cards

System Assist Processor

Channels

Control Units



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SE and HMC

Support Element - For managing the mainframe. Physically on the device

Hardware Management Console - for remote management

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Architecture

Auxiliary memory

Each application, user has its own address space

Logical Partitions (LPARs) for flexible use of hardware

I/O

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Operating Systems

z/OS

Linux

z/VM

z/TPF

z/VSE

This is Zeus, the mainframe of the
IBM z Systems University Program for Europe

z Systems
Europe
University
System

ZEUS

z/OS
z/VM
Linux for z Systems
z/VSE

Access only permitted when authorized by explicit agreement with IBM

To access the Zeus z/OS 1.13 system, type **DIAL ZOS113**
To access the Zeus z/OS 1.9 system, type **DIAL ZOS19**
To access your own university's second-level z/VM system,
type **DIAL** followed by its name, for example: **DIAL FO0VM**

```

ZZZZZZ / VV          VVV MM      MM
ZZ      VV          VVV MMM     MMM
ZZ      VV          VVV MM MM  MM MM
ZZ      VV          VVV MM  MM  MM
ZZ      VVVVV      MM   M   MM
ZZ      VVV          MM     MM
ZZZZZZ / V          MM      MM

built on IBM Virtualization Technology
```

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Linux on the Mainframe

Has been supported since 2000

Uses different type of storage than other mainframe OSes

Does not use standard 3270 display terminals

Operates in ASCII

- Translation between ASCII and EBCDIC needed sometimes

LinuxONE

Enter F1=Help F3=Exit



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z/OS

Introduced in 2000, the successor to OS/390

Consists of:

- Transaction manager
- Databases
- Batch jobs
- Security manager
- Crypto services
- End user interfaces
- Job entry subsystem
- Job output
- SMP/E
- Resource Management Facility
- DFSMS
- And more ..

Enter F1=Help F3=Exit

```
z/OS Z18 Level 0609 IP Address = 192.64.85.185
VTAM Terminal = SC0TCP82

Application Developer System

          // 0000000 SSSS
         // 00 00 SS
zzzzzz // 00 00 SS
       zz // 00 00 SSSS
      zz // 00 00 SS
     zz // 00 00 SS
zzzzzz // 0000000 SSSS

System Customization - ADCD.Z18.*

====> Enter "LOGON" followed by the TSO userid. Example "LOGON IBMUSER" or
====> Enter L followed by the APPLID
====> Examples: "L TSO", "L CICS", "L IMS3270"
```

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Parallel Sysplex

Increases reliability

Multiple systems working together - either in one datacenter or multiple

Parallel sysplex most common form of sysplex

Momoplex, Base Sysplex

Components: STP, GRS, XCF, CDS, coupling links

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z/OS Data Processing

Jobs - Programs that will be run multiple times with
different inputs and outputs

- Written in Job Control Language (JCL)

Job Entry Subsystem

Job Output

Batch jobs

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Other z/OS Components

Resource Management Facility (RMF) - Performance monitoring

System Modification Program Extended (SMP/E) - updating software, managing dependencies, etc.

DFSMS - disk management

Workload Manager

UNIX System Services (USS) - Run UNIX programs on z/OS

End-user Interfaces - TSO, ISPF

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z/OS Security

IBM Security Server - Overall security for the system

- Includes RACF, LDAP, Firewalls, Network Authentication (Kerberos), Enterprise Identity Mapping, PKI Services

Security manager - ensures people can only access authorized resources

System Authorization Facility (SAF) - access control through system authorization for programs

- Can work alone or with RACF

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RACF

Resource Access Control Facility

Profiles - store information about users, resources, and access

Responsibilities:

- Identification and authentication
- Control access to resources
- Authorize users to access resources
- Log authentication failures
- Allow applications to use RACF macros

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Cryptographic Services

Integrated Cryptographic Service Facility (ICSF)

- Encryption and decryption of data
- Key protection and management
- SSL acceleration

Special instructions: CPACF

Hardware: Crypto Express Adapter, Regional Cryptographic Server

Several data sets: CKDS, PKDS

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z/OS Operational Data

Data about the system used for performance monitoring and health checks

Operational Log and Data Analytics - Identify issues

Anomaly Analytics with Watson

Types of data:

- System Management Facilities Data
- Logs from jobs
- Syslog and UNIX syslog
- Resource Management Facility (RMF) reports

Enter F1=Help F3=Exit

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COBOL

One of the main languages associated with mainframes

Used for business applications and commercial data processing

Developed in 1959

43% of banking systems still ran COBOL in 2017

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Sources

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