Driving home the mainframe memories

Forty-four years of disk-drive development

BY JOHN EELLS

Over the past couple issues of *z/OS Hot Topics*, we've been reminiscing over the good 'ol days of the mainframe. From once-pervasive punch cards to printers with hydraulically-driven paper carriages and punched paper tape, we've seen how the state of the art of yesteryear served as stepping stones to today's technology.

This third article on our "Memories of a mainframe" series explores disk drives and their development over the past forty-four years.

Removable disk packs and head crashes

Printers were not the only computer peripherals to use hydraulics. 2314 disk drives, introduced in 1965 with the first removable disk packs, used hydraulic pistons to move the read/write heads in and out of the disk packs during seek operations. 2314s came nine to a bank, but because disk technology was still fairly new in 1965, only eight of them could be used at a time. On many days, there was probably an IBM® Customer Engineer (CE) poking around the ninth one. When a drive failed, the disk pack could be moved to another position on the bank, and the address plug could be moved with it so that the system did not know it had moved. Back then, nobody noticed if you hit Stop (it was an actual button) for a few minutes while you moved a disk pack. Today, initiating the Stop action on the hardware master console (HMC) for a production LPAR would probably generate considerable and immediate attention.

Because the disk packs were removable, there were usually more disk packs than disk drives. Volumes would be mounted and removed when needed, which was a good thing because the amount of storage was very limited and the drives were expensive. What was not a good thing was dropping a disk pack. The platters were made of aluminum, and dropping one was very likely to deform one or more platters. No positive outcome about such an event was ever reported. There were many, many reports of bad outcomes, though, almost all of them carrying the dreaded label "head crash." During this time, it was not unusual to open a disk drive drawer to find powdered aluminum, magnetic oxide powder,

and bits and pieces of what used to be read/write heads in the drawer. When this happened, the true meaning of the SHARE button became clear: “Blessed are the pessimists, for they have made backups.”

State-of-the-art---back then!

When errors occurred on a disk drive, it was not unusual for an operator to try a different drive with the same disk pack. After all, it was more likely that the drive had failed and that the disk pack was fine than the other way around. But sometimes, it was the other way around... and sometimes many disk packs and disk drives were destroyed in near-geometric progression starting with one damaged disk pack. In at least one instance, hundreds of drives were damaged. Although this was the state of the art back then, sometimes “they don’t make ‘em like that any more” for good reason, and removable disk media is one example!

New generations

3330 disk drives followed five years later, in 1970. Far more reliable than the 2314, and with no messy hydraulic oil, they held a whopping 101 MB per removable disk pack. Later, the 3330-11 could store 202 MB per volume. The track length changed from 2314 to 3330 (and again for 3350, 3380, and 3390), but eventually we froze the track length when 3390s became emulated on Redundant Array of Independent Disks (RAID) DASD. Like the 2314s, the 3330s had removable address plugs you could use to swap a volume between drives on the same bank without changing its address. Unlike the 2314, there were eight drives to a bank, the spare no longer being needed as the technology became more reliable.

The 3340, 3350, 3370, 3380, and 3390 all followed in turn. In the 3340, the head-disk assembly (HDA) was removable, but starting with the 3350 all HDAs were bolted down inside the machine. The 3350 was also the last drive to have a window through which you could see the spinning disk pack.The 3380 had two volumes per HDA, and was said to reduce power consumption by up to 70 percent, floor space by up to 65 percent, and heat generation by up to 75 percent compared to equivalent storage based on IBM 3350s.

Also at that time, the IBM 3880 controller introduced Dynamic Path Selection so an I/O could be completed on any available path rather than waiting for the one on which it had been initiated. This new function could be used to improve performance or drive channel utilization higher with equivalent performance. Finally, the 3880 introduced cache to IBM’s DASD controllers.

Along the way, the DASD geometries changed, with both the track length and the number of tracks per cylinder changing from generation to generation. The changes in track length drove changes in block size optimization. Finding that most tracks were used efficiently with block sizes around 6 KB caused a number of people to standardize their block sizes for fixed-block (FB) 80-byte record data sets to 6160 and for load libraries to 6144. Eventually, System-Managed Storage

(SMS) and System-Determined Blocksize (SDB) let us all stop worrying about the block sizes for most data sets.

DASD speeds and feeds changed, too, as you can see from Table 1:

Model	Average Seek Time	Average Latency	Data Rate
2314	75 milliseconds (ms)	12.5ms	291 KB/second
3330	30ms	8.4ms	806 KB/second
3350	25ms	8.4ms	1.2 MB/second
3380	17ms	8.3ms	3 MB/second
3390	12ms	7.1ms	4.2 MB/second
DS8000™ (with 15K RPM disks)	3.5ms	2ms	2-3.7 GB/second

Table 1. DASD speeds and feeds

Although the DS8000 numbers are included in Table 1, today's large caches and correspondingly high hit ratios for many operations render the seek and latency time nearly meaningless for many workloads.

More memories

Interested in reading about the history of punched cards and the development of the IBM mainframe? How about the glory days of IBM printers? Then you need to check out the following installments of "Memories of a mainframe:"

- "Memories of a mainframe: First in a series of mainframe reflections" in *z/OS Hot Topics Issue 20*, March 2009, SA22-7501-16.

- "More mainframe memories: Printers" in *z/OS Hot Topics Issue 21*, August 2009, SA22-7501-17.

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