The Once and Future Hard Disk Drive

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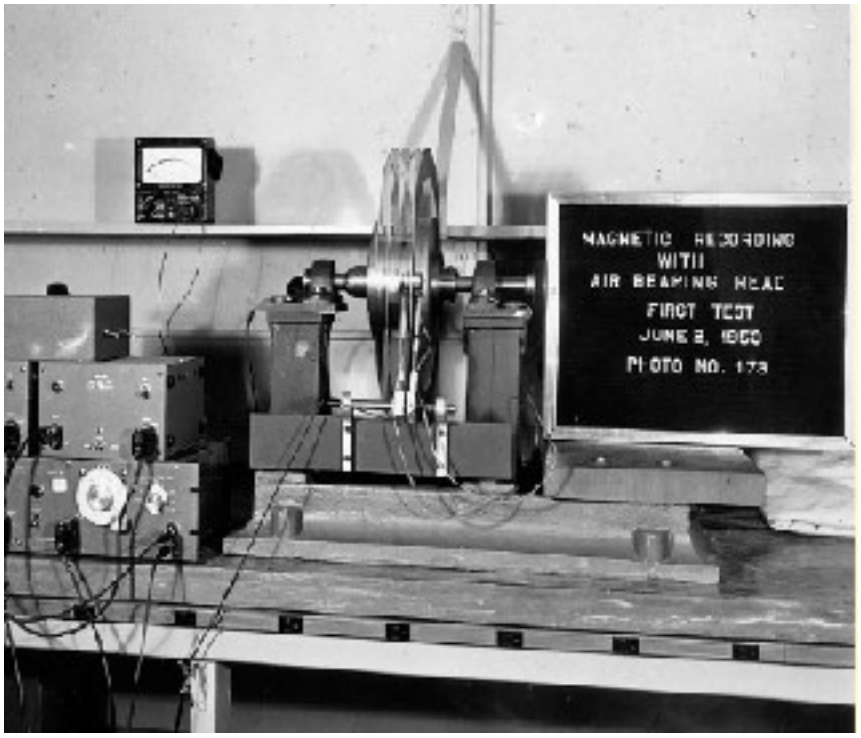
In the early 1950's an IBM manager named Rey Johnson moved from New York to San Jose and started a new research division. Rey had a vision--a storage vision. He dreamed of a device that would store digital information in a way that allowed rapid random access, stable non-volatile storage and the ability to write and read many times without wearing out the device. His vision of a digital rotating magnetic memory to realize these novel features was to become the hard disk drive for the RAMAC computer (**Figure 1**) [picture of testing with the airbearing head designed for the RAMAC disk stack in the laboratory in 1953]. The RAMAC first shipped in September 1956. In the past 50 years, hard disk drives have helped create the mainframe computer industry and then desktop and laptop computers. Today's hard disk drives are smaller, faster and vaster than the refrigerator-sized RAMAC and they offer a value to designers and consumers that has expanded their use to consumer products as well—both products for the home, such as digital video recorders (DVRs) as well as portable devices, such as personal media players and mobile phones.

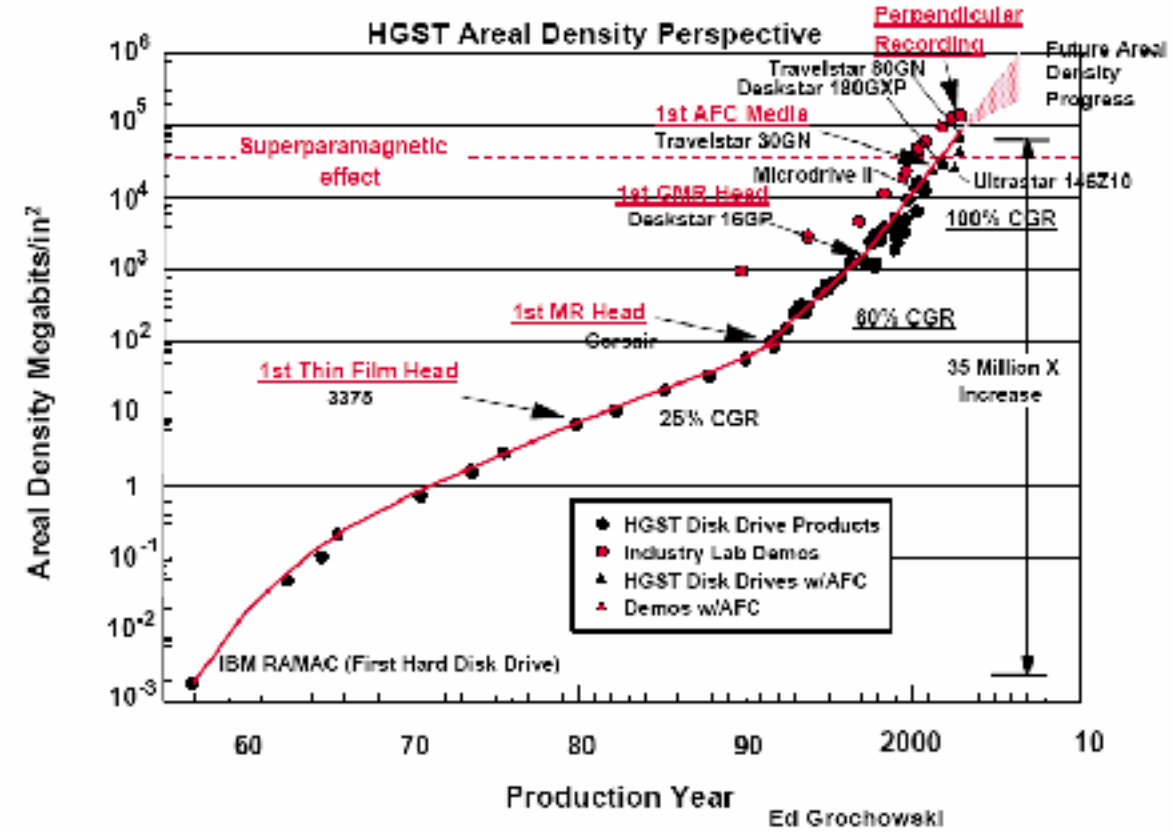
Figure 1. RAMAC Disk Stack at IBM San Jose Laboratory in 1953 (Source Hitachi GST)



Today's hard disk drives are used for a great many applications. In traditional storage in data centers, Fibre Channel and SCSI hard disk drives are used for high performance storage, while ATA-interface high capacity disk drives are used for inexpensive storage arrays for near-line storage. ATA-interface drives are also used in desktop and laptop computers, as well as home storage applications such as digital video recorders. Mobile products are using 1.8-inch and 1-inch disk drives with a few different interfaces. The size of hard disk drives available today range from 3.5-inch form factor to 0.85-inch.

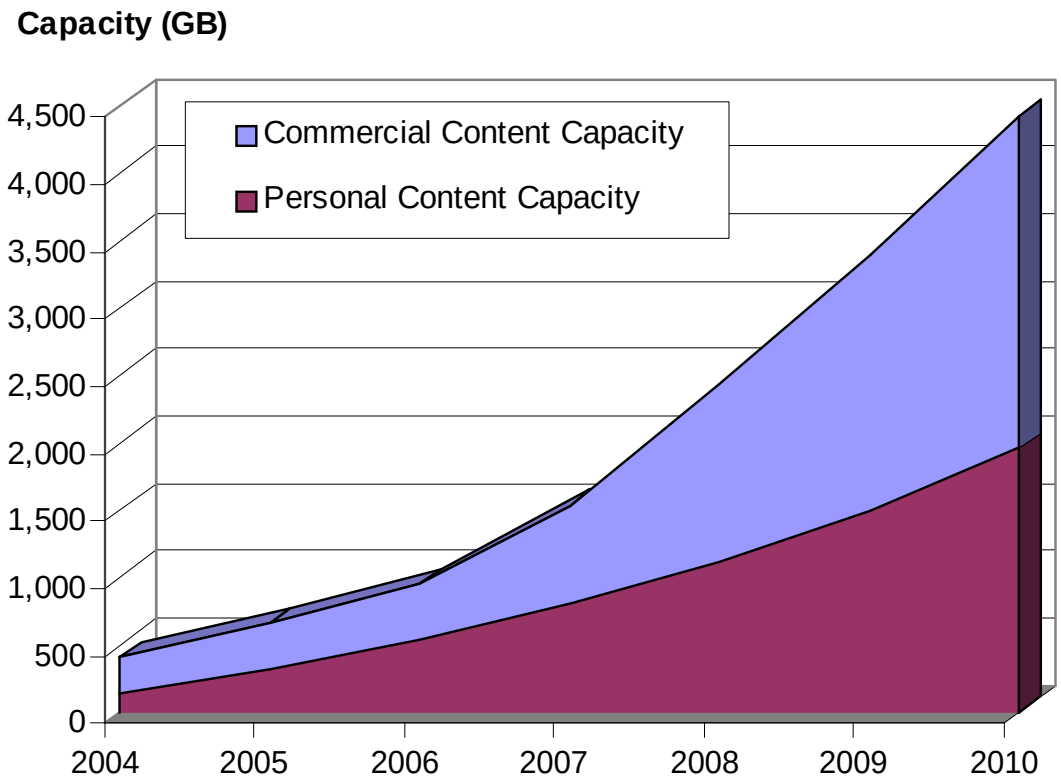
The increasing richness of human content has increased the appetite for digital storage. Hard disk drives have met this challenge by increasing areal density (the amount of information that can be stored on the surface of a disk) over 100,000,000 times since the introduction of the RAMAC (**Figure 2**). This rich history of technology development led to thin film inductive heads which were replaced by Magnetoresistive (MR) heads, then Giant Magnetoresistive (GMR) heads and now Tunneling Magnetoresistive (TMR) heads. Disks have changed in size and complexity from the plastic coated oxide media of the early days of the industry to today's sputtered thin film disks of ever increasing complexity. Likewise, electronics integration has made hard disk drives more and more intelligent and capable of decoding ever smaller recorded signals. As a result of this continuing technological innovation, by 2007 there will be 3.5-inch hard disk drives with storage capacities that will exceed 1 TB each and 1-inch disk drives with capacities that will exceed 20 GB.

Figure 2. Hard Disk Drive History of Innovation (Source Hitachi GST)



Because hard disk drives store all of our important human records security and preservation of data has become ever more important. Hard disk drives with built-in encryption are starting to appear in the market and storage networking and arrays are becoming common in even the smallest businesses. They soon will make their appearance in average homes, as well for primary and backup storage both for personal content as well as for family sharing of commercial content. Original copy personal and commercial storage in an average tech-savvy home could approach 4.5 TB by 2010 (**Figure 3**) and we expect that personal content will greatly exceed commercial content by 2020 driving enormous growth in personal and home storage requirements. Larger storage networks are becoming more aware of their own contents and if we are not to be buried in our own data we will need content aware storage systems utilizing intelligent content indexing and searching technology even in the home.

Figure 3. Growth in Tech-Savvy Home Cumulative Initial Copy Storage Requirments (Source: Coughlin Associates)



Backing up and managing personal and commercial content will drive new demands for networking of devices in and around the home and home network storage demand will grow with this demand. To prevent loss of valuable personal content inexpensive remote backup will also be enabled by the growth in digital storage technology. The concepts of storage networks and storage systems as well as storage management originally created for enterprise storage will migrate into home and small office environments (**Figure 4**)

Figure 4. Hard Disk Drive Storage is Showing up all Over the Home (10 hard disk drive products in this picture, from Hitachi GST Storage Visions 2006 Talk)

Regular people are becoming content creators, as well as content consumers. We are no longer just passive recipients of other people's content. Blogging and podcasts are becoming popular. Young people are now sharing images of their daily activities using cameras built in to their cell phones on social sharing websites. The day when cameras are built into glasses, hats or other personal adornment and are left on all the time is not too far off. The storage requirements for video recording of one's life in a life-log are staggering. As people become content creators they will also need more storage for the editing of their content as well as storing and archiving their content.

If we extend Rey Johnson's vision to the future could we not see a Terabyte of digital storage in a mobile device (a Terabyte in your pocket) and a cumulative digital content in the home of a Petabyte? And if these are the requirements for personal and home storage then an Exabyte in a datacenter is not out of the question. These developments are possible within the next 15 years due to the increasing storage capacity of hard disk drives. The hard disk drive truly represents an ongoing life enabling storage vision.

The Annual Storage Visions Conference: Come join us January 6 & 7, 2007 at the Flamingo Hotel in Las Vegas, Nevada for the 6th annual Storage Visions Conference. Hear our sponsors, such as Hitachi GST, explore and describe new opportunities for digital storage and personal and entertainment content creation, distribution and reception. Meet and network with the creators of the future and explore all the ways that digital storage will enrich our human experience!

