

RAMAC launched disk-drive revolution

Computers weren't new back in the fall of 1956. IBM developed the Mark 1 calculating machine in the 1930s, and researchers at the University of Pennsylvania completed the ENIAC (electronic numerical integrator and computer) in 1945. Many technology historians consider ENIAC the first successful general-purpose digital computer. But the 305 RAMAC (random-access-method-of-accounting-and-control) system, which debuted in September 1956, was the first to include near-line random-access storage in the form of the IBM 350 Disk File. Before the emergence of the Disk File, core, tape, and drum memory provided the only storage option.

The Disk File afforded access to effectively 4.4 Mbytes of data, for the first time making the real-time retrieval and manipulation of database records a reality. The Disk File featured 50 24-in. disks that stored 5 million 7-bit characters. At the product's launch, IBM claimed that, to realize similar capacity using drum memory, one would have had to use a 42-ft-long, 13-in.-diameter

drum. IBM leased the 305 RAMAC with the 350 Disk File for \$35,000 per year.

Although the size of the 350 Disk File—60×68×29 in.—bears little resemblance to modern disk drives, its electromechanical design is remarkably similar to that of today's drives. It used a stack of iron-oxide-coated aluminum platters with magnetic-recording sur-

faces on each side. But it used only a single pair of heads that a motor had to move to predetermined positions on a vertical "way" to the disk of interest. Once the heads reached the correct position, a pneumatic cylinder moved the heads laterally to a position straddling the platter of interest. Amazingly, the design achieved a maximum seek time of 0.7 sec, and an NRZ (non-return-to-zero) recording scheme yielded a transfer rate close to 9 kbytes/sec.

Perhaps the best technical account of RAMAC and the Disk File is from the MHDC (Magnetic Disk Heritage Center, www.sjmdhc.org). The MHDC hosts an exhibit in the building that housed the original IBM lab. The MDHC pegs several other milestones that came on the heels of RAMAC that refined the electromechanical design in today's disk drives. Even before IBM delivered RAMAC, the lab was working on the prototype of the ADF (Advanced Disk File), which would appear in 1961 in the 50-Mbyte IBM 1301. The ADF achieved what IBM called "real-time, online, direct-access storage" by dedicating a flying head to each surface. In contrast, IBM pitched the RAMAC Disk File as "online, direct-access storage." The ADF also pioneered perpendicular recording, although both RAMAC and products that appeared after the 1301 used longitudinal recording.

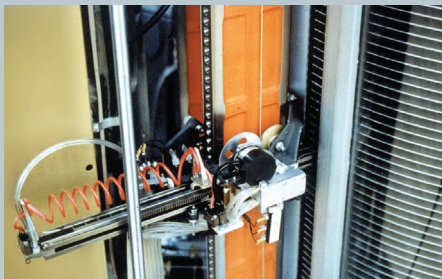
Later, IBM added servo-control information stored on the disks in the SDF (Single-Disk File); both RAMAC and ADF used open-loop control systems. SDF technology came to market as the IBM 3330 in 1971. The 3330 featured a 2-Mbyte removable disk pack, although the fixed-platter design returned later and remains the high-volume architecture. And the capacity march has never slowed. Today, for instance, Hitachi ships 1-in. Microdrives that store 8 Gbytes. Some projections have small MP3 players storing 3 Tbytes or more by 2020. **EDN**

Random Memory

NEW YORK, N.Y.—Built around the IBM disc memory, a random access memory unit has a storage capacity of 5,000,000 digits. Any of these digits can be reached directly without scanning through intervening records. The memory unit consists of 50 magnetic metal discs arranged in a vertical stack. Both sides of the discs are used for recording data, so 100 disc faces are available for storage. There are 100 recording tracks on

each disc face, and each track will hold a stack of ten 100-character records. The entire stack rotates at 1200 rpm, so that any address in the memory can be located in milliseconds.

Designed and produced by IBM, the Model 305 RAMAC uses punched card input and punched card and printer output. This data processing machine relies upon a powerful combination of stored program and control panel wiring for instructions. **EDN**, November 1956



The 50-platter IBM 350 Disk File featured a single pair of heads that moved vertically to reach the platter of interest and yielded a maximum seek time of 0.7 sec (courtesy Magnetic Disk Heritage Center).

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