



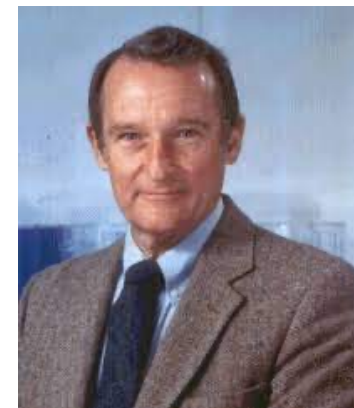
2022 – IMT Webcast

# Why Cray?

## Robert Bell, CSIRO

# Seymour Cray – the person

- Born in Chippewa Falls Wisconsin
- Code breaking during WW II
- B.Sc. in electrical engineering, M.Sc. in applied maths
- *Sources: Cray a supercomputing journey...*, Wikipedia, CSIROpedia Computing History

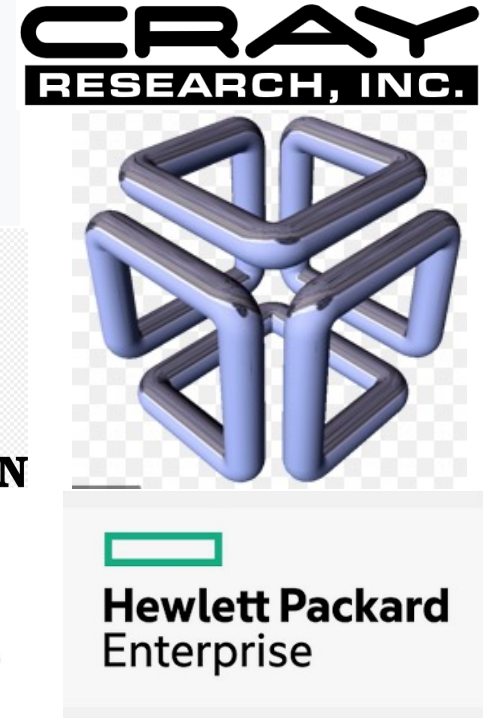
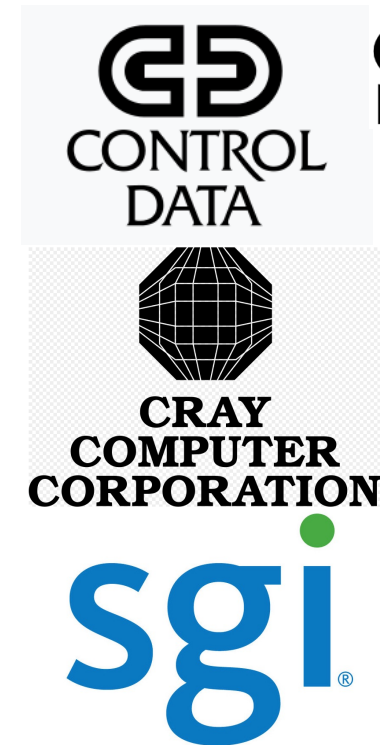


Seymour Roger Cray (September 28, 1925<sup>[1]</sup> – October 5, 1996<sup>[2]</sup>) was an American **electrical engineer** and **supercomputer** architect who designed a series of computers that were the fastest in the world for decades, and founded **Cray Research** which built many of these machines. Called "the father of supercomputing",<sup>[2]</sup> Cray has been credited with creating the supercomputer industry.<sup>[3]</sup> Joel S. Birnbaum, then **chief technology officer** of Hewlett-

# Seymour Cray

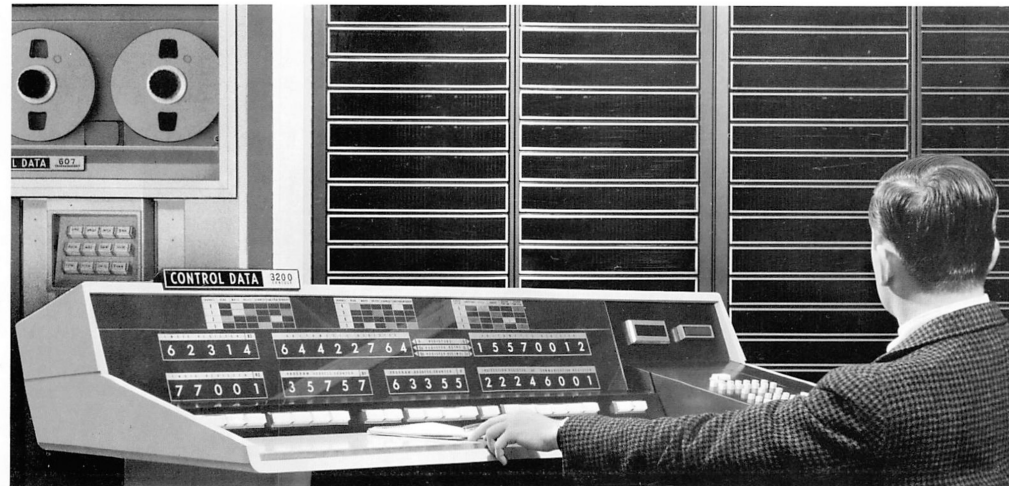
## – companies and his computers

- Engineering Research Associates: 1951-57: ERA 1103  
– first successful scientific computer
- Control Data Corporation: 1957-1972: 1604, 3600, 6600, 7600
- Cray Research: 1972-1989: Cray-1, Cray-2
- Cray Computer Corporation: 1989-1995: Cray-3, Cray-4
- SRC: 1995-1996
- In October 1996, Seymour Cray died as a result of a traffic accident.
- Through various takeovers, etc, the name lives on in HPE



# Seymour Cray – some machines

- CDC 3600: Cray did initial design work
  - CSIRO acquisition in 1964, with compatible 3200s in Sydney, Melbourne and Adelaide
  - His desire was to "*produce the largest [fastest] computer in the world*"
- CONTROL DATA® 3200 Computer System / Scientific Applications



# Seymour Cray – some machines – CDC 6600

- CDC 6600 - 1963
- *The 6600 was the first commercial supercomputer, outperforming everything then available by a wide margin. (3X? - ~8X CDC 3600)*
- Multiple functional units
- Eliminated i/o interrupts – polled request from one of 10 peripheral processors
- *world's fastest computer from 1964 to 1969*

IBM response:

MEMORANDUM

August 28, 1963

Memorandum To: Messrs. A. L. Williams  
T. V. Learson  
H. W. Miller, Jr.  
E. R. Piore  
O. M. Scott  
M. B. Smith  
A. K. Watson

Last week CDC had a press conference during which they officially announced their 6800 system. I understand that in the laboratory developing this system there are only 34 people, "including the janitor." Of these, 14 are engineers and 4 are programmers, and only one person has a Ph. D., a relatively junior programmer. To the outsider, the laboratory appeared to be cost conscious, hard working and highly motivated.

Contrasting this modest effort with our own vast development activities, I fail to understand why we have lost our industry leadership position by letting someone else offer the world's most powerful computer. At Jenny Lake, I think top priority should be given to a discussion as to what we are doing wrong and how we should go about changing it immediately.

TJW, Jr:jmc

T. J. Watson, Jr.

cc: Mr. W. B. McWhirter



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# Seymour Cray – CDC 6600 – CSIRO access

- CSIRO Information Circular January 1970:  
CDA bureau service in Sydney

(1) Additional facility

Due to unforeseen delays in the procurement of new equipment, the load on CSIRO's computing facilities has increased to a stage where the equipment currently in use cannot cope with the demand. The Executive has therefore looked for alternative means of satisfying scientists' computing needs on modern equipment available in Australia and has decided that a MARC II 200-User Terminal should be installed at the premises of the Division of Computing Research in Canberra. The terminal will be linked by a private telephone line to the Control Data 6600 in Sydney, owned and operated by Control Data, Data-Services Division.

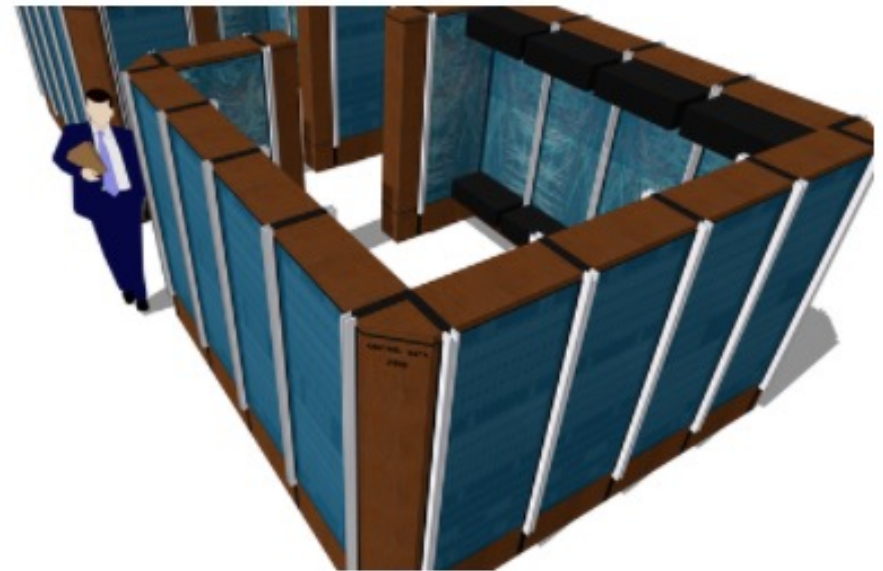
(a) Rental for storage of disc documents:

\$0.04/track/day (1 track = 8,000 characters)



# Seymour Cray – CDC 7600

- CDC 7600 - 1969
- 5 to 10 X CDC 6600
- *From about 1969 to 1975, the CDC 7600 was generally regarded as the fastest computer in the world*
- CSIRO acquired a Cyber 76 (re-badged 7600)

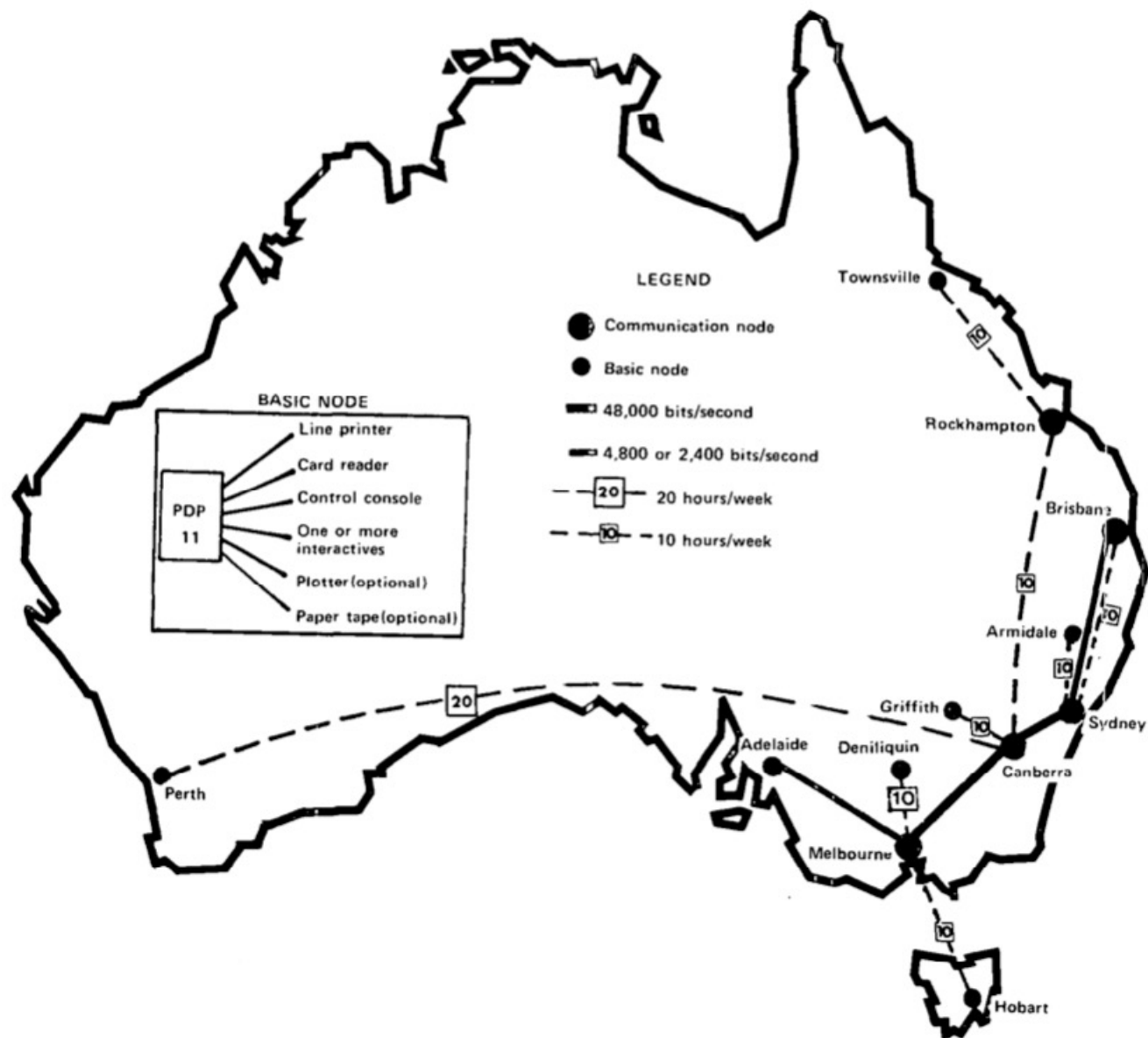


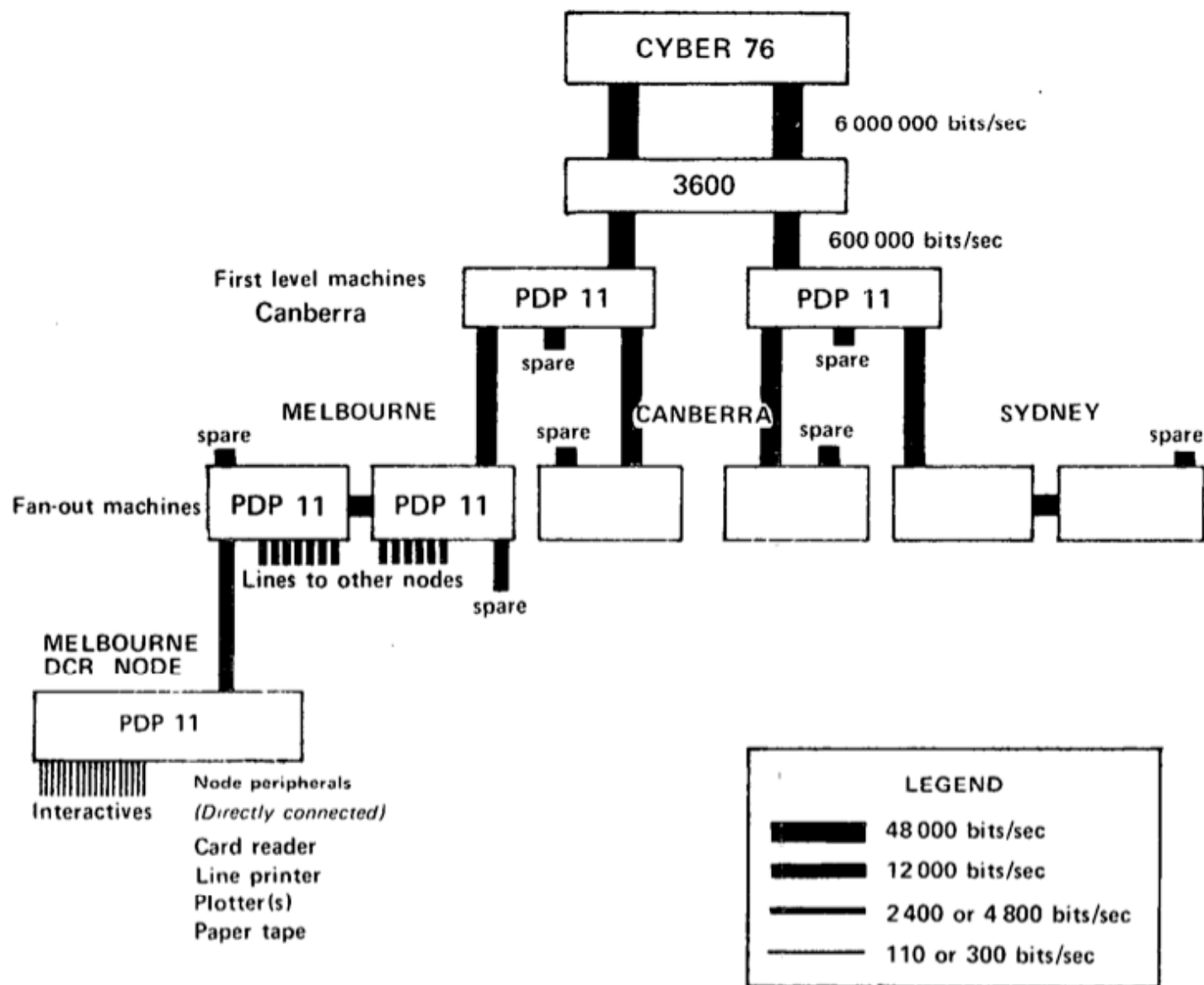
## CSIRO Cyber 76 (updated 7600)

- Installed in July 1973
- 30 tons on chartered Boeing 707
- Used for just about all CSIRO computing
- CDC 3600 became front-end (until 1977)
- Then standalone, including up to 100 interactive users around the country

# CSIRO Cyber 76



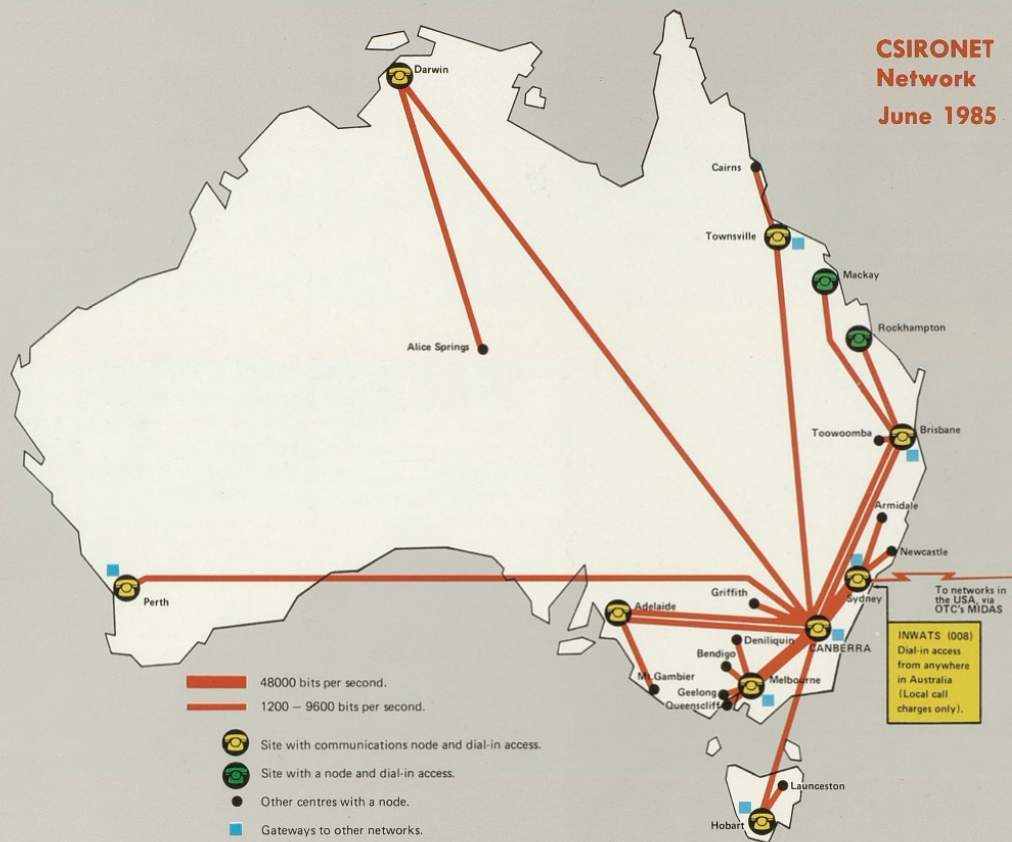






# CSIRONET SERVICES

**CSIRONET  
Network  
June 1985**



# Seymour Cray – Cray Research – Cray-1

- Cray-1: 1976
- 4 X CDC 7600
- Vector processor
- From about 1976 to 1982, fastest computer in the world
- Seymour Cray aimed for each successive system he designed to have an order of magnitude higher performance than its predecessor – part of this was achieved by advances in the hardware, but also by advances in the architecture.
- Pioneering designs – RISC-like, separate functional units, pipelining (assembly line), packaging, liquid cooling, memory banking, vector instructions: in current processors.



# Seymour Cray – Cray Research

- Cray Y-MP – 13 weeks wiring (notice Bob Smart)
- CDC 3600 – serial with i/o offloading – 0.35 Mflop/s
- CDC 6600 – multiple functional units – 3 Mflop/s
- CDC 7600 – pipelined multiple functional units – 36 Mflop/s
- Cray Research Cray-1 – vector processor – 160 Mflop/s



# Seymour Cray

- Cray Research
  - Not Cray X-MP, Y-MP, J90, SV1, etc, but his instruction set and design influenced these.
  - Cray-2 – first one sold had more memory than all previous Crays sold. Fully immersed.
- Cray Computer: 1989-1995: Cray-3 (one delivered), Cray-4
- Hitachi, Fujitsu and NEC copied Cray's vector machines



# Cray and CSIRO continue

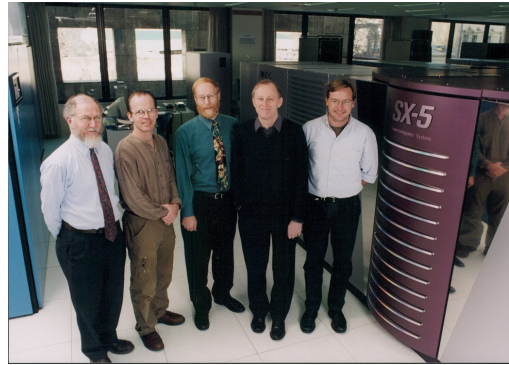
- Joint Supercomputing Facility, Port Melbourne: Cray Y-MP 2/216 – 1990-1992
- CSIRO Supercomputing Facility, UoM: Cray Y-MP 4/364 & 4/464 – 1992-1997
- Bureau/CSIRO HPCCC: Mel CBD: Cray J916se – 1997-2004
- Pawsey:
  - Cray XC galaxy, magnus, 2014
  - Cray XE setonix – 2021-



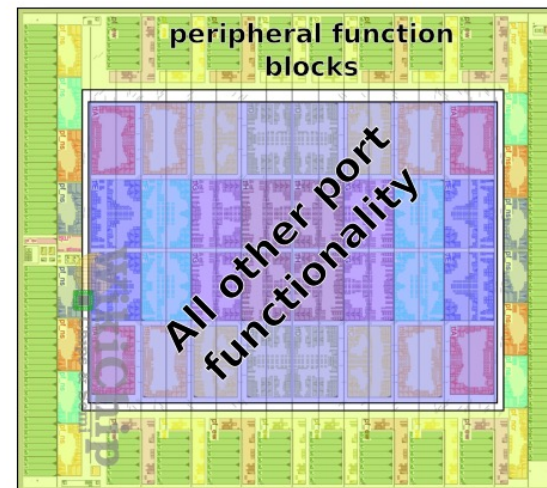


# Why Cray – memory access

- Cray vector systems – multiple memory banks – lots of wiring
- NEC took this to the next level: HPCCC SX-5 – 32,768 banks, 32 processors, maybe 0.5 million wires
- Pawsey: Cray XC galaxy, magnus, 2014-; Cray XE setonix – 2021-
  - Slingshot network
  - Rosetta Router chip – 64 x 200 Gbit/s ports
- Balance:
  - Cray vector: 12 bytes/flop
  - Bracwell CPU: 0.13 byte/flop
  - Bracwell GPU: 0.03 byte/flop
- Software – own compilers, tools, libs.



Rosetta



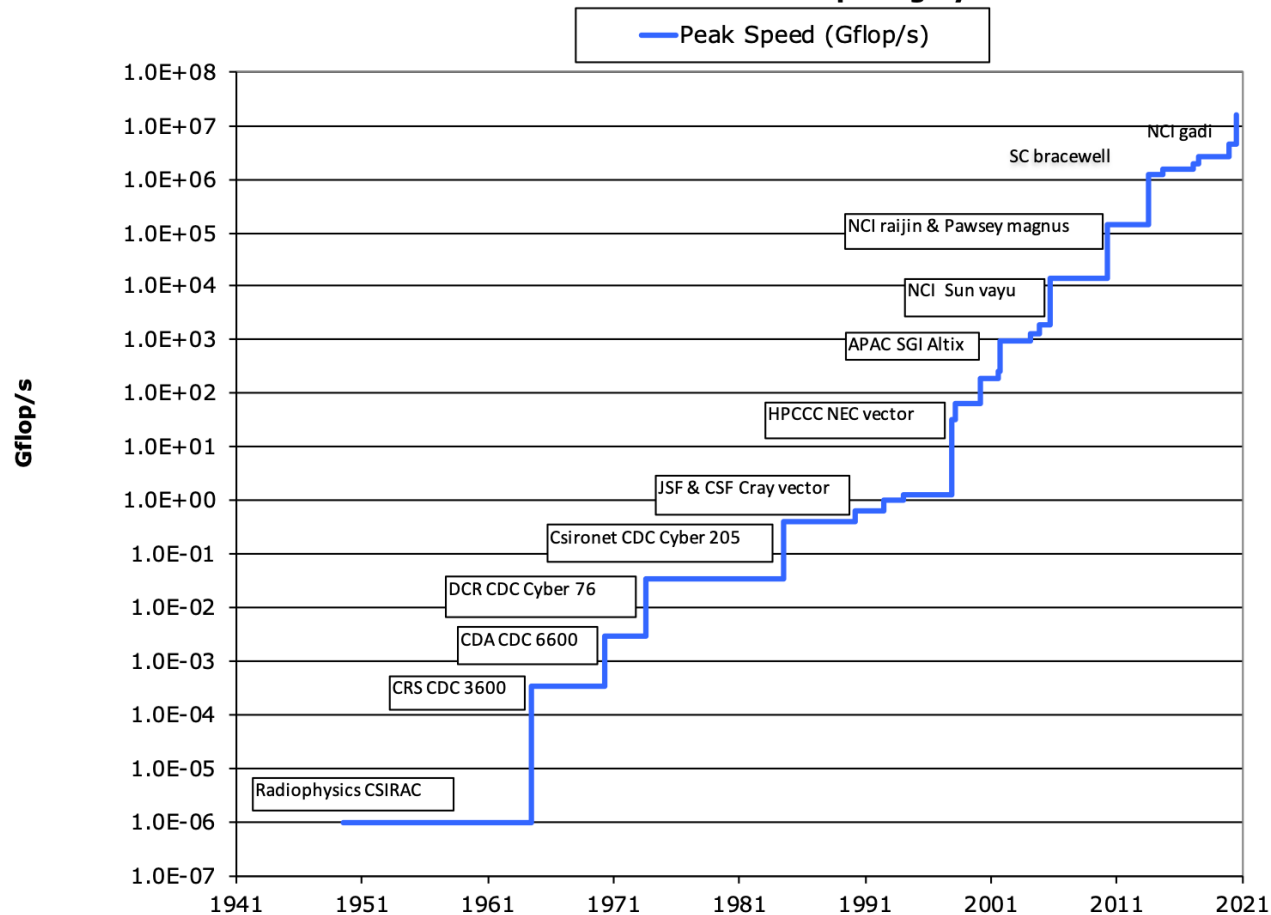
# The name of Cray continues

- Cray continues to supply some of the world's biggest and fastest computers
  - Top500 list
- George Cotter, Chief Scientist, NSA, 1995:  
*"We would not have won the cold war without Cray"*

*Quote: Computers were invented to solve problems in ballistics, cryptanalysis and nuclear weapons – don't kid yourself that these have gone away.*

Perhaps meteorology has supplanted the first of these, with the UK Met Office announcing in May 2021 a 10-year £1.2 billion contract for services based on Microsoft-integrated Cray systems.

## CSIRO Peak Available Computing Systems



Peak systems  
available to CSIRO:  
13 orders-of-  
magnitude increase

# Thank you

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