Business Machines for Enterprise Computing

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An early mainframe called S/360. It was used for science and business applications.

Objectives

1. **Discuss the history of this significant computing invention right up to the present time—more than 60 years of development.**
2. **Explain, in general terms, some of the important technical innovations.**
3. **Discuss use of enterprise computing hardware and software by businesses and other organizations.**
4. **Reveal additional details from my experience working with the technology and enterprises.**

Definitions

What Business Machines?

Mainframes or **Enterprise Platforms** also called **IBM System Z**

What Characterizes Organizations that Use Mainframe Computers?

- Their systems cannot be down
- They are legally accountable for their data
- They need to process significant transaction volumes predictably
- Security and auditability are non-negotiable
- Change must not disrupt operations

Definitions

What are The Reasons Enterprises Use IBM System Z?

Zero Downtime and Reliability

Economic Efficiency

Hybrid Cloud Integration

Quantum-Safe Cryptography

Massive Transaction Processing

Pervasive Encryption

Backward Compatibility

AI and Real-Time Insights

Definitions

What is “Eight Nines”?

99.999999% Availability

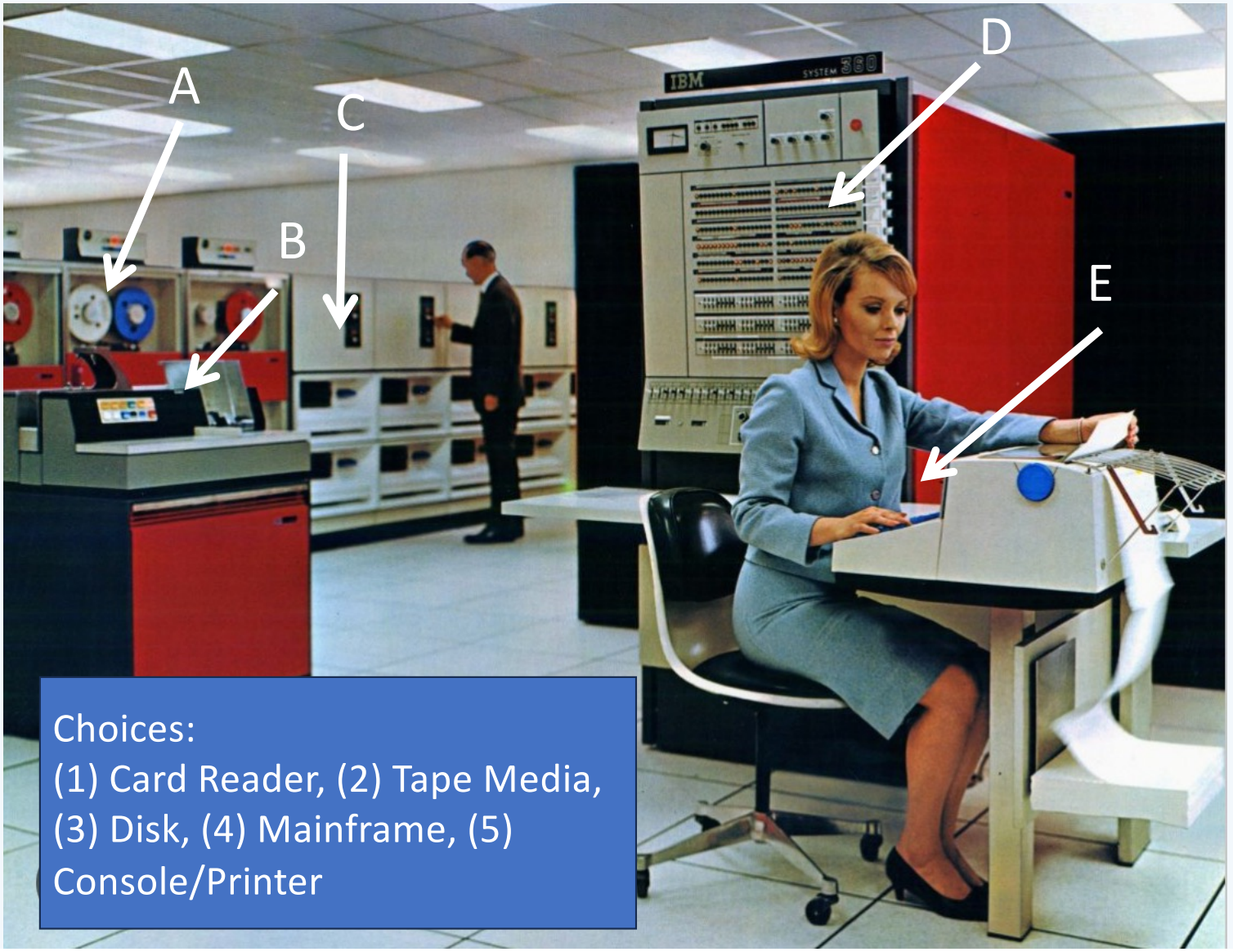
About 0.32 seconds of downtime per year

That’s roughly 315 milliseconds annually.

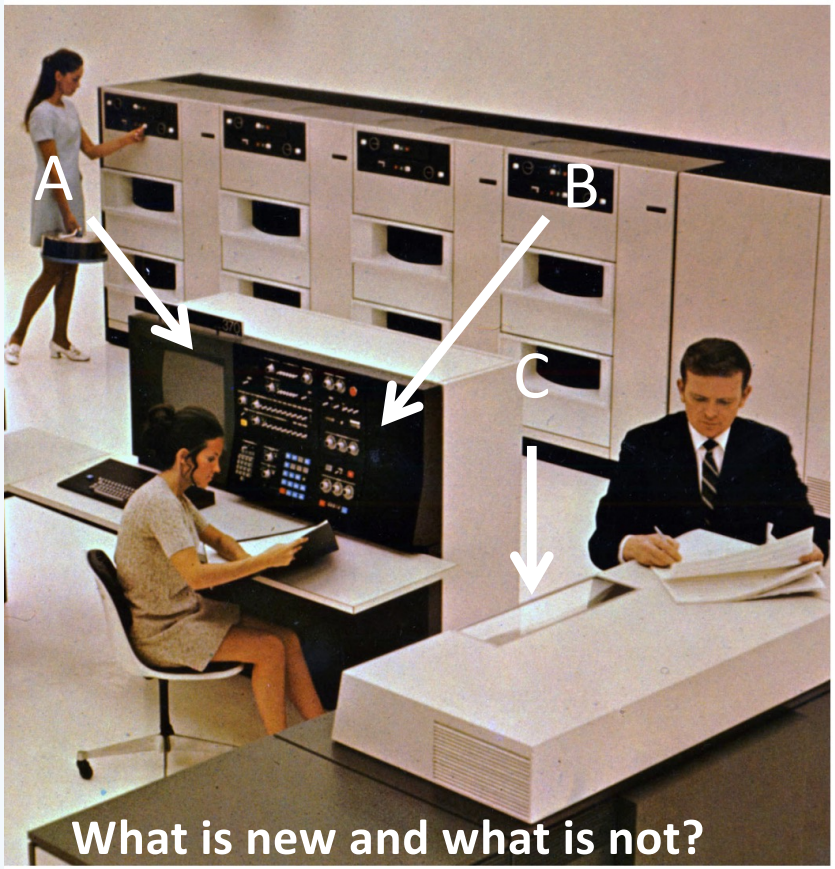
In enterprise terms, especially for IBM Z environments, this level of availability typically assumes:

(1) Planned maintenance excluded (2) Redundant components and (3) Continuous operation with failover (not single-instance uptime)

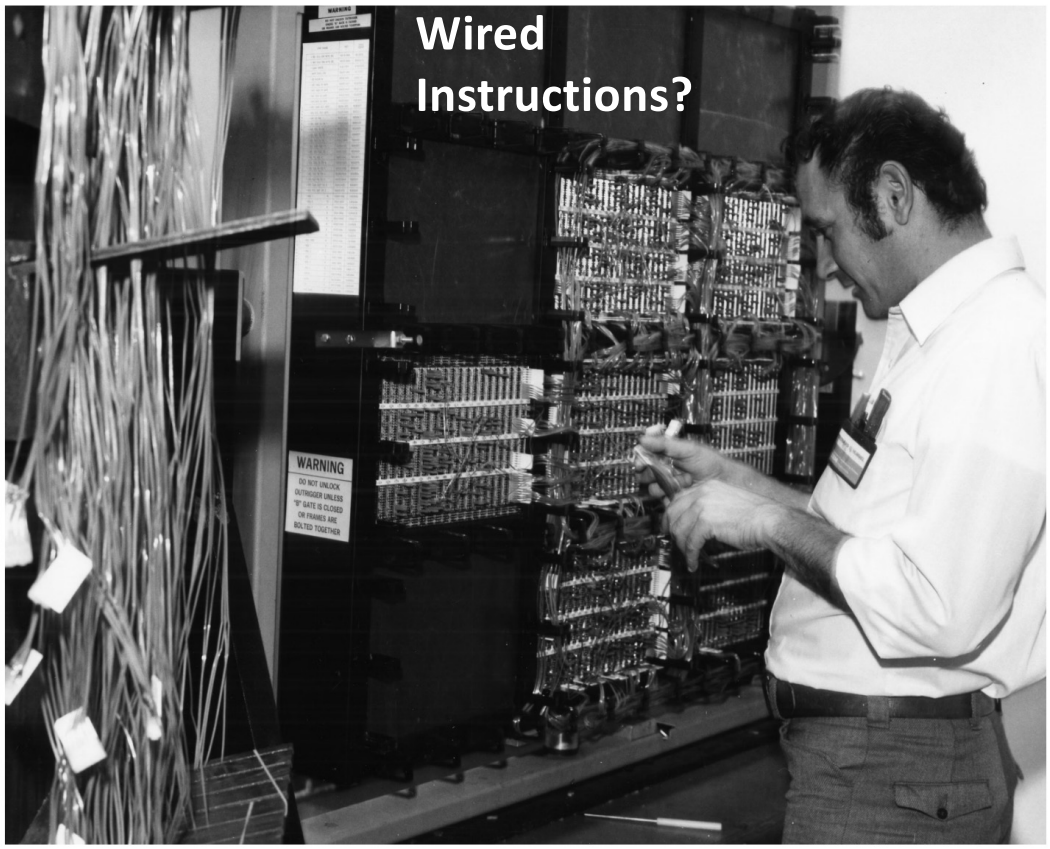
Business Machines


A
B
C
D
E
IBM
SYSTEM 360
Choices:
(1) Card Reader, (2) Tape Media,
(3) Disk, (4) Mainframe, (5)
Console/Printer

Mainframe Around 1970



mainframe system



When System/370 debuted, Watson Jr. predicted that the computer would “stand out as the landmark for the 1970s.” As it turned out, it was IBM’s leading mainframe through the 1980s.

What Can You Do With the Mainframe?

In early times, batch processing …

- Jobs
  //DAILYRUN JOB
- Steps with Programs
  //VERTRANS EXEC PGM=
- Data Definition
  //TRANSIN DD DSN=
  //EXCPRPT DD SYSOUT

Now, JOBs plus …

- Online real time transaction processing with CICS and IMS
- Distributed, networked, client/server integration
- WWW, Java, and Linux on Z
- Cloud, API, and mobile integration
- AI and real time analytics

System Z

This is 1 fully configured computer (it looks like 4, right?)

CPU

– up to 208 cores on 26 chips

Memory

– up to 64 TB or 65,536 GB

Cooling

– water

Power Distribution Units

– support components

Special-Purpose Units

– cryptographic, AI and others

Interfaces

- I/O frames and networking

IBM z16 Configuration: PDU base I/O and CP Expansion

✅ A-Frame (Primary Frame)
Central Processor Complex (CPC) drawers: Contains the Telum II processors.
Memory modules: High-speed memory with redundancy and virtualization features.
Radiator Cooling Unit (RCU): Air-to-liquid heat exchanger for internal cooling.
Oscillator cards and system control: For timing and system management.
✅ B-Frame (Optional Expansion Frame)
Additional CPC drawers and **Second RCU** for enhanced cooling and redundancy.

✅ **I/O Frames**
PCIe+ I/O drawers: These contain the I/O cards and interfaces for external connectivity.
I/O subsystem: Includes support for FICON, OSA, and other high-speed interfaces.
Network and clustering connectivity: For external LAN/WAN and sysplex configurations.
✅ Optional Frames
Power Distribution Units (PDUs): For power management and redundancy.
Special-purpose features: Cryptographic accelerators, clustering modules, etc.

When Did IBM Create Mainframes? How Big a Project?

IBM's development of the System/360 mainframe in the early 1960s was one of the most ambitious and expensive business projects in American history.

Launched: April 7, 1964
Investment: Estimated $5 billion over four years

Equivalent to $45–$50 billion today, adjusted for inflation.

Often referred to as “IBM’s $5 billion gamble” or a “bet-the-business” move.

Was It Revolutionary?

Before System/360

- IBM had multiple incompatible product lines (e.g., 1400 series, 7000 series).
- Customers had to rewrite software every time they upgraded hardware.
- There was no standard architecture across systems.

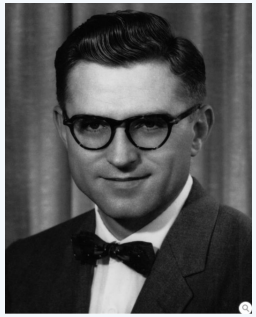
System/360 Introduced

- A single, unified architecture for both *business* and *scientific* computing.
- Software compatibility across models.
- Customers could start small and upgrade without rewriting code.
- Set the 8-bit byte standard, still used today.

What were the Engineering and Organizational Feats? What was the Mainframe's Impact and Legacy?

Engineering leadership required

Led by Gene Amdahl (chief architect), Fred Brooks (software), and Erich Bloch (hardware).



11/16/1922-11/10/2015

4/19/1931-11/17/2022

1/9/1925-11/24/2016

Required IBM to Innovate

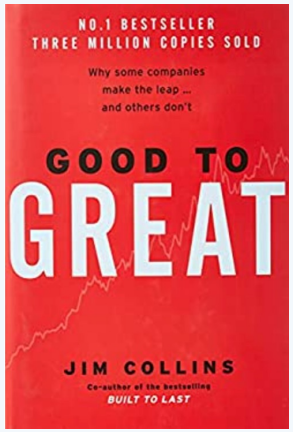
Develop its own Solid Logic Technology (SLT); build new manufacturing, distribution and infrastructure; reorganize the company too.

Impact

- The gamble paid off: Over 1,000 units sold in the first month.
- By the late 1980s, System/360 and its descendants accounted for over half of IBM's revenue.
- It became the foundation of modern enterprise computing and influenced generations of system.

Legacy

Ranked by Jim Collins as one of the top three business accomplishments of all time, alongside Ford's Model T and Boeing's 707 jetliner.



What Did a Mainframe cost in 1964? What about today? What Do You Get?

Feature	IBM System/360 (1964)	IBM z17 (2025)
Cost Range	$133K-$5.5M	$2.5M-$10M
Performance	Thousands to millions of instructions/sec (MIPs)	A fully configured IBM System Z delivers on the order of 1.5 to 2.5 trillion instructions per second
Architecture	Solid Logic Technology (SLT) replacing tubes	Advanced semiconductor technology, virtualization, and resilient system design
Pricing Model	Purchase or rental	Added Usage-based
Legacy Compatibility	Introduced 8-bit byte standard	Backward compatible to System/360

Innovations and The State of Things

Other Key Innovations

- **COBOL (1959):** Still widely used in mainframe environments.
- **Core Memory (1970):** Replaced earlier technologies for faster, more reliable storage.
- **Virtualization (1972)**: Allowed multiple operating systems and workloads on one machine.
- **Docker & Kubernetes (2015)**: Containerized applications are being used in different systems worldwide.

Mainframes Today

Capacity: IBM Z can support a very large number of:

1. Containerized workloads across multiple Kubernetes clusters
2. Virtual Machines (VMs)
3. Linux instances
4. z/OS address spaces

All executing simultaneously under hardware-enforced isolation.

Enterprise Organizations

What Enterprises and What Applications?

Banking & Financial Services

- Bank of America
- JPMorgan Chase
- Citigroup
- Wells Fargo
- BNP Paribas
- Deutsche Bank
- HSBC
- Capital One
- American Express
- FIS, Fiserv, First Data (payment processors)

44 of the top 50 largest banks rely on IBM Z. These institutions use mainframes for 70% of all global financial transactions:

- Core banking systems
- ATM and POS transaction processing
- Batch settlement and reconciliation
- Interest rate forecasting
- Loan processing and approval
- Financial crimes detection, anti-money laundering

What Enterprises and What Applications?

Insurance

- Aetna
- MetLife
- Liberty Mutual
- Blue Cross Blue Shield
- Allianz
- AIG
- State Farm
- MassMutual

These institutions use mainframes for:

- Policy management
- Claims processing including adjudication
- Actuarial systems
- Real-time fraud detection for claims and images
- Pricing and actuarial analysis

What Enterprises and What Applications?

Airlines & Travel

Mainframes are used for reservation systems, loyalty programs, and ticketing:

- Delta Air Lines
- British Airways
- Air France
- Amadeus
- Sabre
- Emirates

Healthcare

Used for patient records, billing, and insurance processing:

- Kaiser Permanente
- UnitedHealth Group
- Express Scripts
- Medicare
- Emblem Health

What Enterprises and What Applications?

Government

Mainframes support tax, social security, and defense systems:

- IRS
- Social Security Administration
- U.S. Department of the Treasury
- State governments
- Customs & Border Enforcement

Retail

Retailers use mainframes for inventory, logistics, supply chain and POS systems:

- Walmart
- Target
- Home Depot
- Macy’s
- Kroger

Design thinking IBM z16 co-created with clients

70+
enterprises

- IBM Z Sponsor user program
- IBM Z Design Council
- GM Advisory Council
- Cross section of users (geos, industries, size)
- 1 on 1 Interviews and Surveys
- Hill value validation
- Prototype evaluations

1100+
interaction hours

2x more engagements over IBM z15 from developers, architects, to execs

Driven by early engagements across IBM Z and LinuxONE

Innovations through cross-team alignment from product management, design, marketing, development, sales and support

23
user personas

- Application Architect
- Application Developer
- Application Owner
- Auditor
- Chief Data Officer
- Chief Privacy Officer
- Chief Sustainability Officer
- Cloud Architect
- CTO, CIO, CFO, CISO / CIRO
- Data Architect
- Dev Ops Engineer
- Director of Mainframe Datacenter
- Evidence Provider
- Infrastructure Architect
- Line of Business Owner
- Security Architect
- System Admin
- VP of AI / Analytics
- VP of Application Development
- VP of Infrastructure

The changes are driven by client needs, innovation possibilities from new technology and changes in the IT marketplace.

What Fills Me With Wonder?

Instruction Set of over 1,000 machine instructions.

Number of CPUs and **speed of each core**—huge impact on the quality of the experience.

Virtualization where every program behaves like it ”owns” the machine—full range of addresses.

COBOL where you can start programming business applications after 3 months of learning.

Parallel Processing as there are significant concurrent actions, and they are beautifully orchestrated with no programmer intervention is needed.

Rich Interfaces because in a modular world, the quality of interfaces matters.

Implementation of the zero-downtime goal like not requiring IPLs for changes and utilizing recovery processing for every kind of fault.

Then and Now

Then

IBM Web Hosting ➔ New Business Opportunities ➔ GOM creating "things to sell" ➔ Europe then Asia

Now

Thought Leader

Published 450 articles in print and on MSP web sites and in emails that are distributed to mailing lists. I wrote 24 articles last year that is now assembled in a book releasing in June—**A Mainframe Computing Reader**

Projects, Some On-Going -- Mostly working for CEOs of small software and services companies:

- Designed a customer-facing report that is delivered after the migration planning phase of the project.
- Wrote the web content for streamfoundry.com.
- Independent compliance work for them and recording sessions with their technical marketing leader.

Publishing, Educational Services and Communications

- Alazar Press, an Imprint of Royal Swan Enterprises. Children's books and now includes books for adults, Also, educational services and help to people wanting to publish books.

Questions?

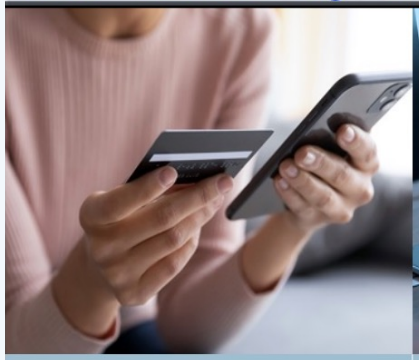
Backup

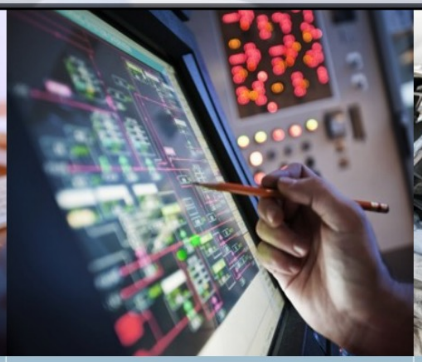
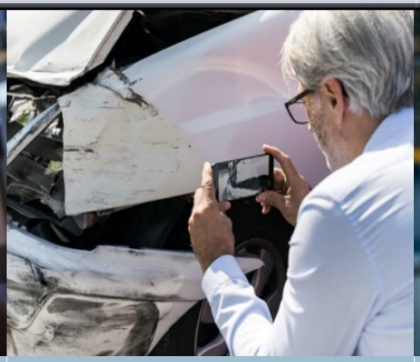
Context for Enterprise Organization's Use of Mainframes

LEVEL	SYSTEM TYPE	PURPOSE	EXAMPLES
Strategic	Executive Support Systems (ESS)	Long-term planning, trend analysis	Executive dashboards, BI tools
Management	Decision Support Systems (DSS), Management Information Systems (MIS)	Tactical decisions, forecasting, reporting	Forecasting models, performance reports
Operational	Transaction Processing Systems (TPS)	Routine transaction handling	Payroll systems, POS systems

Transaction Processing Systems, Management Information Systems, Decision Support Systems and Executive Support Systems

Use Cases by Industry




Banking

Examples

- Compliance Testing: account ID take over and identity theft
- Gaming the system – reward cards and account openings
- Interest rate forecasting
- Loan processing & approval

Finance

Examples

- Enable point-of-sale payment processing with fraud detection
- Financial crimes detection, anti-money laundering (AML)
- Wealth management with predictive models

Trading

Examples

- High frequency trading analytics
- Algorithmic trading
- Clearing & Settlements

Insurance

Examples

- Real-time fraud detection for claims and images
- Claims adjudication
- Pricing & actuarial analysis for better risk assessment

Other

Examples

- Supply Chain
- Payroll processing
- Manufacturing
- Scientific research
- Computer design
- Biosecurity
- Mining
- Healthcare

If you were going to get a mainframe from IBM, what would be the variables that impacted the price?

Several key hardware and software configuration variables affect the overall price.

1. Number of Processors (CPs)
2. Specialty Processors (zIIP, zAAP, IFL, ICF, AIU)
3. Memory (RAM)
4. Storage and I/O Configuration
5. Software Licensing - IBM uses Tailored Fit Pricing, which includes:
   - Usage-based billing (e.g., per MSU or workload type).
   - Bundled software packages (e.g., z/OS, DB2, CICS, MQ).
   - Capacity on demand options.
6. Physical Configuration
7. Security and Compliance Features
8. Support and Services

Note: Software costs can exceed hardware costs depending on the environment.