Asynchronous Computing
3. Mutual Exclusion: Who's first?

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Outline

- Quantize a continuous variable
- Time is our continuous variable
- Which (of two) happened first?
- Exactly the same time?
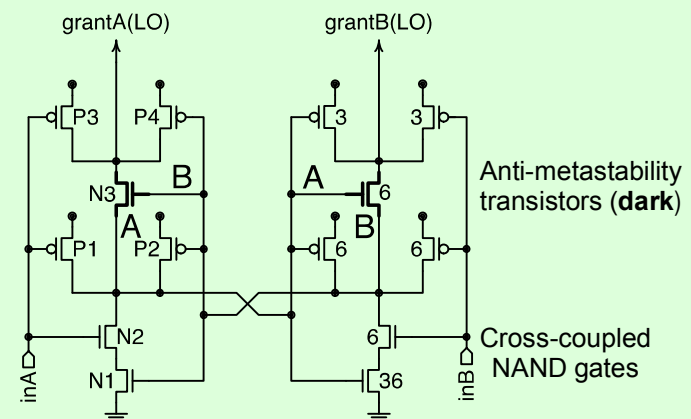- Mutual Exclusion circuit (Arbiter) will decide, but may take time

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Mutual exclusion

- Two events at "same" time
  - which choice doesn't matter
  - but choice must be clean
- Flip-flop can hang metastable
  - exit is Poisson distributed
  - may take a long time, but rarely will
- Asynchronous system can wait

Mutual exclusion (Seitz)

Continental divide

Continental divide

CONTINENTAL DIVIDE
RABBIT EARS PASS
ELEV 9426 FT

PACIFIC WATERSHED ←

ATLANTIC WATERSHED →

Continental divide

View east **View west**

Moving the Continental divide
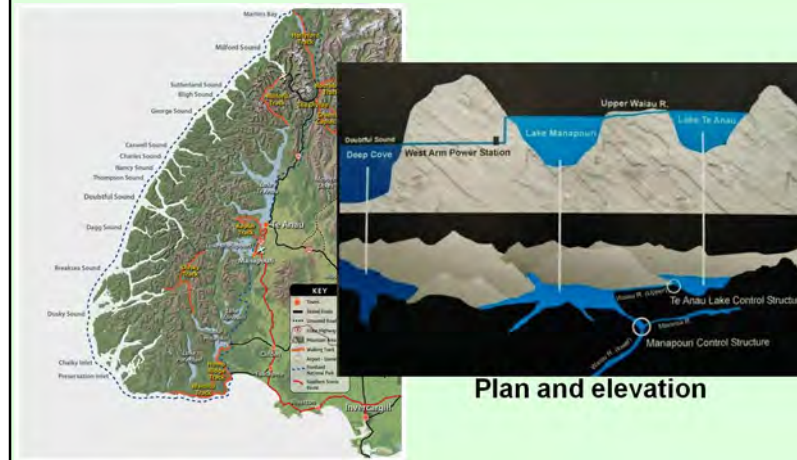
Plan and elevation

Manapouri powerplant, NZ

Metastability demonstration
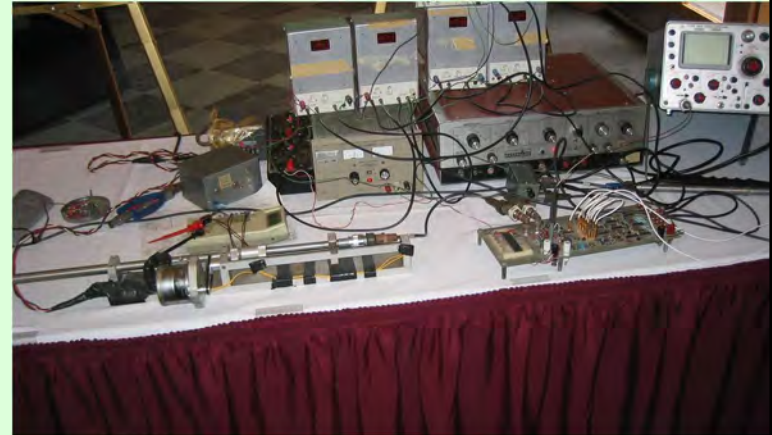
Scope trace
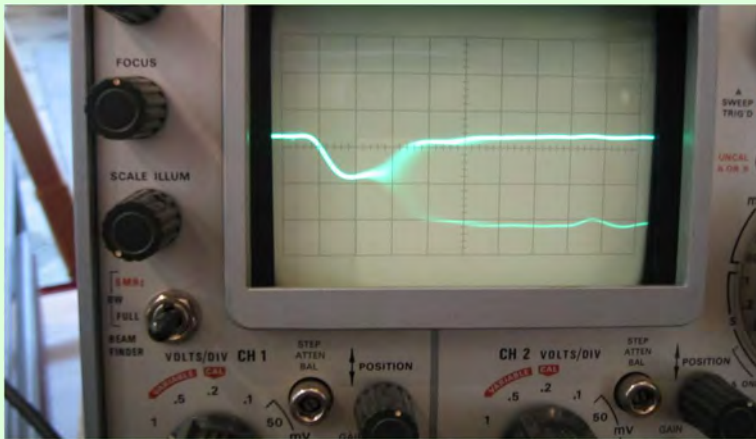
Zeke to test arbiters (1998)

28 stage rings
with arbiters
between stages
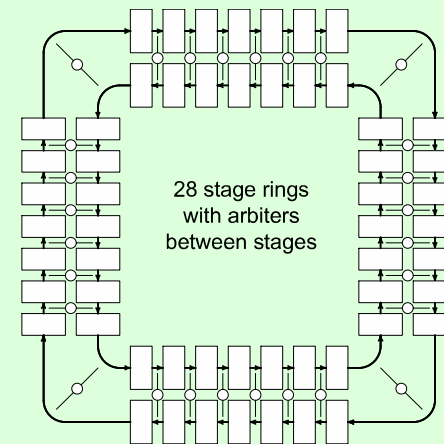
Infinity test (2008)

Demand Merge
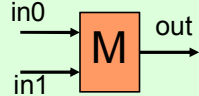
Data-directed Branch
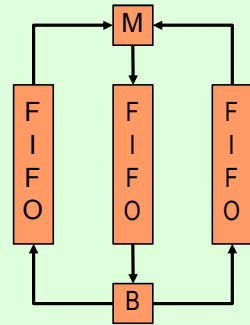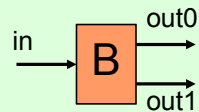
Infinity: Throughput vs Occupancy
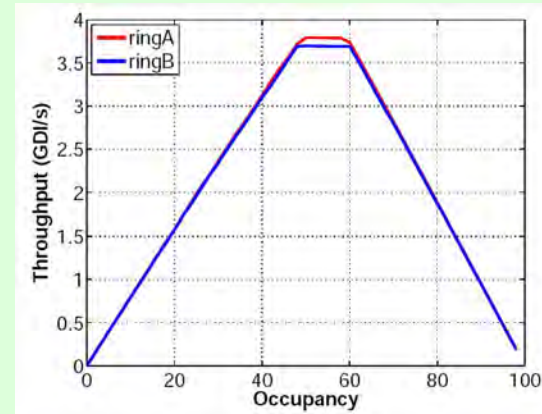
Stopping self-timed systems

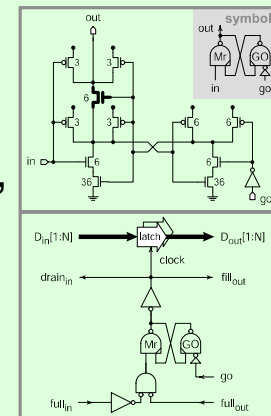- Clean stop requires arbitration
  - Stop in mid action   OR
  - Finish the action, then stop
- Without arbitration, runt pulses
  - Give chance of data error or
  - Loss of whole data item

MrGO

- Half an arbiter
- To stop cleanly
- A "proper stopper"

- *Shall I stop now or complete this action?*