

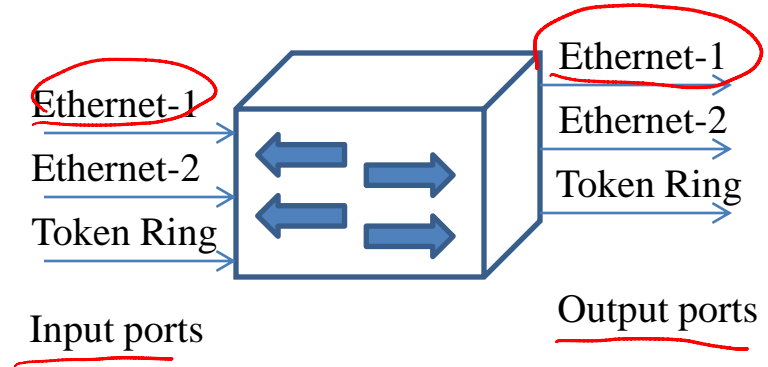
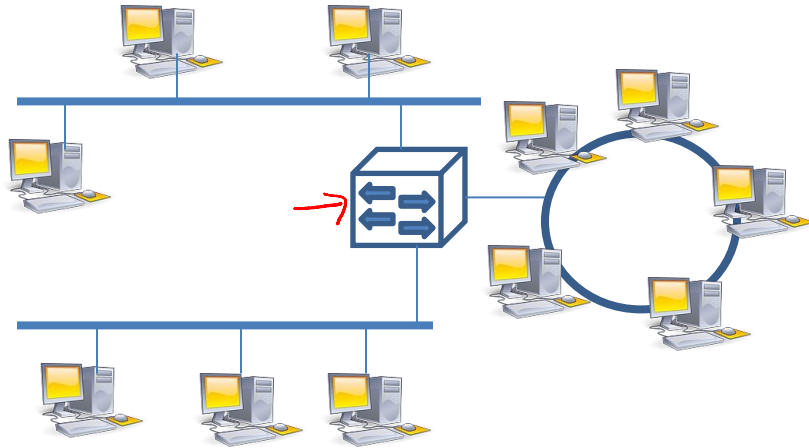
Inside a Router

Kameswari Chebrolu

Recap

- IP protocol helps interconnect heterogeneous networks in a scalable fashion
- Best effort datagram delivery model
- Many things to address
- First: A look inside a router

Inside a Router



Inside a Router

Terminates physical link;
Performs data-link-layer
functions;

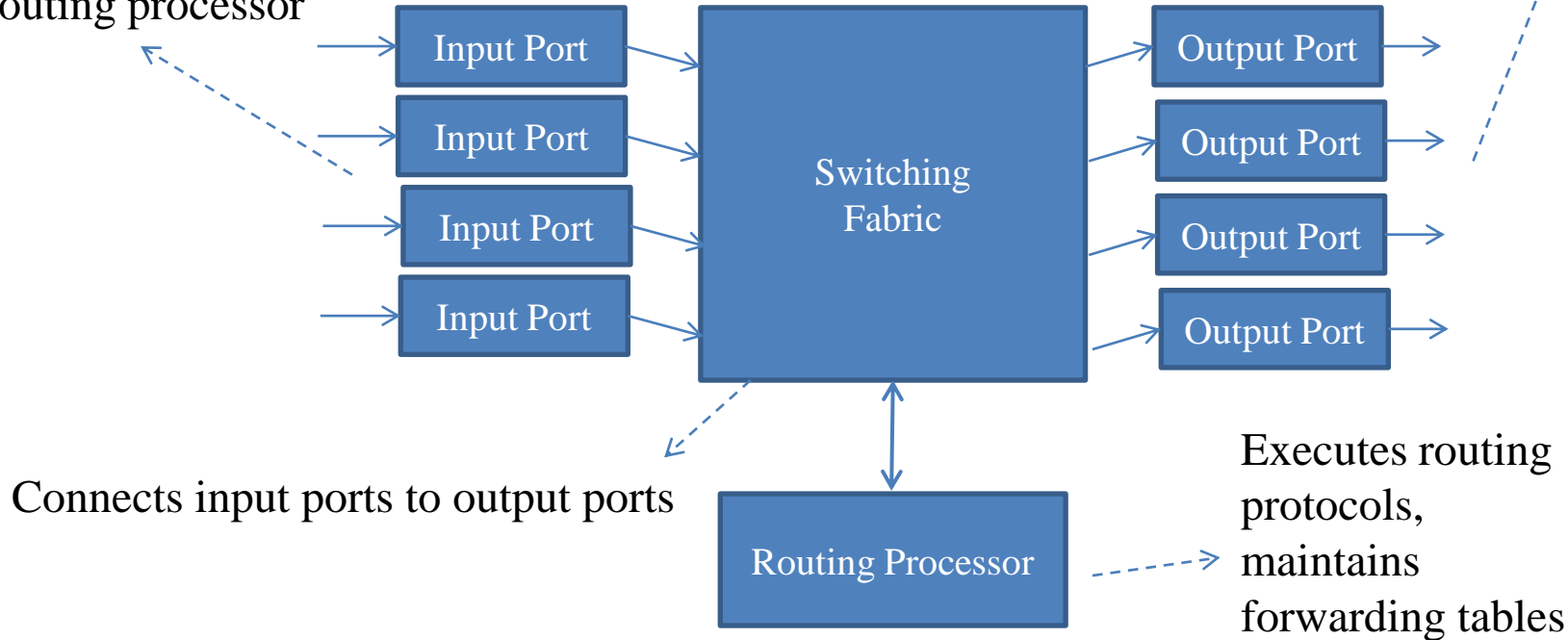
Can also perform look-up,
forwarding, Queuing;

Routing protocol info passed to
routing processor

Stores incoming packets
(queues) and transmits on
outgoing link;

Performs data-link, phy layer
functionality

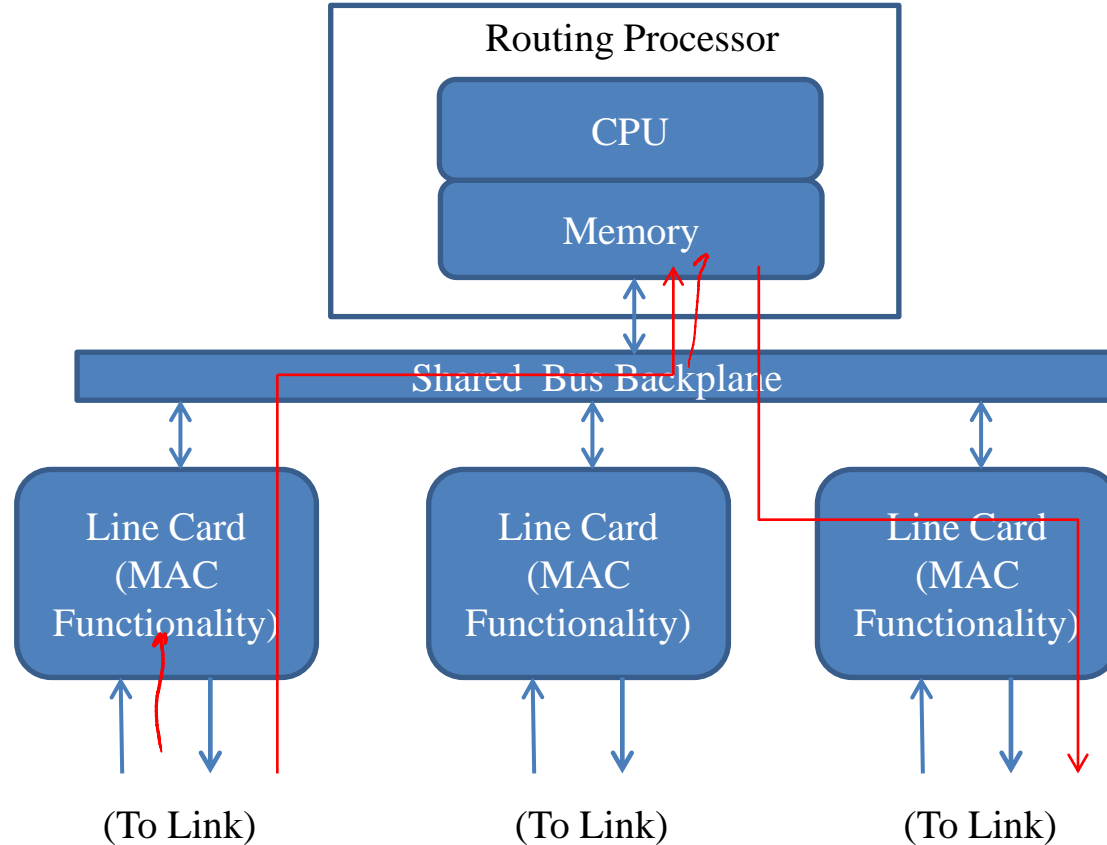
if input port also maintains
shadow copies of Frwd.Table
its the responsibility of Processor to
ensure correctness



Router Functions

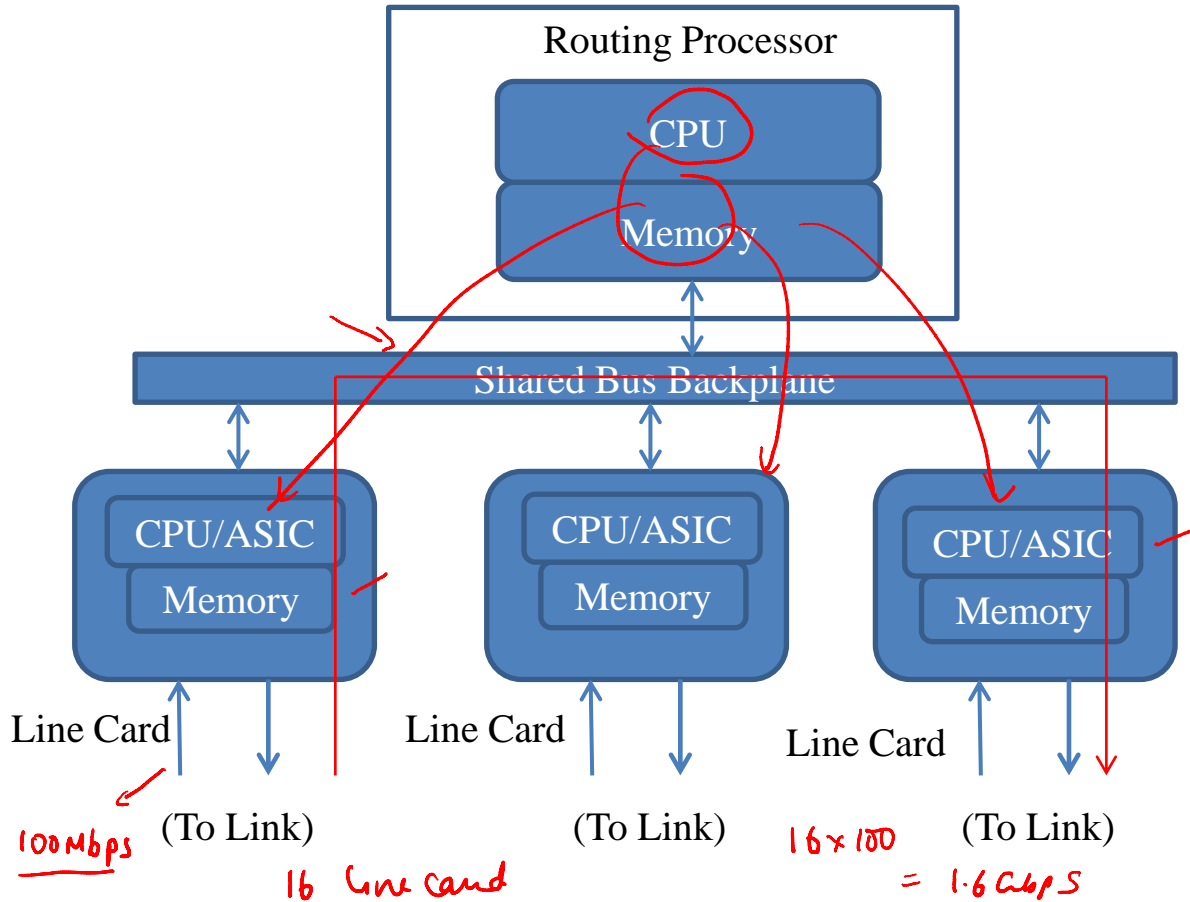
- Data-path functions: Operations performed on every datagram
 - forwarding, checksum calculation, FIFO scheduling etc
 - Often implemented in specialized hardware for high speed
- Control functions: Operations performed infrequently (packet exchange for routing protocols, system/network management)
 - Implemented in software

1st Generation Routers



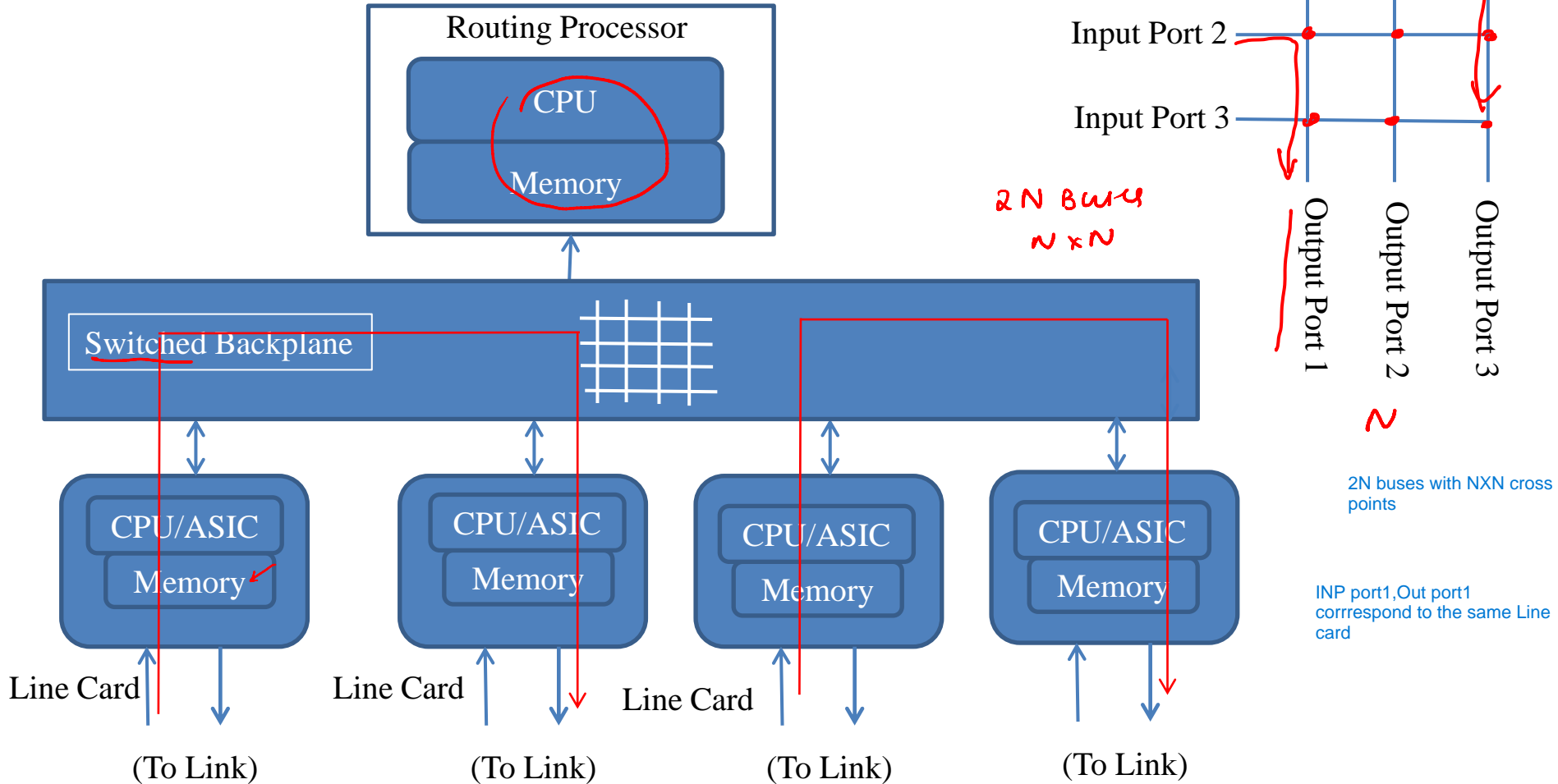
- In 1980's
- Every packet involves the Processor
 - Processor becomes bottleneck
- Packet goes over bus twice

2nd Generation Routers



- Early 1990's
- Parallelism:
More hardware
in each line card
- Packets travel
bus only once
- Limitation: Bus
becomes the
bottleneck

3rd Generation Routers



Router Performance

→

Forwarding

- Minimize delay, losses → high ~~switching~~ speeds
- Look-up speed: determine output port
 - Forwarding table look-up at incoming port itself
- Look-up speed should exceed line-speed
 - E.g. 1Gbps link, packet size is 40 bytes → ~3 million packets per second → lookup speed has to be greater than 3 million lookups per second → each lookup should be under 8ns
- Major Research Area: Improve look-up speeds

FT

→
1Gbps

40 byte

- Switching fabric speed (S): Rate at which packets are moved from input to output
- N input and output ports with identical line speeds
- Input Port: No queue build-up if $S > (N * \text{line speed}) \rightarrow$ No loss
- Output Port: queues can build and losses can occur
 - If all N incoming packets on different input ports are directed to same output port

see lec again



Summary

- Router: a core device at network layer
- Components: input/output ports, switching fabric and a routing processor
- Evolved over the years with better forwarding speeds
- Performance dictated by table look-up and switching speeds
- Ahead: IP Protocol -- Packet format, Fragmentation and reassembly