HISTORY OF THE FLOPPY DISK AND ASSOCIATED HARDWARE

The floppy disk or diskette became an icon of the personal computer revolution in the late seventies and early eighties, but its roots extend well before that era. With the advent of computer semiconductor memory in the late nineteen-sixties came the annoyance that the loss of electrical power meant the loss of all data stored in the central memory. International Business Machines (IBM) technicians needed a simple, inexpensive way to get the initial "operating system code" back into the semiconductor memory. Prior to floppy disks, punch card decks and magnetic reel-to-reel tapes were the only realistic alternatives of transferring this operating code into the semiconductor memory. The need was for a simple, inexpensive serial tape-like medium that could have a capacity of at least 65 kilobytes. (Engh 1981, p. 701)

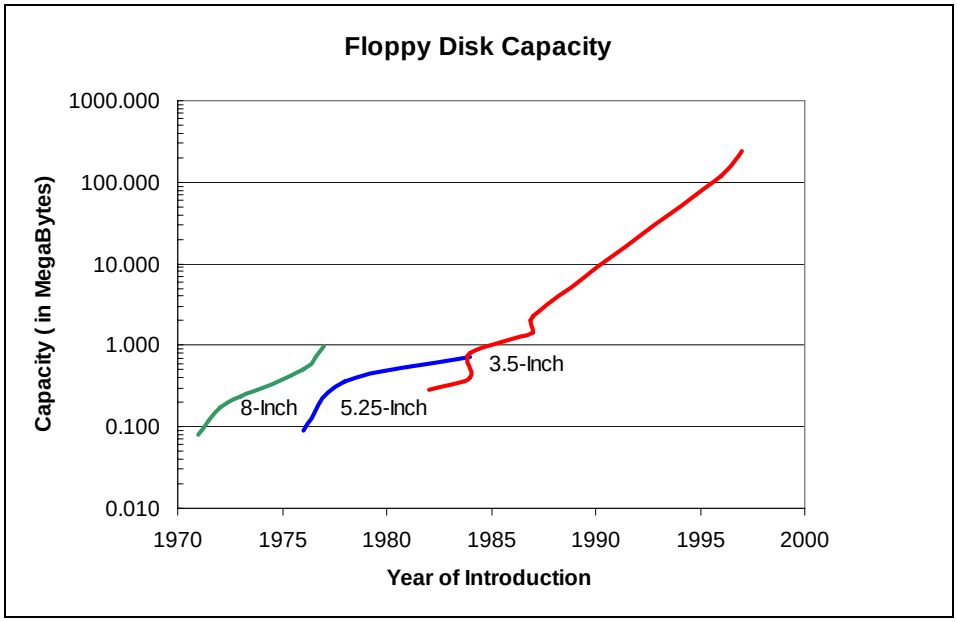
Taken into consideration were rigid magnetic disks, magnetic belts, dictating machine recording disks, 45-RPM (revolution-per-minute) phonographic records, and audio tape recording cartridges. After evaluating these choices at the IBM San Jose Development Laboratory in 1967, the recommendation was to proceed with the development of a removable flexible-disk-type device. (Engh 1981, p. 701)

The invention of the floppy disk is not due to any single individual (excluding Dr. Nakamatsu's claim noted below), but rather a team effort according to Allen Shugart, director of Engineering for the IBM Systems Development Division at that time. During a speech in 1998, Shugart bestows most of the credit to Dave Noble, the floppy disk program manager at IBM in 1967. In Shugart's words, "Dave Noble…is the real father of floppy disks in my judgment." During the same speech, he credits Herb Thompson and Ralph Flores with the development of the jacket that housed the disk, which according to Shugart, was just as important to the floppy's success. (Shugart, 1998)

Some credit Dr. Yoshiro Nakamatsu (AKA Dr. NakaMats) of Japan for the invention of the floppy disk. (Hornyak, 2002, p. 8) According to Dr. Nakamatsu, he invented the floppy disk while working on a project at the University of Tokyo in 1952, twenty years before the research at IBM. However, IBM says it owns the patent to the floppy, but also confirms that they did make several nonexclusive patent agreements with Nakamatsu in the late 1970s to avoid conflicts. (Hornyak, 2002, p. 8)

The initial purpose of the floppy disk was to act as a distribution system for IBM code. Since all writing to disks took place at IBM facilities, the field units could only read from disks. This arrangement kept costs lower for read-only devices. However, as engineering refinements continued, is was possible to make the field devices also capable of writing to a floppy disk, thus providing a media for the inexpensive off-loading, sharing, and long-term storage of data in the field. Continuing refinements to the floppy disk made the physical disk progressively smaller while increasing the storage capacity as illustrated in Table 1.

Table 1: *Floppy Disk Capacity History*



Source Data for creation of graph from: http://en.wikipedia.org/wiki/Floppy_disk

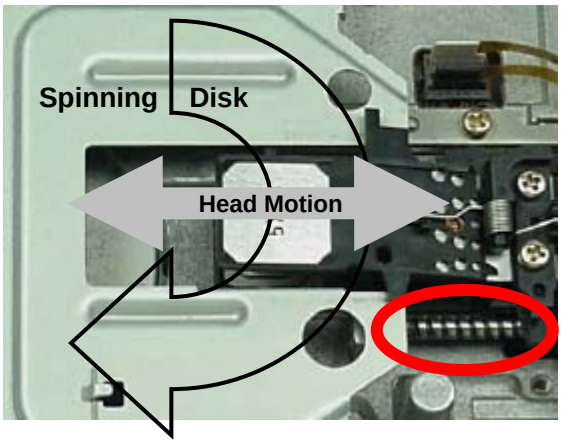
With the advent of the personal computer in the nineteen-eighties, the popularity of the floppy disk grew rapidly as it provided the ideal media for the saving and sharing of applications and data between computer users. The first major commercial personal computer to offer the option of a 5.25-inch floppy disk drive was the Apple II computer in 1977. (Wozniak & Smith, 2006, p. 216) Then in 1984, Apple once again made history with the introduction of the Macintosh computer, which included a Sony 3.5-inch floppy drive. (Hertzfeld, 2005, p. 160) In both cases, the IBM PC market soon followed Apple's lead.

With the introduction of the 3.5-inch floppy, a sturdy plastic case replaced the thick plastic-impregnated paper jackets of the original eight and then 5.25-inch disks. Unlike the original disks, the opening in the jacket for the read/write heads now included a metallic cover, which automatically opened upon insertion into a disk drive unit. These improvements and the higher capacity thus created a 240-megabyte portable data carrier that fit in a shirt pocket, a sizeable improvement over the original 1971 concept of Dave Noble and his IBM team.

The floppy disk unit consists of a mechanical drive device, electronic circuits that control motors within the device, software that drives the circuits, and of course the removable floppy disk. The electro-magnetic and operational theory of the floppy disk device is too complex to explain in this short paper, so what follows is a very brief and simplified explanation of how a 3.5-inch floppy disk drive works.

The floppy disk is a thin, round piece of plastic coated on both sides with a magnetic material and encased within a plastic jacket. Both the jacket and disk have a hole in the center to allow an electric motor to spin the disk inside the jacket. Placing the disk into the drive moves the thin protective metal cover out of the way exposing the magnetic coated disk to the read/write heads of the floppy drive. There are two read/write heads in the traditional drive, one

for the top, and one for the bottom of the disk, allowing the use of both sides of the disk. Electric motors, under the control of the drive's electronics, rotate the disk at a precise speed. Another motor moves the heads across the disk's surface using a screw gear, circled in Illustration 1, which moves the heads back and forth as shown in Illustration 1. This provides the heads with access to most of the disk's magnetic surface. The electronics that control these motions utilize computer code called firmware. Firmware is a permanent type of software code built into the electronics of the disk drive unit.

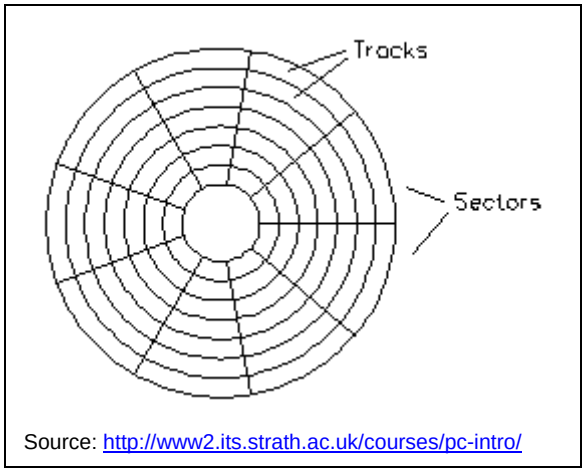


Source: http://computer.howstuffworks.com/floppy-disk-drive2.htm

Illustration 1: *As the disk spins, the screw (circled) moves the head back and forth over the spinning disk.*

The main distinction between the floppy disk drive and tape devices is the mechanics of how the magnetic media passes under the reading and writing heads of the device. A tape device moves a ribbon of magnetic coated tape under the read/write head, while a floppy disk device moves the read/write head over a spinning magnetic coated disk. The difference is significant. While the tape unit writes and reads data sequentially, from beginning to end, the floppy disk unit can write or read data randomly to any spot on the spinning disk. A random writing/reading device is much faster at storing or retrieving data. The IBM card readers are also sequential and read-only devices, reading from the first to the last card.

Before using a new disk to store data, formatting of the disk must occur. This involves the computer sending instructions to the floppy disk drive's electronic circuits, which use the write head to place magnetic markers onto the disk's surface, much the same as striping a parking lot with numbered spaces, but in this case for the parking of data, not cars. This process results in the creation of concentric tracks similar to those illustrated in Figure 1, including a number of segments within each track, which act as holding areas for storing data.



Source: http://www2.its.strath.ac.uk/courses/pc-intro/

Figure 1: *Floppy disk tracks and sectors*

Formatting a disk also creates a File Allocation Table (FAT) on the disk. This table not only tracks the location of the tracks and sectors (the numbered parking spaces) but also what data is stored in each of the spaces. Using software instructions from the computer, this table allows the computer to write and locate data on the floppy disk. Since the magnetic coating retains the electro-magnetic patterns written to the disk, disk drives in other computers can read data written by a floppy drive in a different computer. Of course, the real operation of a disk drive is much more complex than this description, but this explanation covers the basic idea of how the floppy disk works.

The floppy disk, once the symbol of the personal computer, is swiftly evaporating into computer history. Apple stopped offering floppy drives with the introduction of the iMac in 1998 and Dell announced that it would stop offering floppy disk drives as standard equipment in their higher-end desktop computers in 2003. Other companies, such as Hewlett-Packard, are quickly following their lead. (Swartz, 2003, p. 12) Two factors are driving this shift, inexpensive universal serial bus (USB) flash memory devices and the Internet. The smaller USB flash device holds thousands of times more data and is less susceptible to magnetic and physical damage, while the Internet offers inexpensive and unlimited capacity, better security, and the ability to retrieve data anytime from anywhere in the world. In a few more years, the floppy disk will join the venerable IBM 80 column punch card, just another relic from the past.

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