Lesson 06-01: Network Layer Intro and Router

CS 356 Computer Networks

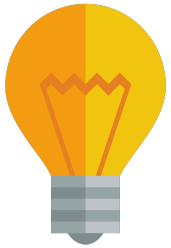
Mikyung Han

mhan@cs.utexas.edu

Outline

0. Administrivia

Internet Reference Model



Example Protocols		Responsible for
FTP, HTTP, SMTP	Application	application specific needs
TCP, UDP	Transport	process to process data transfer
IP	Network	host to host data transfer across different network
Ethernet, WiFi	Link	data transfer between physically adjacent nodes
802.3 PHY	Physical	bit-by-bit or symbol-by-symbol delivery

3

Outline

1. Why Network Layer?

Why network layer?

- **Responsible for delivering a packet from src host to dst host**
- **Figures out which intermediate hops (route) to take from src to dst**
  - Global action of routing determined by routing algorithm
  - Computed either in a distributed manner (traditional) or centrally (SDN)
  - Control plane's job

- **Each hop should know where to send to the packet received**
  - Includes src, dst, and ALL intermediate hops
  - Local action of forwarding dictated by routing algorithm
  - Data plane's job

- **Each hop MUST understand this routing/forwarding**
  - Everyone needs to speak the "same language"
- **ONE protocol: IP**
  - IPv4 and IPv6

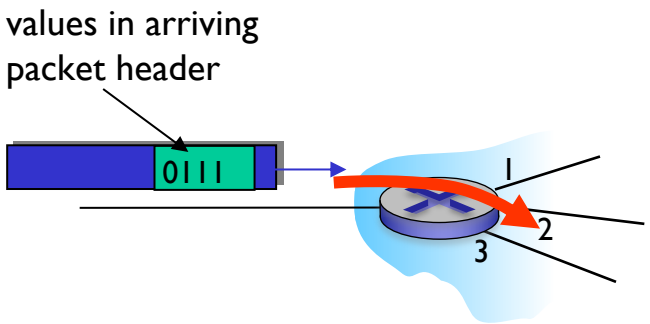
A packet in network layer is called …

- Datagram!

Data plane vs control plane

Data plane

- local, per-router function
- determines which output port to forward for a given datagram arriving at router's input port



Control plane

- network-wide logic
- determines the end-to-end route from src to dst that this datagram should travel

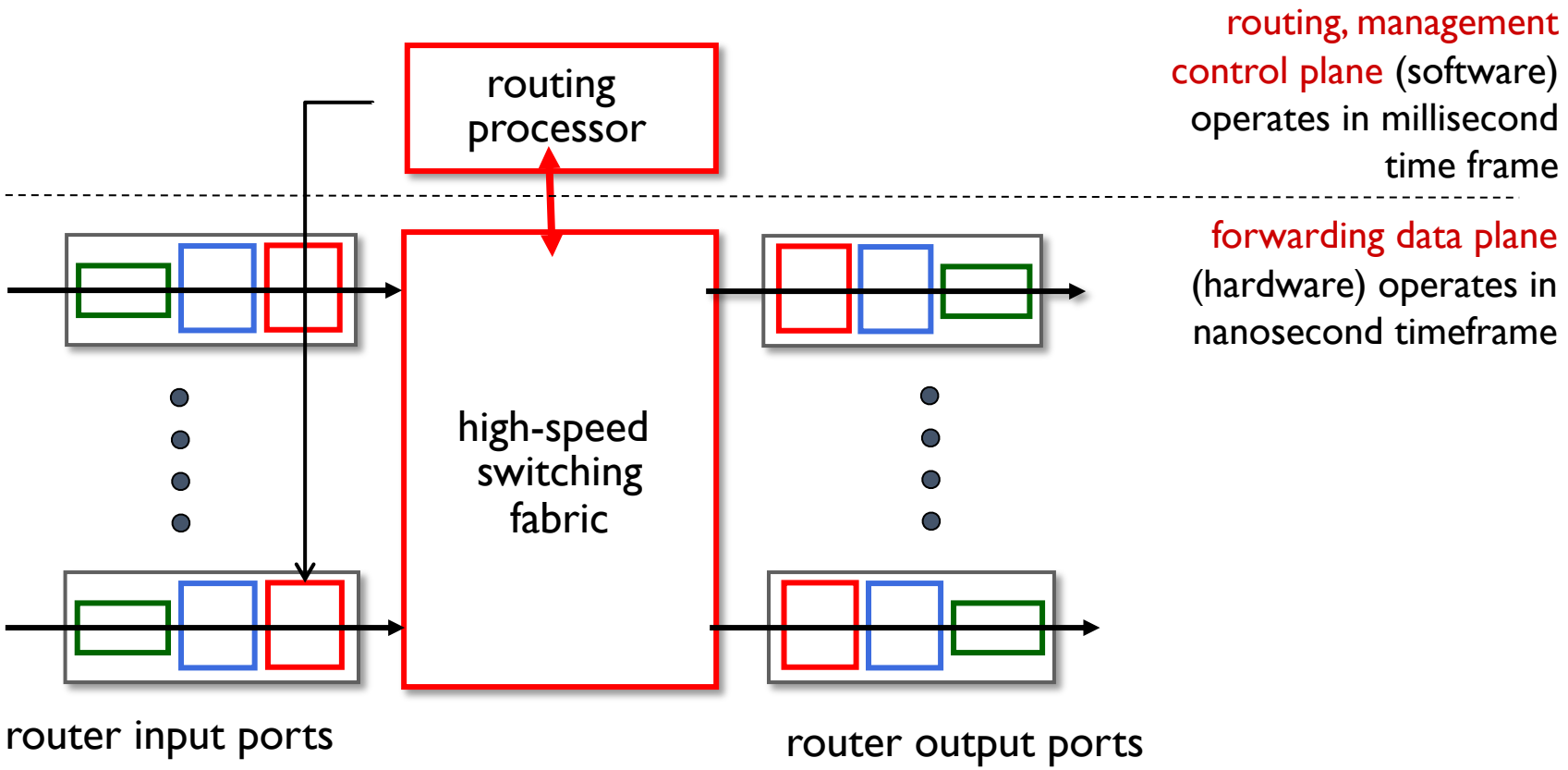
- two approaches:
  - Computed in distributed manner by each router
  - Done centrally by SDN controllers

Which (forwarding vs computing routes) should be done faster?

Outline

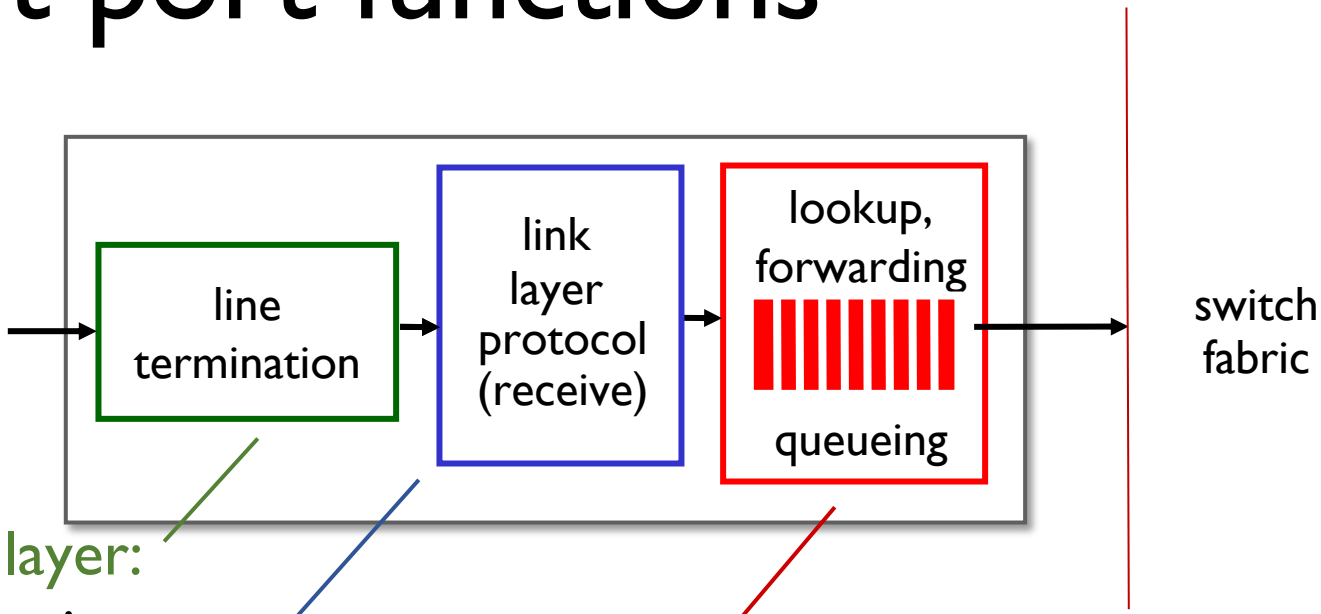
1. Why Network Layer?
2. Router architecture

Router architecture



False! Router performs physical link and network layer functions

Input port functions



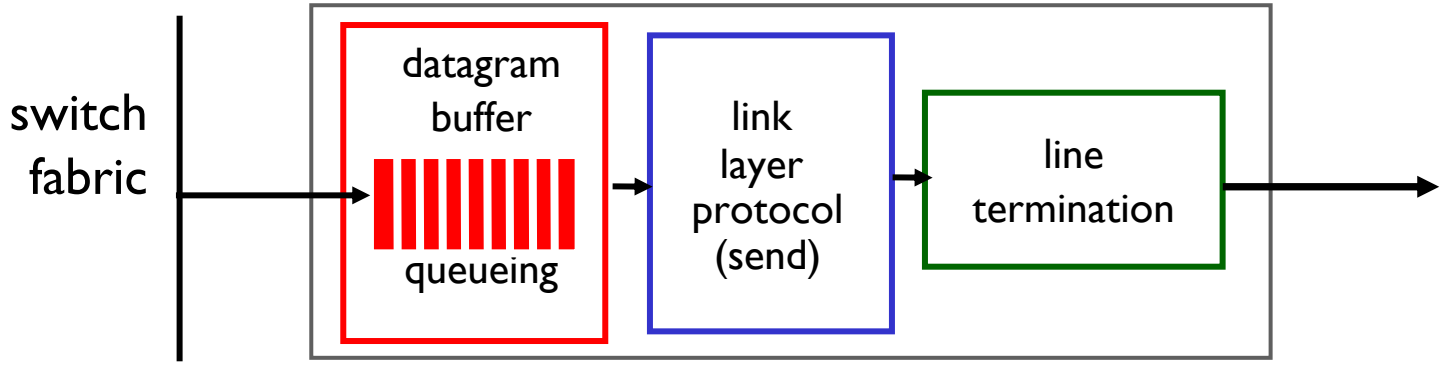
physical layer:
bit-level reception

link layer:
e.g., Ethernet
(chapter 6)

Match plus action forwarding

- Read header fields, lookup output port in forwarding table
  - destination-based forwarding: forward based only on dst IP address
  - generalized forwarding: forward based on any header fields including other layers (IP header, Ethernet header, Transport header, etc…)

Output port functions

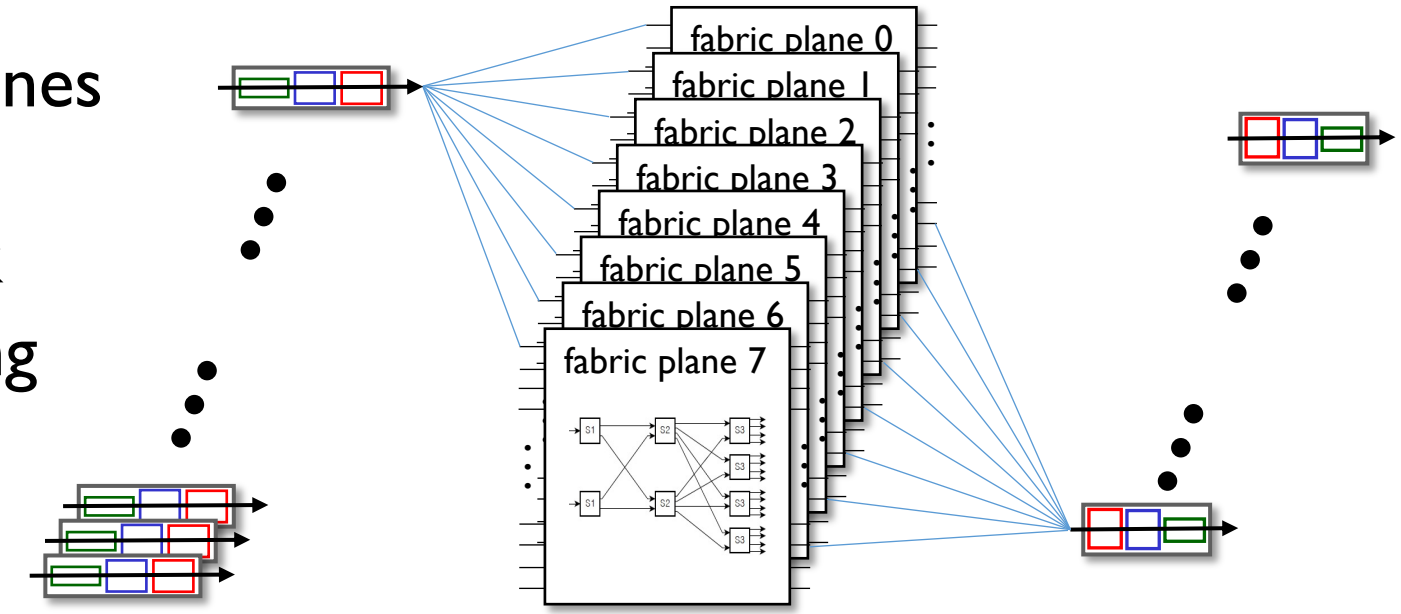


- Buffering required when datagrams arrive from fabric faster than link transmission rate.
- Drop policy: which datagrams to drop if no free buffers?
- Scheduling discipline chooses among queued datagrams for transmission

Fabric Switch

- scaling, using multiple switching "planes" in parallel:
  - speedup, scaleup via parallelism

- Cisco CRS router:
  - basic unit: 8 switching planes
  - each plane: 3-stage interconnection network
  - up to 100's Tbps switching capacity



Outline

1. Why Network Layer?
2. Router architecture
3. Destination based forwarding

Destination-based forwarding considers dst IP address only when it does lookup from the forwarding table

- How does forwarding table look like?

Dst IP	Output port
123.456.0.1	1
123.456.0.2	1
123.456.0.3	1
234.567.0.1	2
…	…

Forwarding table uses ranges of IP address

- What if dst IP is 345.10.2.1?

Dst IP ranges	Output port
123.456.0.*	1
234.567.*.*	2
345.10.*.*	3
345.*.*.*	4
otherwise	5

Longest prefix matching: Look for the most specific requirement!

Acknowledgements

Slides are adopted from Kurose' Computer Networking Slides