NCR CRAM (Card Random Access Memory)

1962   NCR CRAM (Card Random Access Memory)
        First commercially significant bulk storage subsystem

Why this is important

NCR was the first company to incorporate bulk storage as an integral element of online inquiries. Bulk storage provided accessibility to a larger capacity than could be cost-justified on secondary storage devices such as disk drives. The cost/bit was reduced by using removable media, transport mechanisms, and read/write stations.

See also http://www.computerhistory.org/groups/storagesig/media/docs/STK-4400.pdf
  1987   STK 4400 ACS (Automated Cartridge System)
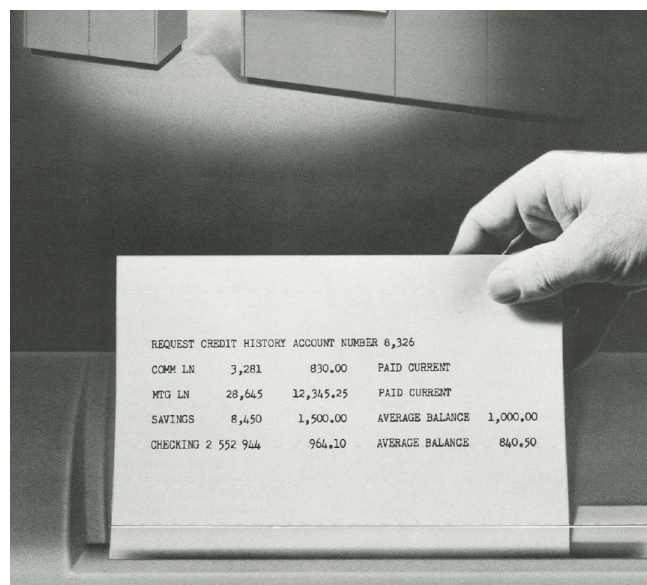   *Most commercially significant bulk storage subsystem*

Discussion

It's 1964, and you need to buy a washing machine. There is no credit card, and there may not be enough in the checking account so you stop by the local bank to check the balance.

The teller walks over to a cabinet and starts leafing through the green lined computer printout, reaches for a pen and writes a number down. Just enough, but then you are told it is the balance as of Monday last week. Uh oh, now you have to add up your checks and deposits and then check with your spouse to see about any other checks and deposits that may have been made.

That was normal for the time, unless your checking account was at a bank with the latest NCR equipment.

The teller pressed some keys on the posting machine, and turned to chat about the weather. Next came the sound of a teletype bursting into life, and when it was finished you were handed a sheet of paper which listed the last 10 entries (checks, deposits, interest) along with the current balance.

Source: Reference 1

NCR's 315 was the first commercial system to integrate real time processing and bulk storage. The promise of near-immediate access to information was thus extended to a broad spectrum of applications which were normally processed on tape. It took years for others in the industry to catch

up (aided by the ever-increasing capacity of disk drives). The brochures of the time were clear about the intended purpose.

> *Computers...store data in a language of their own that cannot be read by human beings. Because of this, most computer systems must perform special print routines to generate reports for human use. However, with CRAM and the 315, Remote Inquiry Stations can be operated online - permitting humans to interrogate the computer files and receive immediate answers to inquiries.*
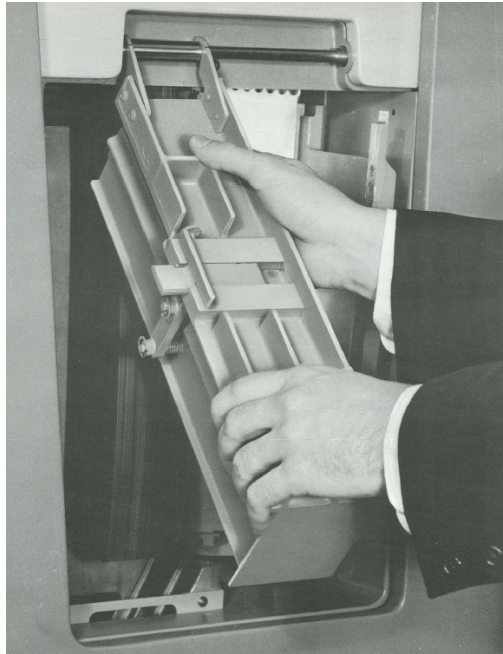

Source: Reference 1

Some paragraphs were prescient.

> *In savings institutions, Class 42 Window Posting Machines can be operated online with an NCR 315 CRAM System to provide real-time processing of savings transactions. With the Online Savings System, the bank's savings accounts will be stored on CRAM cards. As a transaction occurs on the banking floor, the bank's record and the customer's passbook will be updated simultaneously under computer control. In effect, this system places the 315 CRAM Computer at the finger tips of every teller.*

Others not so much.

> *Even though Banks do not normally have branches located hundreds of miles apart, it is possible to communicate to or from any point in the United States where telephone lines are available.*

Though performance and immediacy was stressed, the boasting was only valid if the account holder's information was online. If not, the CRAM the operator would be advised to change decks, so instead of seconds it would be minutes (still way better than two weeks).

Source: Reference 1

If 60 tellers would depress the account number keys on their consoles at the exact same time, it would take 20 seconds to complete the 60th teller's transaction.

The difficulties incurred by outages were anticipated.

When the computer is back 'on-the-air', the teller again sub-totals the Class 42 console and then operates 'online'. At the end of the day, the teller merely re-enters each of the transactions that occurred off-line.

Merely? That reads like a lot of work for the tellers, unless one already knows that the Console stored transactions made in off-line mode. All it took was a couple of key presses.

The complexities of the CRAM went beyond mechanical and electrical, it depended heavily on pneumatics to make it work. A removable deck originally held 256, later 512, magnetic cards that were 14" long and 3.25" wide. The 56 heads recorded 7 parallel tracks of 8 bits, and later recording was serial with a sliding bar of 36 heads that could be moved to any one of four positions.

Source: Reference 1

The cards were notched to create unique binary combinations. Separate jets of air blowing over the 8 (later 9) rods kept the cards separated so that the one selected could drop into a chute which guided it to the drum which revolved at over 20 mph where vacuum pressure sucked it against the surface. To recover from a situation when the selected card failed to drop, NCR provided a 'pencil' made of glass to aid physical separation.

The first impression that hit anyone walking into a machine room full of CRAMs was the wall of noise from the four vacuum/blowers in each unit. Not only was there a constant flow of air being forced over the rods and the vacuum pressure used to suck the card against the drum, the return path of the card also relied on pneumatics.

One sound could penetrate the wall of noise and strike fear into the heart of operators: the screech emitted when two cards dropped together and concertina'd as they tried to squeeze into the drum entry. Neither card survived, so operators used an NCR tool to cut matching notches in blank cards. If there was a backup kept (on tape or a duplicate), the cards could be restored.

Static electricity was an enemy, which is why wax coated the magnetic side of the mylar cards and the flip side was done with carbon. Cards were not compatible over the life of CRAM. Early models recorded 8 bits/character (6 data/1 parity/1 clocking) and the later higher density models recorded 7 bits/character (14-bit word/2 parity bits/automatic clocking).

CRAM was a successful product. Introduced on the 315, it was a mainstay of the next generation Centurion series computers until the Criterion series was introduced in 1976. By then, the applications had long been migrated to disk drives, but some CRAM units remained in use into the early 1980s.

It was over 20 years before the most successful bulk storage product came along, the1987 STK 4400 Automated Cartridge System, which introduced the concept of 'near line' data.

Moderator: Dal Allan

References:
(1) http://archive.computerhistory.org/resources/text/NCR/NCR.CRAM.1960.102646240.pdf
(2) http://archive.computerhistory.org/resources/text/NCR//NCR.315.1960.102646241.pdf
(3) http://archive.computerhistory.org/resources/text/NCR//NCR.315.1960.102646242.pdf