IBM 1301 (including Models 1301/1302 and 353), 1961

The 1301 disk drive, which followed the RAMAC disk, is of historical significance because it introduced a dramatic advance in disk drive technology.

The 1301 was the first disk drive product to use flying magnetic heads. This design had a head-per-surface disk drive with a lower head spacing and became the direction for the development of future disk drives. The head-per-surface disk drive with a low head spacing provided much shorter access times (by a factor of 10) and greater storage capacities and extended transaction processing into business data processing for real-time applications.

Without the development of flying heads, magnetic disk drives would have had no future. First, the costs of the pressurized air bearing heads that had been used on the RAMAC would have been exorbitant. In addition, the low head to disk spacing required for higher capacity was not possible with the pressurized air bearing heads of the RAMAC.

A flying head made it possible for each disk surface to have its own recording head, so there was no need to move a head out from another disk to get data. A head for each surface dramatically reduces seek time as no single head ever covers more than one surface. Since the 1301 all disk drives essentially use a head per surface.

Background

The 1301 disk drive began as the Advanced Disk File (ADF) project in 1955. Although the RAMAC had not yet been announced, the goal of the ADF project, led by IBM manager Rey Johnson, was to achieve ten times the capacity of the RAMAC with about one-tenth the access time. To achieve this goal three new technologies were originally chosen: 1) flying heads, which had never previously been used on a rotating magnetic disk stack; 2) a hydraulic actuator to position a large head “comb” having one recording head per disk surface; 3) perpendicular rather than longitudinal recording that used oxidized steel disks.

The flying head (a self-acting, air-bearing head) is a small contoured slider in which the recording head is embedded. This slider avoids disk contact because it is supported by the boundary layer of air on a rotating disk. The head thus essentially “takes off” as the disk begins spinning, “flying,” and then “landing” as the disk comes to a stop.

In August 1959, product tests showed the steel disks contained too many imperfections to be useable. In January 1960, a special IBM corporate task force concluded that perpendicular recording be dropped and that the product design be switched to longitudinal recording as used on the RAMAC.

Many design challenges remained with flying heads. As a result, product announcement and shipping dates had to be delayed. In this crisis, Al Shugart was made program manager while Jack Harker was chosen to lead the flying head effort, which included Russ Brunner, Bill Gross, Ken Haughton, and others. This group carried out the fundamental research to better understand the design of flying heads for disk surfaces. Their efforts were critical.

The disks of the 1301 rotated at 1,800 rpm. The disk drive provided 50 tracks per inch and recordings of up to 520 bits per inch (thanks to a reduction in the average head-to-surface spacing from 800 to 250 micro-inches). The storage density was increased by a factor of 13 over what it had been on the RAMAC. The key initial customer for the 1301 was American Airlines with their planned Sabre reservation system.

The 1301, along with the RAMAC, were the only disk drives that used 24-inch disks. The 1301 had two disk modules of 20 disks each that were individually accessed. (The 1302 was a higher capacity version of the 1301.)

The designers of the IBM Stretch (a leading-edge supercomputer system for the Los Alamos National Laboratory) planned to use a 1301 which would differ from the commercial 1301 only by the addition of parallel data transfers through multiple read/write channels. This disk drive could not be developed in time to meet the schedule of the Los Alamos contract. The agreed-upon solution was to use Special Engineering. Special Engineering was a group in San

Jose headed up by Ralph Golub to handle special customer requests using existing products. This group was given the task of using RAMAC technology (i.e. air bearing heads and not flying heads) to meet the Los Alamos contract deadline. The capability of the RAMAC technology was far short of what the Stretch system required; what IBM sent to Los Alamos was a temporary substitute until the 1301 disk drive Los Alamos needed could be developed.

The original RAMAC hardware at Los Alamos was replaced with a 1301 which included parallel data transfers. Subsequent units with the specialized nature of this disk drive were designated as 353. All the Stretch high-end systems included the 353. The RAMAC was the original 350. The next disk drive is the 1301 and the 1302 was a slightly enhanced version of the 1301. The choice of 353 to designate this disk drive appears to be an acknowledgement of the role the San Jose Special Engineering group had in cobbling together RAMAC technology to save the reputation of the San Jose Laboratory when the contract deadline could not be met.

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March 1, 2013