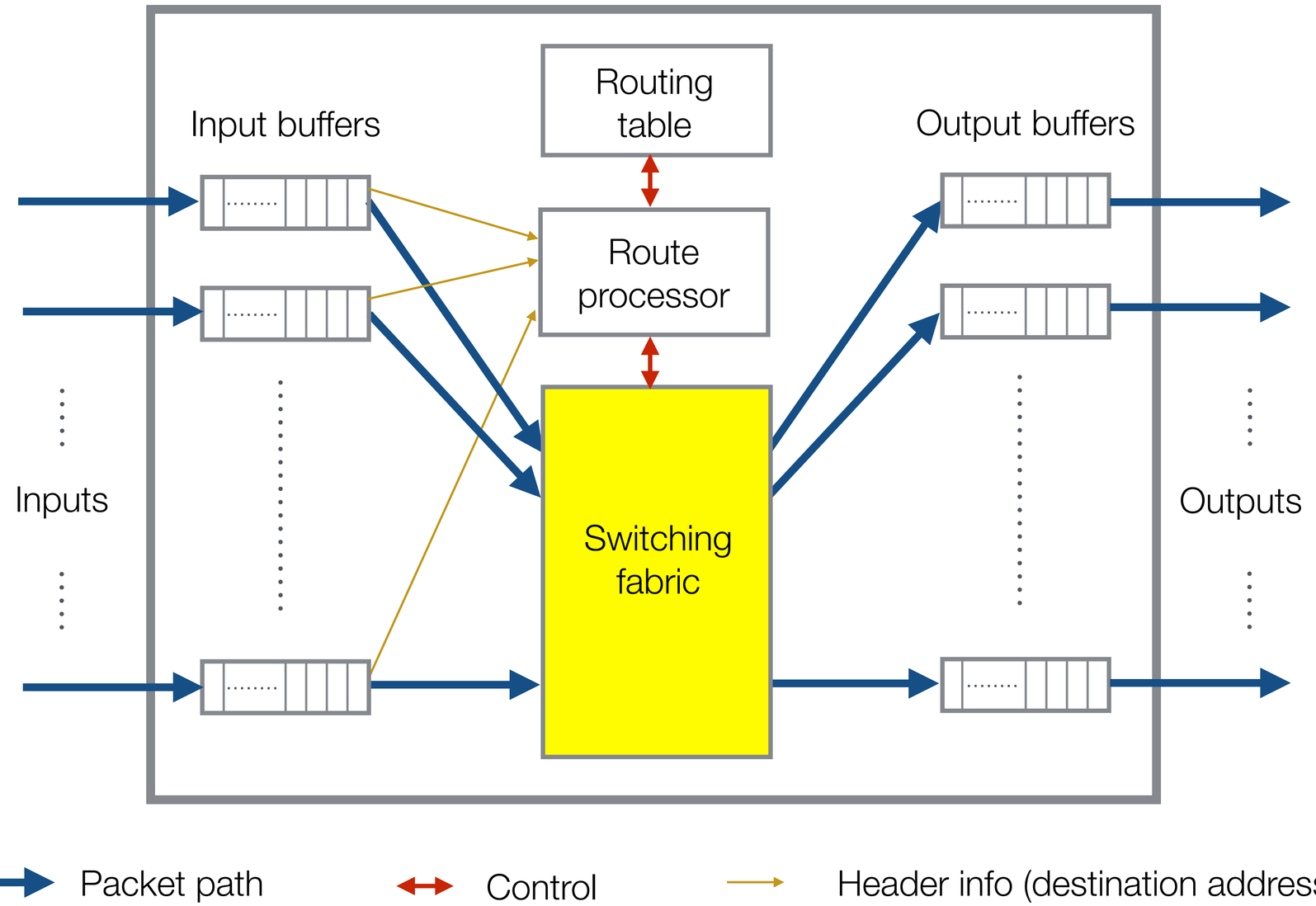
CS 925

Lecture 24

Router/Switch Architectures

Tuesday, April 30, 2024

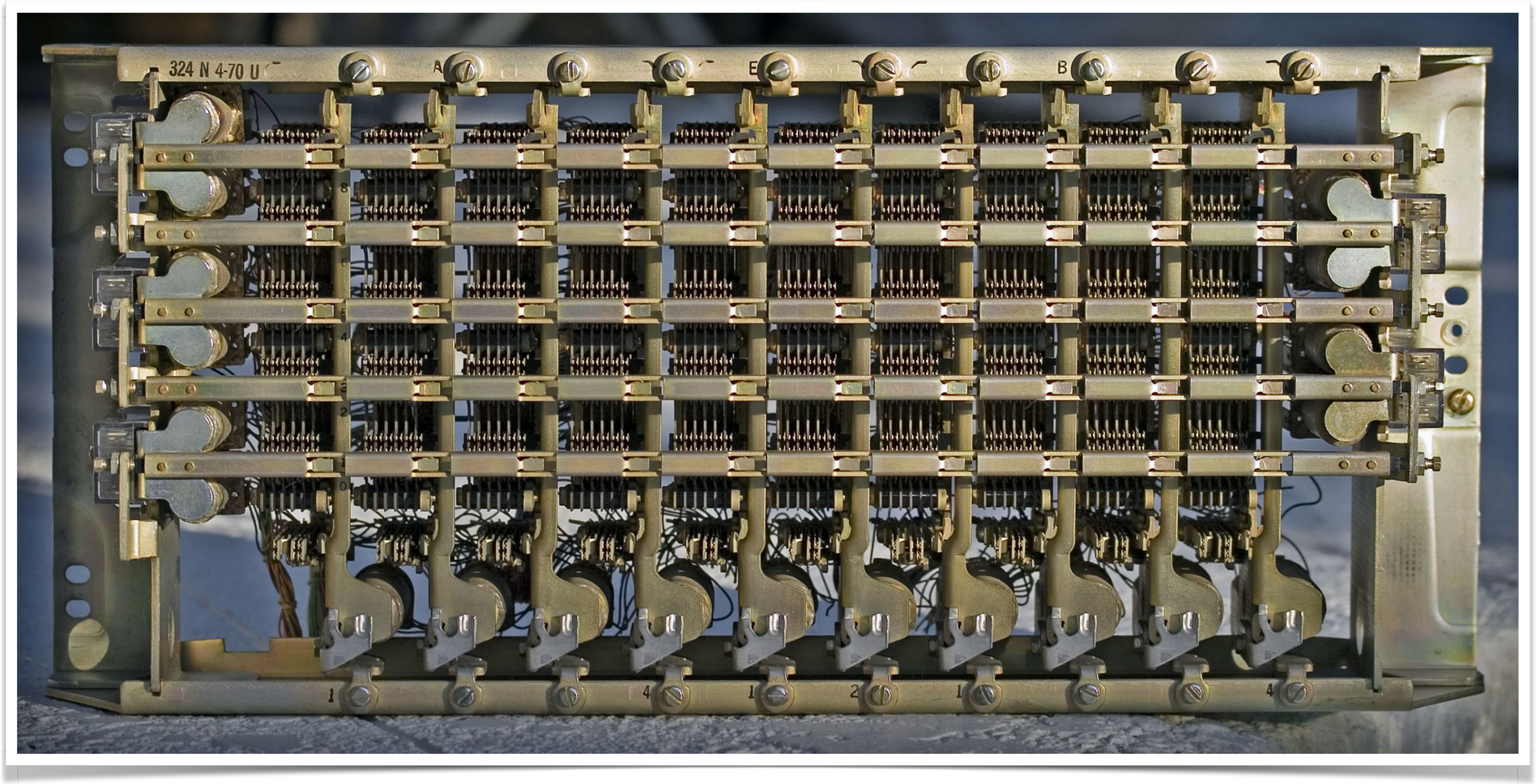
Router Architecture (review)



Switching Fabric

- N inputs and M outputs (often M = N)
- Solutions
  - bus
  - crossbar
  - multistage interconnection network (MIN)
- Cost / benefit analysis
  - number of crosspoints (switches)
  - latency
  - permissible requests / cross-section bandwidth

Crossbar switch



Switch Properties

- A switch is non-blocking if all one-to-one connections are compatible.
- A non-blocking switch is called strictly non-blocking (SNB) if any new connection can be made without modifying existing ones,
- … otherwise, it is call a rearrangeably non-blocking (RNB)

Clos Switch Properties

- A Clos switch (IN, N_1, N_2, N_3, OUT) built using RNB modules is itself RNB iff

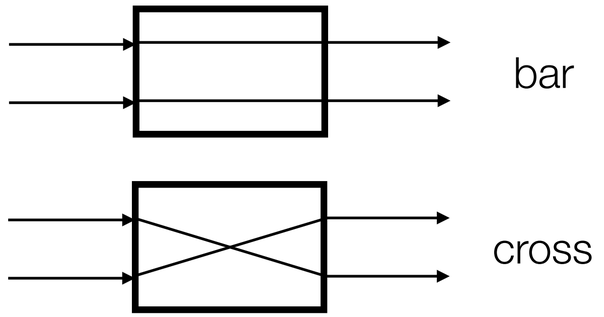
$$N_2 \geq \max(IN, OUT)$$

- A Clos switch (IN, N_1, N_2, N_3, OUT) built using SNB modules is itself SNB iff

$$N_2 \geq IN + OUT + 1$$

Elementary Switch

- 2 x 2 switch



- Multiplexing equivalency
  - space
  - time
  - wavelength

Costs…

- For simplicity, assuming M = N
- Bus
  - O(N)
- Crossbar
  - $O(N^2)$
- Multistage Interconnection Networks
  - Typically O(N log(N)) or $O(N \log^2(N))$

Better than $O(N^2)$…

- What is lost?
  - output and internal conflicts
- Clos network
  - Beneš network
- Delta networks (self-routing networks)
  - Banyan, Baseline, Omega, Flip
- Batcher sorting network

Beneš network properties

- Number of switches
- Rearrangeably nonblocking network
  - “binary” path choices
- Recursive routing algorithm