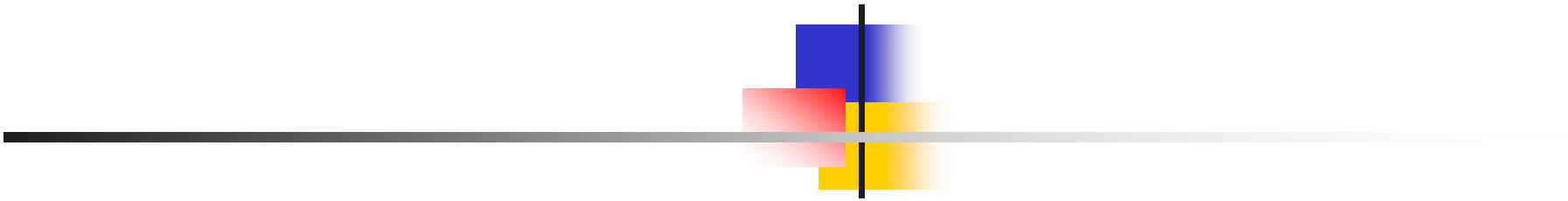
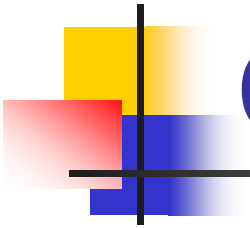
CSE398: Network Systems Design



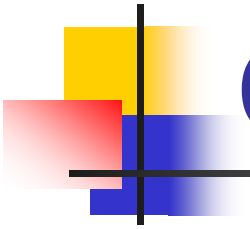
Instructor: Dr. Liang Cheng
Department of Computer Science and Engineering
P.C. Rossin College of Engineering & Applied Science
Assistant Professor, Lehigh University

January 24, 2005



Outline

- Recap
  - Encoding, framing, error detection, IEEE 802.3
  - Jamming
- Switching and forwarding
- IP (Internet Protocol)
- Summary and homework

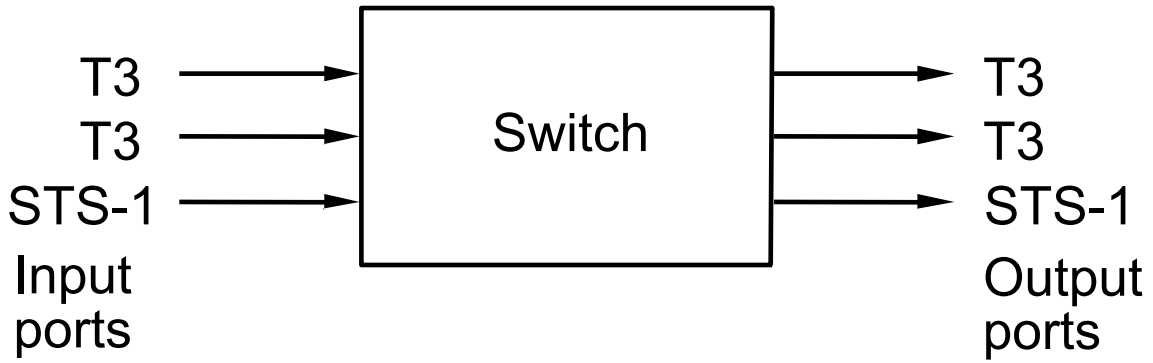


Outline

- Recap
- Switching and forwarding
- IP (Internet Protocol)
- Summary and homework

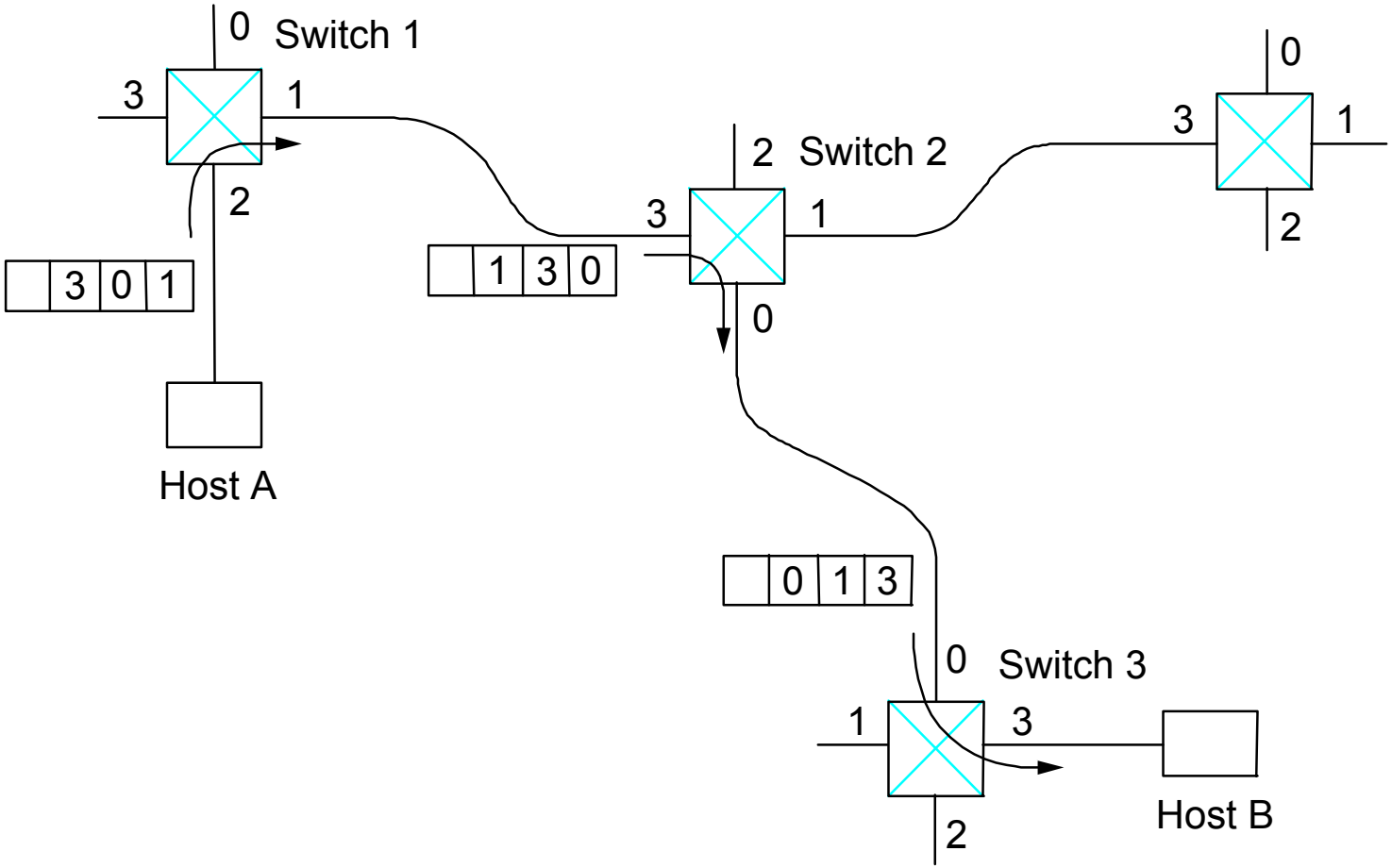
Switching

- Switch
  - Forwards frames from input port to output port
  - Port selected based on address in frame header



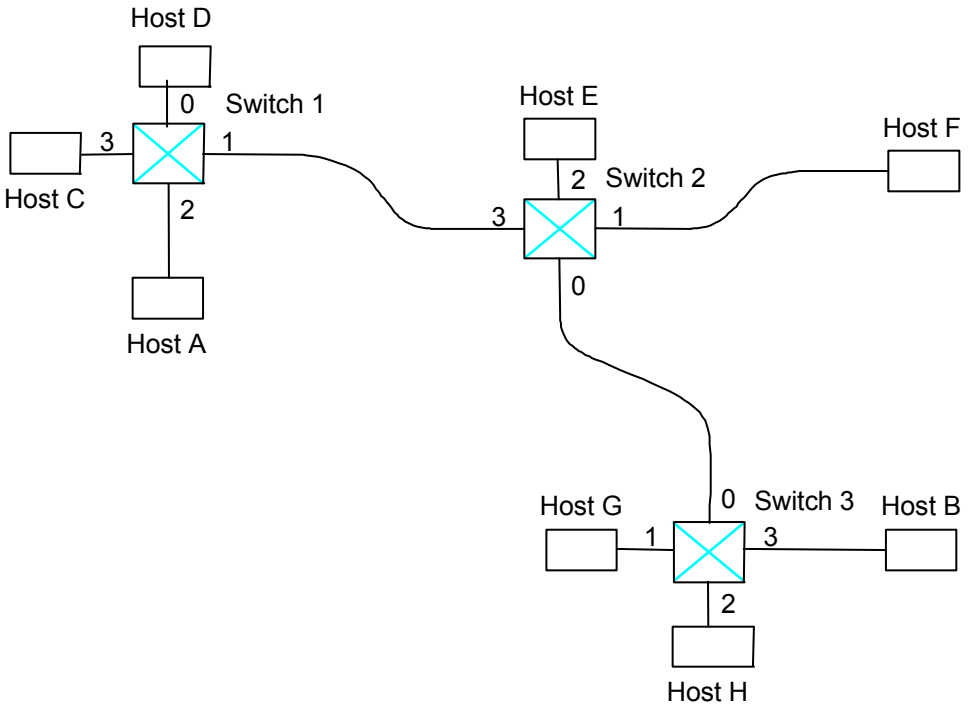
- Benefits
- Topology

Source-Routing Switching



Datagram Switching

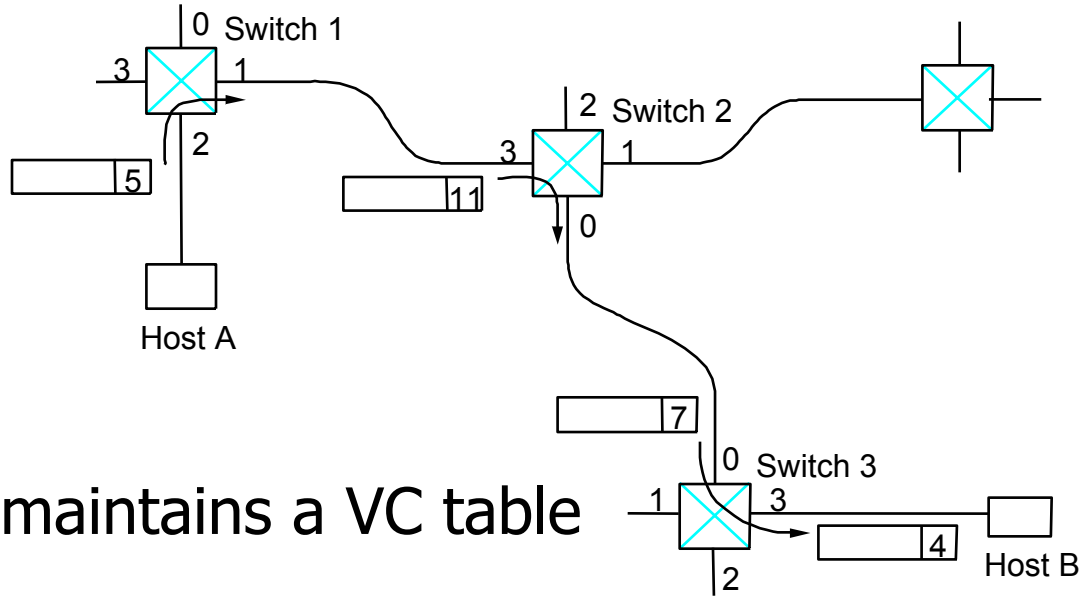
- No connection setup phase; complete destination addr
- Packet forwarded independently
- *Connectionless* model



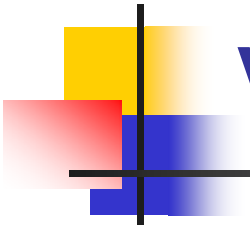
- Analogy

Virtual Circuit Switching

- Explicit connection setup (and tear-down) phase
  - Permanent VC vs. switched VC: virtual circuit identifier
- Subsequence packets carrying VCI follow same circuit
- *Connection-oriented* model

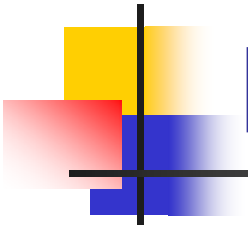


- Analogy
- Each switch maintains a VC table



Virtual Circuit Model

- Typically wait for connection setup
- Connection request: full address
- Data packet: a small identifier/overhead
- Broken connection: establish a new one
- Connection setup provides an opportunity to reserve resources.

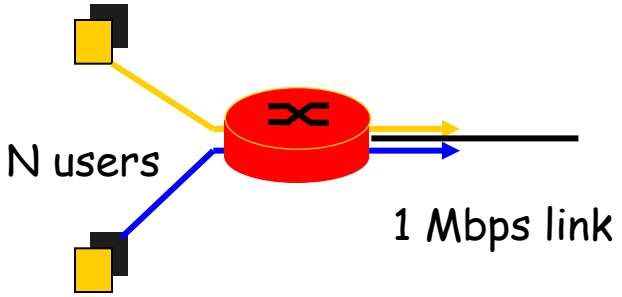


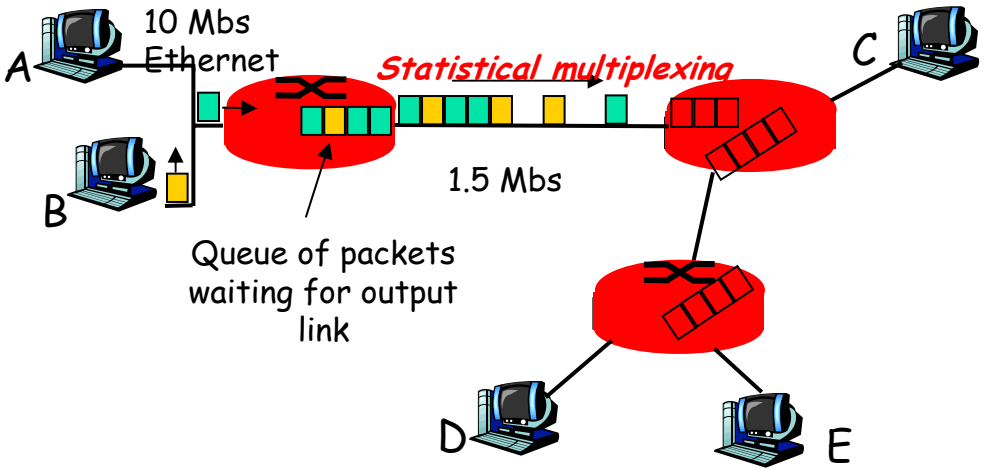
Datagram Model

- No RTT delay waiting for connection setup
- Source not knowing if the network is capable of delivering a packet or if the destination host is even up.
- Possible to route around link/node failures
- Full destination address: overhead per data packet is higher

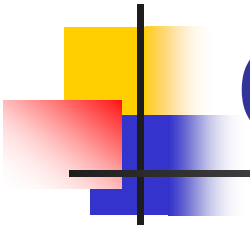
Multiplexing in Circuit Switching and Packet Switching

- Circuit switching
  - TDMA
  - FDMA
- Datagram switching
  - Statistical multiplexing





- Each user:
  - 100 kbps when "active"
  - Active 10% of time
- Circuit-switching: 10 users
- Packet switching: With 35 users, probability > 10 active less than .0004

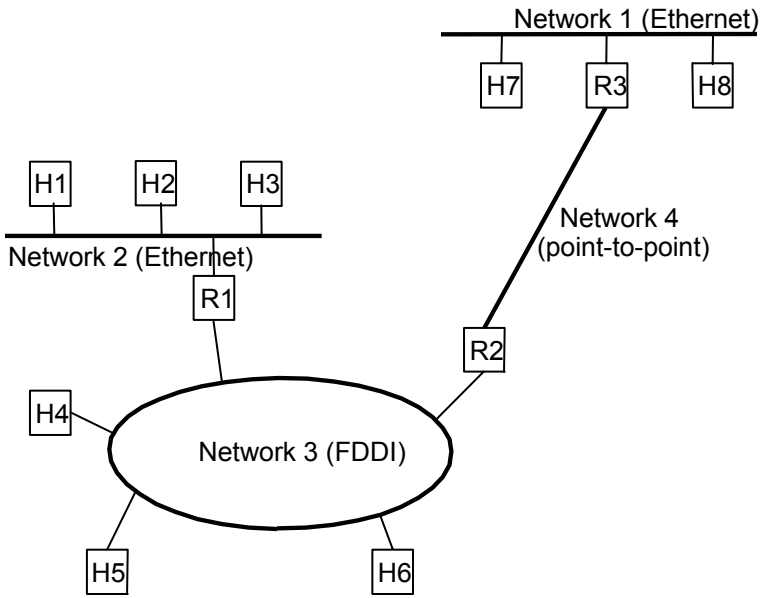


Outline

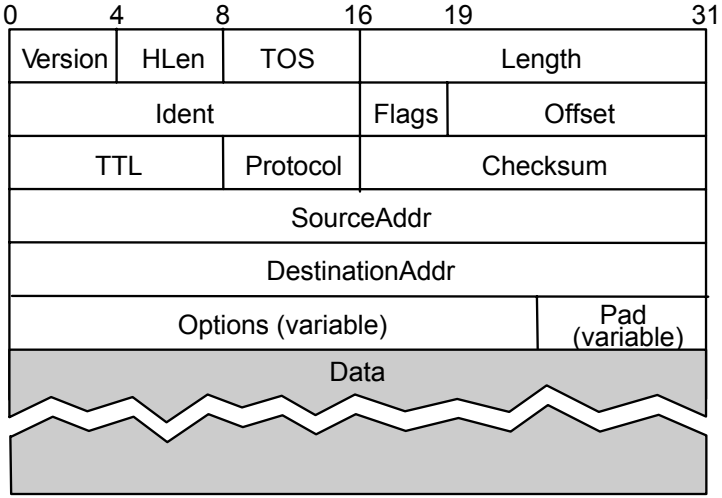
- Recap
- Switching and forwarding
- IP (Internet Protocol)
  - Service model, IP header, fragmentation, routing
- Summary and homework

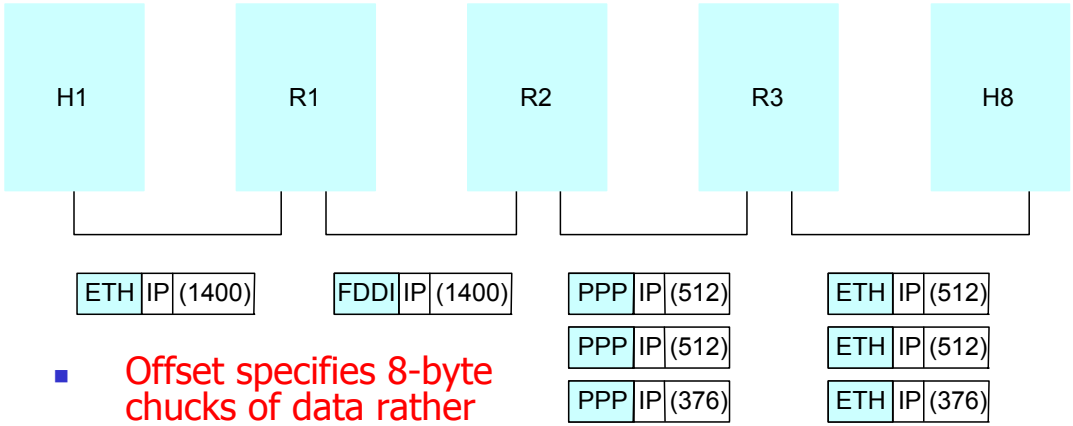
IP Internet

- Internet: concatenation of networks by router/gateway
- Fragmentation and reassembly

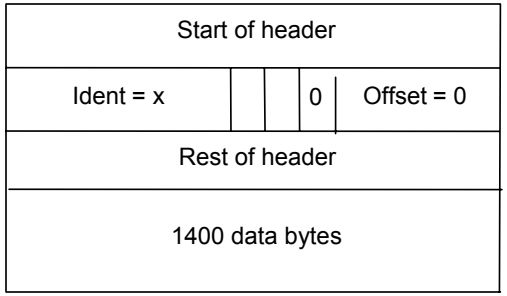


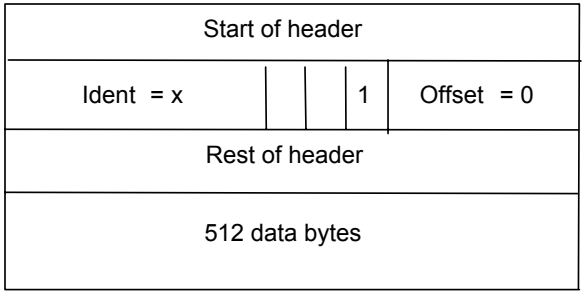
Fragmentation

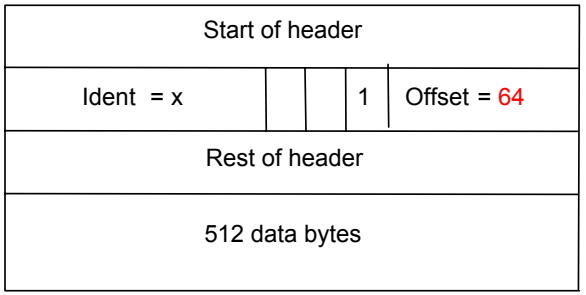


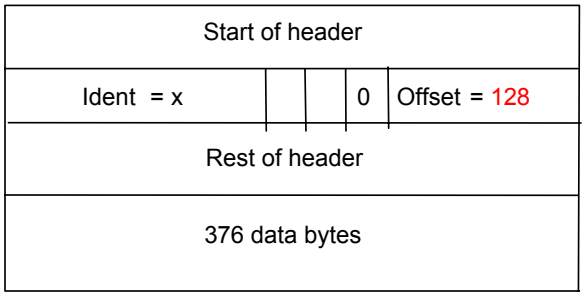


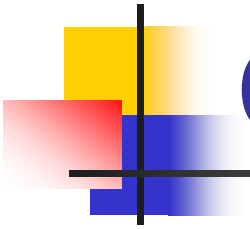
- Offset specifies 8-byte chucks of data rather than individual bytes





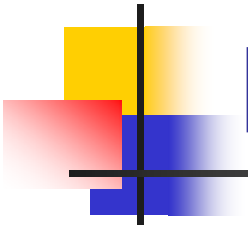






Outline

- Recap
- Switching and forwarding
- IP (Internet Protocol)
- Summary and homework



Lab on 01/31

- Traffic monitoring and throughput measurement
- Location: PL112

Homework (due on Jan. 31st before the class)

- 2.1. Suppose a datagram that contains 2068 bytes of data is passed to IP for delivery across two networks of the Internet (i.e., from the source host to a router to the destination host). The first network uses 14-byte headers and has an MTU of 1024 bytes; the second uses 8-byte headers with an MTU of 512 bytes. Each network's MTU gives the size of the largest IP segment/packet that can be carried in a link-layer frame. Give the sizes and offsets of the sequence of fragments delivered to the network layer at the destination host. Assume all IP header are 20 bytes.
- Off-line discussion question (no need to hand in): verify the numbers of the multiplexing example for packet switching, i.e. with 35 users, probability > 10 active less than .0004