World's First Magnetic Disk Drive

Disk Storage Development, IBM San Jose Lab, 1952 – 1986

The story of the invention of the disk drive predates Silicon Valley. In 1952, in order to attract resident West Coast research and development talent, IBM opened a new laboratory on Notre Dame Avenue in downtown San Jose, not far from its 1940s punched card plant. Within a year, Lab Director Reynold ("Rey") B Johnson and manager Louis ("Lou") D Stevens recruited sixty engineers, scientists, and technicians (including a few self-professed "wild ducks"), fostering a collaborative and innovative culture. They investigated random-access storage technologies to supersede serially accessed magnetic tape and the manual searching of tubs of punched cards. By January 1953, Rey farsightedly focused the lab on its design for a disk drive: a stack of fifty rapidly rotating disks with magnetizable surfaces, accessed by magnetic read-write heads positionable to any surface and data track via one or two retractable arms, each controlled by a servomechanism.

While some engineers dismissed the intrepid design as unsound, even deriding it as a "bologna slicer," Rey steadfastly advocated for its continued development. Bill Goddard, an experienced aircraft engineer, alleviated concerns by crafting a read/write head that could fly on a compressed air "bearing" merely a hair's width above the undulating disk surface. John Haanstra, a UC Berkeley graduate (and later president of IBM's General Products Division), designed an "in-line" data transaction system called RAMAC: Random Access Method of Accounting and Control. Developmental snafus included a dramatic failure of the initial servomechanism and a spinning stack that unexpectedly disintegrated, injuring two engineers.

Working multiple shifts, the IBM San Jose Lab staff built, tested and debugged several disk drives during the spring of 1955. Collaborating with Endicott and Poughkeepsie staff, they then tirelessly assembled, tested and refined 14 prototype RAMAC systems, the first delivered to Zellerbach Paper Corporation in June 1956. In September, IBM announced the RAMAC 305, with its integral 350 Disk Storage Unit (Model 1), along with the similar 355 disk storage unit for its popular 650 computer. At the 1958 Brussels World's Fair, a RAMAC captivated crowds by printing out answers to questions about historic events in ten languages. In 1959, to showcase American innovation and know-how, Thomas J ("TJ") Watson Jr led the Soviet Union's leader Nikita Khrushchev on a tour of IBM San Jose's new 190-acre futuristic-looking industrial campus on Cottle Road.

During the next decade, IBM San Jose Lab engineers designed and manufactured higher-capacity and faster disk drives, based on self-actuating air-bearing heads and removable disk packs, for use in IBM's 1401 and S/360 computers. By the 1970s, competing firms were selling IBM-compatible disk drives and soon began to offer drives based on emerging open industry standards. In the 1980s, IBM's 3380 Direct Access Storage Device (DASD), the first gigabyte disk drive, accrued revenues of $25 billion. By the 1990s, the disk drive industry was doubling disk capacities annually, shrinking sizes and lowering costs. In 2003, IBM sold off its disk drive operations to Hitachi, while retaining its profitable storage system business, research and development. By 2018, the industry had sold approximately 9 billion drives worth about a trillion dollars in revenue.

Innovations at the IBM San Jose Lab also included thin-film read/write heads, voice-coil-motor actuators, error correction codes and techniques, disk cartridges, floppy disk, data cell drive, a relational database (System R), the Structured Query Language (SQL), a mid-1970s prototype of RAID, and Count-Key-Data storage subsystem emulation. In 1986, the San Jose Research Lab moved into the Almaden Research Center atop the nearby Santa Teresa Hills, a testament to IBM's invention and commercialization of disk storage, one of the foundations of the Information Technology era.

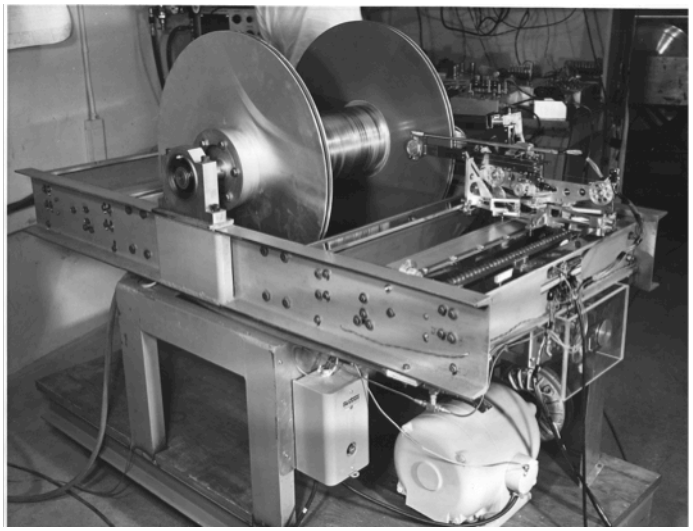
IBM 350 Disk Storage Unit (Model 1)

Capacity: 5 million characters
50 disks (24" diameter), 1200 revolutions/min
  Character = 6 bits (48 symbols) + 1 parity bit
  50,000 100-character records
  20 tracks/inch (on outer 5"), 100 bits/inch
  Random Access Time: 600 msecs average
Physical: 1,730 pounds, 68 ft^3
Rental Price: $650/month (equiv. $5,600 in 2018)
Purchase Price: $34,500 (equiv. $300,000 in 2018)
Units delivered (all models): ~2,000 350s, ~1,000 355s

IBM 305 RAMAC

Capacity: One or two 350 Units (5 or 10 million characters)
Technology: Vacuum tubes, relays, discrete components,
  100-character magnetic-core buffer
Programming:
  Up to 200 instructions stored on 6,000-rpm magnetic drum
  Conditional tests specified by plug-wire control panel
Physical: 5,300 pounds, 220 ft^3
Rental Price: $3,200/month ($28,000/month in 2018)
Purchase Price: $190,000 ($1.6 million in 2018)
Systems delivered: ~ 1,300

IBM 305 RAMAC at United Airlines, 1957



IBM San Jose Lab disk and head test bed, 1954

IBM 350 disk being unloaded from a DC-7 for "Exhibition of The Atom," Amsterdam, 1957

Demonstrating RAMAC at Brussels World's Fair, 1958

IBM CEO Thomas J Watson Jr and
Soviet Union Premier Nikita Khrushchev tour
IBM San Jose RAMAC production line, 1959

Photos courtesy of IBM Archives