

IBM 1401

The legendary data processing system



The IBM *1401* was the first computer widely adopted by businesses and institutions worldwide. Announced in 1959, it was one of IBM's earliest transistorized computers and led a movement away from seven decades of punched-card accounting machines. The most popular computer during most of the 1960s, by the middle of that decade half of all computers in the world were *1401*s or members of its family.

Background

In the mid 1950s, business data processing—inventory, billing, receivables, payroll—was accomplished by passing decks of punched cards through electromechanical “unit-record” machines that sorted, calculated, collated, and tabulated. Operations were determined by hand-wired control panels. By contrast, tube-based mainframes offered flexible stored-program processing and magnetic tape storage, but were too costly for most businesses.

Origins

Responding to a European competitor, in 1957 IBM France and Germany built a multi-function transistorized “World-Wide Accounting Machine” (WWAM) prototype. Even though it used a control panel (stored programming was considered too expensive), its entry-level configuration came out too costly. Back in Endicott, New York, an outspoken system architect, Mr. Fran Underwood, found that he could economically replace its control panel with stored-program control. Keeping the WWAM's data paths, he designed an instruction set tailored for business applications, and called the new computer SPACE (Stored-Program Accounting & Calculating Equipment).

SPACE's development was headed by Charles Branscomb,

who expanded the team to 40 engineers working 24/7, incorporated a printer already in development, discouraged extra features and met the entry-level cost goals. By mid 1959, with a prototype running and sales training underway, the officially renamed *1401* was poised to revolutionize the business marketplace. Nevertheless, approval from IBM's forecasting department came just several months before product launch.

“Dawn of a new age”

On October 5, 1959, the *1401* was announced via closed-circuit TV to 50,000 participants in 102 locations. Remarkably, 5200 systems were ordered in the first five weeks alone, outnumbering its lifetime sales forecast and all commercial computers in the world! A year later, the first system was delivered to Time-Life, which transferred 40 million punched cards to just several hundred magnetic tapes. In this manner, *1401* tape systems freed users from the seven-decades-old practice of storing data records on punched cards.

Sales

By 1962, *1401* revenues surpassed those from traditional accounting machines. By 1965, the *1401* and its family—models *1410*, *1440*, *1460*, and *7010*—comprised half of all computers in the world and peaked at 16,000 systems in 1967.

Cost

The majority of *1401*s were leased. Rental for an entry-level *1401* was \$2,500/month, comparable to three accounting machines and a calculator. A typical system rented for



IBM *1401* system. From left to right: *1402* (card reader), *729* (tape drive), *1407* (console), *1401* (CPU), *729*, *1403* (printer)

\$6,500/month, or \$500,000 purchase (\$45,000 and \$3.4 million in today's dollars)—about 1/10th the cost of a mainframe.

Scale

Known as a “small-scale” computer, a 1401 system weighed 2–4 tons, consumed up to 13,000 watts, and contained about half a million parts. Mostly maintained by IBM customer engineers, reliability was renowned and many operated 24/7.

Architecture

The 1401 was designed around the serial processing of digits and characters. During its 11½-µsecond clock cycle, an instruction could add two decimal digits or input, output, or format a character for printing. Variable-length numbers and strings were stored one digit or one character per memory position. Memory size ranged from 1,400 to 16,000 positions, each 8 bits (6-bit character, end-of-number/string bit, parity bit).

Speed

The 1401 processor clock ran at 87,000 cycles per second. Today's 4-gigahertz PC can add two 20-digit numbers about a million times faster than a 1401.

Technologies

The 1401 used inexpensive Germanium alloy-junction transistors and point-contact diodes on about 3,000 Standard Modular System (SMS) cards. Core memory, a stack of meshes of tiny magnetic donuts threaded with fine wires, cost about 60 cents/bit (\$3 in today's dollars)—300 million times more expensive than today's DRAM.

Peripherals

Success of the 1401 galvanized competition. Pivotal to the 1401's popularity were its peripherals: 1403 chain printer whose speed (600 lines/min, fast skip) and outstanding print quality (horizontally rotating interchangeable chain) made it into an industry workhorse; 1402 card reader and punch (800 and 250 cards/min); and 729 mainframe magnetic tapes (13 million characters/reel). The 1405 RAMAC disk (20 million characters) and a bank check optical reader were available by 1961.

Software

Assemblers for machine-level programming (Autocoder, SPS), compilers for FORTRAN, COBOL, and Report Program Generator (RPG) languages; and sort and I/O utilities were offered. IBM did not have an operating system for the 1401 (but did for the 1410).

Competition

In late 1963, Honeywell challenged IBM's market dominance by announcing the faster and more capable H200, along with its “Liberator” software that ran 1401 programs unmodified.

Succession

In 1961, IBM began planning for the unification of its many computer lines. The System/360, announced April, 1964, consolidated software, peripherals and support in one compatible computer family. One key technology was flexible “control store” that enabled its low-end Model 30 to competitively run 1401 programs, thereby holding the fort against the H200. 1401 emulation also allowed IBM to deliver Model 30s when S/360 system software was late to market. Although 1401 family development wound down with the S/360 announcement, 1400s outnumbered S/360s up to 1968. The 1401 was offered by IBM until 1971 and PC-based simulators are available today.

Music & cinema

The 1401 could play music by melodically firing 1403 print hammers or by modulating its emission of radio waves received by an AM radio. Inspired by a recording of radio music made at a 1401 decommissioning ceremony in 1971, an Icelandic composer scored in 2001 a 60-piece orchestration *IBM 1401: A User's Manual*. In the 1964 movie *Dr. Strangelove*, actor Peter Sellers makes his opening appearance in front of a 1403.

Restoration

Computer History Museum volunteers, including a dozen retired IBM customer engineers, worked over 30,000 hours to restore two 1401s, one acquired in 2004 from a German garage and another in 2008 from a Connecticut home (operated until 1995). If you are interested in volunteering, or have memorabilia, stories or artifacts to contribute, please see the project web site at www.computerhistory.org/restorations.

