History: Seymour Cray's computers

- Univac/ERA/CDC

- 1960: CDC 1604

- 1963: CDC 3600 – CSIRO – parallelisation by DAD – overlap i/o with computation, drum

- 1965: CDC 6600 – CSIRO access – parallelisation – multiple functional units, PPs

- 1967: CDC 7600 – CSIRO – parallelisation – pipelined multiple functional units, PPs

- 1976: CDC 8600 -> Cray-1 – vector instructions – pipelines, with high memory bandwidth (Cray-2, Cray-3, Cray-4; Cray X-MP, Y-MP, C90, J90, T90, SV1, SV2; NEC, Fujitsu, Hitachi)

Seymour Cray's computers – a pattern for the future

- RISC – not many instructions – 15- and 30-bit instructions – 6-bit op-code

- CDC 6600 – multiple functional units

- CDC 7600 – pipelined multiple functional units

  - Instruction stack able to hold instructions for a small loop

  - 8 A registers, 8 X registers, 8 B registers

  - No load/store instructions

  - Changing any of A1 to A5 resulted in auxiliary hardware loading into X1 to X5

  - Changing A6 or A7 resulted in the storing of the contents of X6 or X7

DAD

The basic item of information is a document which can be for example a program, a sub-progra, data, program and data, etc. In general a stack of documents will be read by the card reader and whatever their final requirements the information from these documents will be written on to the magnetic drum under the control of a background program. Similarly input from the paper tape or magnetic tape stations and from the keyboard consoles can be routed to the drums by the background program. These documents if required for execution as indicated on the relevant control cards will be entered on to one of two Execution Lists either EL1 or EL2. Short running jobs i.e. less than K mins., (K at present is 5) will be placed on EL1 which will have priority over all the jobs in EL2.

DAD

When the DAD system is fully operational the user will be able to retain documents containing data or relocatable subroutines or Fortran subroutines on the drum. Using the keyboard consoles he will be able to edit old documents, create new documents and call documents for execution.

DAD March 1967: saving for extended periods signalled discarding

<u>Saving Documents Future Policy</u>

It is expected that within a few months the system will be able to save documents for extended periods. It will then become necessary, at times, to discard documents when the drums are full. Documents which have names with the last two characters in the identification field numeric and in the range 01 to 69 will be discarded first.

Charging: set in advance: $108 per hour for compute, $7.50/Mbyte/day.

CSIRO

October 1967: disc added: 75 Mbyte

<u>Disc Files</u>

Computers in the C.S.I.R.O. network are presently having their total storage capacity increased by the addition of disc files. Some notes on the use which it is planned to make of these facilities is given below for both the 3200 and 3600 systems.

3600 Disc System

The 3600 computer in Canberra is being equipped with a disc controller and Type 813 non-interchangeable disc file of 100 million characters capacity (i.e. $12\frac{1}{2}$ million 3600 words).

It is proposed to make approximately 10% of this available to DAD users as a random access bulk store, similar to the random access facility for the drum. The remainder of the disc file will be used by the DAD system as a bulk store of serial documents. It is a design aim that documents on the disc should survive most DAD system failures, and that, in any case, it would be most unlikely that all documents would be lost as a result of a single failure.

CSIRO

March 1968: documents able to be retained on-line: removed each weekend

Display Program DISCDOCS

DISCDOCS has been added to the 3600 display program library as a general purpose means of allowing users to retain documents from day to day in the disc file system. At present the facility is only available to display users, however, software is being developed to extend the facility by means of control card options in main jobs. As the system is still under development, no guarantee is given at the present time that documents will remain on the disc, and currently they are not saved over the weekend.

CSIRO

August 1968: documents saved to tape across weekend:
– oldest discarded!

II. 3600.

Disc Saving

Formerly, disc documents were retained during the week only, maintenance at weekends causing loss of these documents.

Now the disc documents are transferred to magnetic tape storage at the beginning of this weekend maintenance period, and are restored at its end according to the following algorithm:

At disc shutdown, all disc documents are sorted on the date of most recent activity, and saved on magnetic tape.

During disc startup, documents are returned to the disc in order of most recent activity, until all documents are restored, or until the disc reaches a pre-determined level of capacity.

CSIRO

Feb 1969: more flushing, not just over weekends

<u>II.   3600</u>

Due to the increasing use of the disc, and the attempted indefinite retention by users of disc documents, it has been found necessary at times to expunge unaccessed documents of earliest retention date.

Currently at the close of the week's processing all disc documents are sorted into order of latest reference date, and these documents are copied to a number of magnetic tapes. A full disc requires about 7 magnetic tapes.

At the start of the next week's processing four of these tapes are copied back to the disc. The remainder of the tapes are held for a short period and then reused.

The retention time of disc documents remains undefined, as it depends on total disc activity. Recently it has ranged from 6 to 10 weeks.

It is hoped that in the near future it will be possible to transfer documents between the drums and magnetic tapes. In the meantime it is advisable for the user to write his document on magnetic tape if he wishes to retain it for an indefinite period but does not intend to make frequent use of it.

July 1969: Flushing – possible down to 15 minutes old – by access time!

- Dealing with filling filesystems
- Files sorted by date of last access, and older files discarded.
- Retention period not defined – depends on activity – right solution, rather fixed age currently still practised.

Document Flushing

All documents held on the magnetic drum have an entry in the Main Document List to identify them. One word of this entry has contained the date of last activity. The format of this word has been changed to include the time of last activity also. At present FLUSH makes use of this new information to avoid deleting any document less than 15 minutes old. This use of the time by FLUSH is only tentative at present and will probably be improved.

Feb 1970: charging: for inactive files only; 'touch' disabled!

(a)   Rental for storage of disc documents

The term 'rental of storage' used in the circular refers only to inactive disc documents, that is, documents which have not been used within a period of one day. The mechanism to be adopted is that all disc documents will be scanned once a day, and those with an activity date and time more than 24 hours earlier than the scanning time will be charged one day's rental. Where the computer is not being operated, for example over a weekend, the daily rental will not be charged.

It can be seen that 'shared files', that is, documents placed on the disc by one user for his own benefit and that of others, will not have rental charged to the originator if other users are making use of such documents.

It should be noted that from the date of application of the new charges the command

                *DFLOCATE, parameters

will not update the activity date.

CSIRO

Sep 1970: flushing again: max: two months: min two days

AUTOMATIC DISC FLUSH | 3600 |

As from 21 September, the retention of documents on the disc will again be subject to automatic flushing procedures. The flushing procedures were suspended after charges introduced for storing inactive documents on the disc in February this year produced a sharp drop in the use of the disc for long term storage. Since then no documents have been deleted. However, the document storage area on the disc is now becoming full, and it is necessary to clear space for new documents.

At the beginning of each week, all documents of age greater than two months will be flushed from the disc. (The age of a document is defined as elapsed time since it was last copied from the disc to the drum or since it was created, whichever is the lesser.) Further documents will then be deleted, starting with the oldest, until sufficient space remains for new documents to be added during the week. Initially it is expected that it will not be necessary to delete documents less than two months old, but as disc usage increases the life expectancy of an unreferenced document will decrease.

Users are reminded that a 'card' document on the disc may be punched out on cards by submitting the following job.

```
*JOB,charge code,ident,time
*ERASE,62
*DFCOPDR,62,,docname
*EOD
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Documents that cannot be punched on cards may be saved on magnetic tape by using UTILITY (see INSTANT DAD).

Two month maximum age – then flushing to reach threshold
Can still make card decks!
Later – two days grace period – allowing for delayed airline flights

CSIRO

March 1971: saving flushed files to tape, allowing restoration: HSM!

A project in hand will shortly be introduced as a service to save flushed documents on magnetic tape and to render them accessible to the user for a period of eight weeks after flushing. References made to flushed documents will then result in a diagnostic

DOCUMENT SAVED ON TAPE DATE. . . . .

or similar, to the user. Details of this service will be announced shortly.

CSIRO

May 1971: 8 weeks retention for flushed documents; control statements provide info. on off-line copy

DISC DOCUMENT FLUSHING   3600

From the beginning of this month documents flushed from the disc will be held on magnetic tape for a period of eight weeks. It was decided to introduce this back-up service following the abrupt change that took place two months ago in the ages of unreferenced documents left on the disc after weekly flushing procedures (see Newsletter 67).

A set of DFSAVE tapes will be maintained in the machine room, each tape having a label of the form

DFSAVE*dd/mm/yy*

where *dd/mm/yy* is the creation date of the tape.

An attempt to access a flushed document using the disc control statements DFCOPDR or DFLOCATE will result in the diagnostic

DOCUMENT SAVED ON TAPE LABELLED DFSAVE*dd/mm/yy*

and processing continues. (A call to DISCDOCS from a Fortran program will return the value 11.)

May 1973: retention period up to 99 days

DOCUMENT RETENTION AND ARCHIVAL

It is now possible to retain documents in the document region for a period of up to 99 days. This is done using the SV declaration, either in an EQUIP statement or a MABEL request, appended with nn, where nn is a two-digit number 00-99 indicating the desired retention. For example:

May 1973: charging for storage: up-front!

A charge of 0.225 system seconds per sector per day of specified retention is made when the SVnn declaration is executed. (Note this differs from the way daily charges are made for documents on the disc document store.)

- Brilliant control:
  - charge up-front by size and retention period!
- (Terrible for users? But they could specify a short retention period, and extend when needed.)

CSIRO

History: 1960s