IBM Operating System/360
Announced 1964; Shipped 1965

Fred Brooks
System/360 Manager, 1961-65
OS/360 Manager, 1964-65

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Basic Concepts

• *One OS for a whole computer family
• Second-generation OS: for all applications
• Control program plus lots of compilers, etc.
• *Mandatory disk for system residence
• *Multi-tasking of independent jobs
• No operator manual intervention
• Remote job submission, editing
• *Device-independent I/O, teleprocessing
One OS for A Computer Family

• Versions optimized by memory size
  • 16 K, 64 K, 256 K

• Seven computers in first batch
  • Models 20, 30, 40, 50, 65, 75, 91

• Today’s MVS, backbone of Enterprise

• Events occasioned other OSs for S/360
  • DOS/360
  • Model 67 and TSS
  • VM/360
Second-generation; All apps

- 2nd-generation computers used 1st-generation operating systems
  - Machines: 7090, 7080, 7074, 1410, 7010, Stretch
  - OS: SOS, IBSYS, 1410/7010 OS, Stretch OS
  - Independent evolution of interrupt-handlers (supervisors), schedulers, and I/O

- Different use styles for commercial, scientific
Full Software Support

• Control program
  • Generatable in various memory sizes

• Language compilers, for multiple sizes
  • FORTRAN (3), COBOL (2), PL/I, RPG, Algol, Macroassemblers

• Utilities
  • Sort generators, media converters, spoolers, etc.

• About $350 million (1963 $1 = 2001 $6)
Mandatory Disk

• The most crucial new concept
  • Prototyped in Stretch OS and Ted Codd’s Stretch Multiprogramming OS
  • Concurrent with Multics, other T-S systems

• System residence with short access time

• Unlimited OS size
Full Multiprogramming

• Kilburn (Atlas) and Codd (Stretch) had paved way in 1959-60

• SPOOL a universal way of life

• Multitasking of independent jobs possible because of machine features

• Multiple fixed tasks

• Multiple variable tasks
No Operator Intervention

- Operator is hands and feet *only*:
  - Mounting tapes, disks, cards
  - OS tells operator what to do
- All scheduling automatic, but operator can override
- Time-out and aborting automatic
- Catastrophe detection automatic
- Console is a terminal
Terminal Operation

• Remote
  • job submission
  • job retrieval
  • job editing

• So an interactive batch system, not really time-sharing
I/O: Support New Hardware

- 144 new products on April 7, 1964
- Big shift: 8-bit byte, EBCDIC char. set
- New:
  - tapes, disks, drums, printers, card I/O, even keypunches
- New new:
  - character terminals, graphics engines, multiplexers, networks, check sorters, factory data-acquirers, magnetic strip bins
- Single standard interface for all devices on all computers
Device-Independent Data Mgt

- OS/360’s major innovation
- Data management is 40% of control program
  - Includes device drivers
- All datasets, mounted or not, are known to OS
- Datasets have uniform names, headers
Deferred Dataset Binding

• Program’s dataset names bound to actual datasets, devices only at scheduling time

• Job Control Language (JCL) and Data Definition (DD) statements/cards

• SPOOLing a trivial special case (Simultaneous peripheral operation on-line)
Data Access Methods

• Optimized for disk performance
• Sequential A-M (tape-like, buffered)
  • e.g., for sorting
• Direct A-M (pure random access)
  • e.g., airline reservations
• Partitioned A-M (fast block transfer)
  • e.g., systems residence
• Indexed sequential A-M (sequential, buffered, with query)
  • e.g., utility billing
Overall Structure of OS/360

- **Supervisor:**
  - handles interrupts
  - allocates memory dynamically
  - allocates cycles among tasks

- **Scheduler:**
  - Sequences and parallels jobs
  - Commands operator

- **Data Management**
OS/360 Should Have Been Different

- Job Control Language—wrong concept
- *But not* time sharing—Not our market
- Fixed-length blocks on all disks, etc.
- One channel, control unit per device
- One sequential access method
- Only interactive debugging
- Streamline function ruthlessly
- Sysgen-optimized standard packages
Process Should Have Been Different

• Rigid arch control over *all* interfaces
  • *Included* external variable declarations

• Built in PL/I, not PLS-Assembler
  • Trained: “How to write *good* PL/I”

• Hidden the control blocks
  • but 7 years before Parnas

• Surgical teams

• Maintained a performance model
Key Players

- Labs: Poughkeepsie, Endicott, San Jose, New York City, Hursley (England), La Gaude (France)
- OS/360 Architect— Martin Belsky
  - Key— Bernie Witt, George Mealy
- Control Program Manager— Scott Locken
- Languages Manager— Dick Case
- OS/360 Assistant Manager— Dick Case
- OS/360 Manager from 1965— Fritz Trapnell