Packet Switching

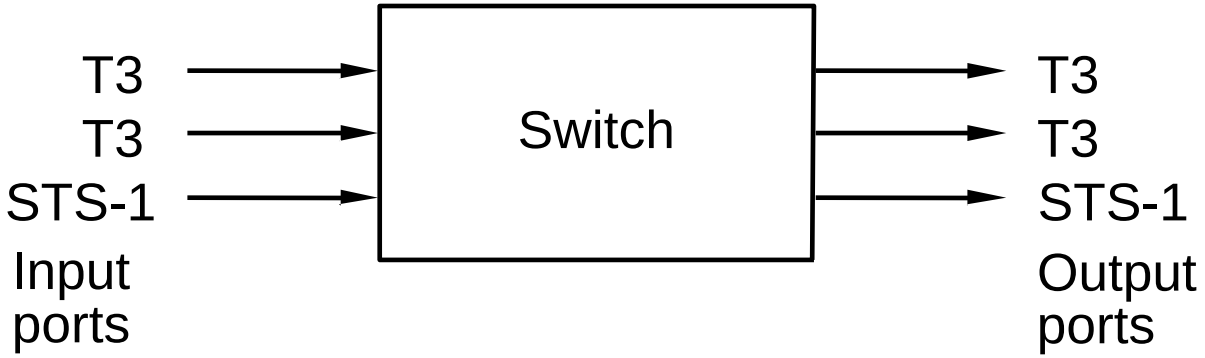
Ref: book by Peterson and Davie

Packet Switching

- Switches are used to cover wide geographical area as LANs have their own drawbacks such as scalability
- A packet switch is usually a store-and-forward switch
- A switch has a number of input and output links (or ports)
- A switch can be connected to other switches or hosts through ports
- Contention is said to occur on a link when packets that are required to leave through the link arrive at a faster rate than the rate of the link
- Buffers are used to solve the contention problem
- Congestion is said to occur in a switch when buffer overflows and the packets are discarded

Scalable Networks

- Switch
  - forwards packets from input port to output port
  - Port can be represented as a number or as a link
  - Output port is selected based on address in packet header

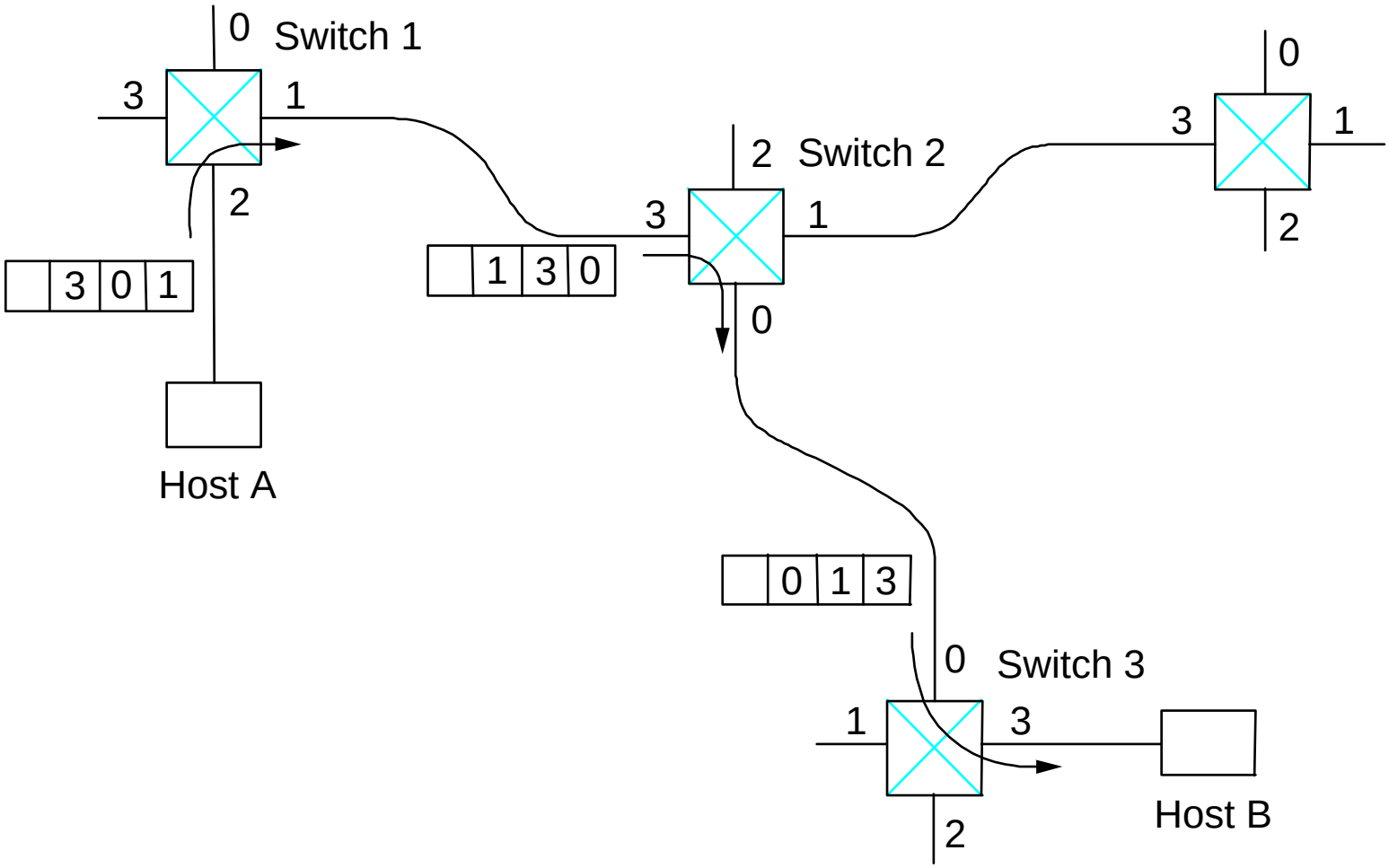


- Advantages
  - cover large geographic area (tolerate latency)
  - support large numbers of hosts (scalable bandwidth)

Approaches to Switching

- Datagram (Connectionless)
  - eg. ARPANET, Internet
- Virtual circuit (Connection Oriented)
  - Asynchronous Transfer Mode (ATM), X.25, Frame Relay
- Source routing
  - Source node attaches the route information as a part of the header in the packet
  - Results in long and variable header

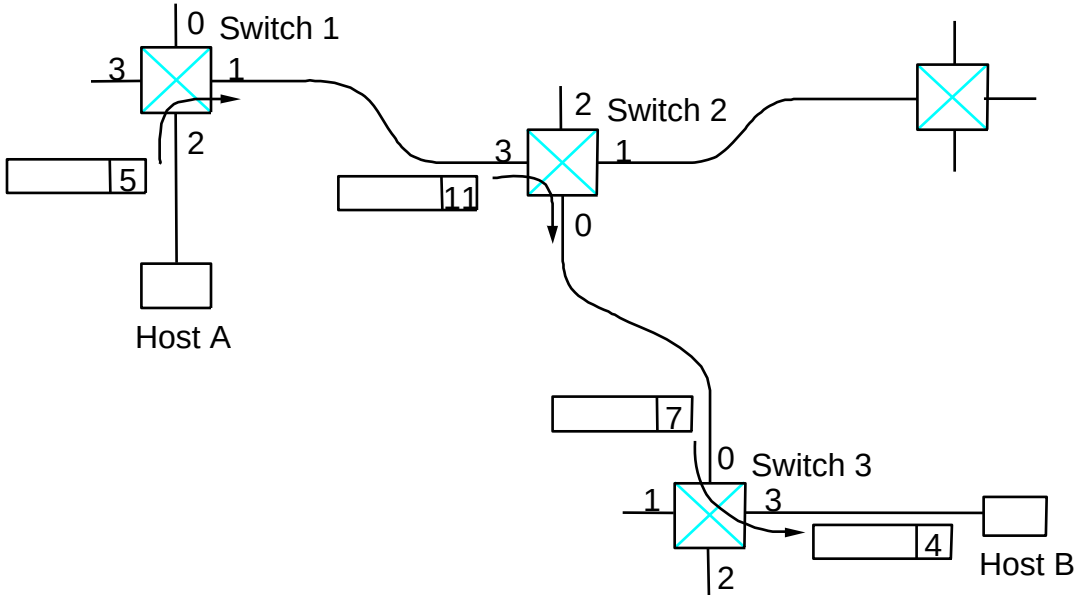
Source Routing



Virtual Circuit Switching

- Explicit connection setup (and tear-down) phase
- Subsequence packets follow same circuit
- Sometimes called *connection-oriented* model
- Each switch keeps a virtual circuit table
- Table entry: <VCI_{in}, $port_{in}$, VCI_{out}, $port_{out}$>
- VCI – virtual circuit identifier

Virtual circuit Switching: An example



VCI tables

Switch 1

VCI_{in}	$Port_{in}$	VCI_{out}	$Port_{out}$
5	2 (A→1)	11	1(1→2)

Switch 2

VCI_{in}	$Port_{in}$	VCI_{out}	$Port_{out}$
11	3 (1→2)	7	0 (2→3)

Switch 3

VCI_{in}	$Port_{in}$	VCI_{out}	$Port_{out}$
7	0 (2→3)	4	3(3→B)

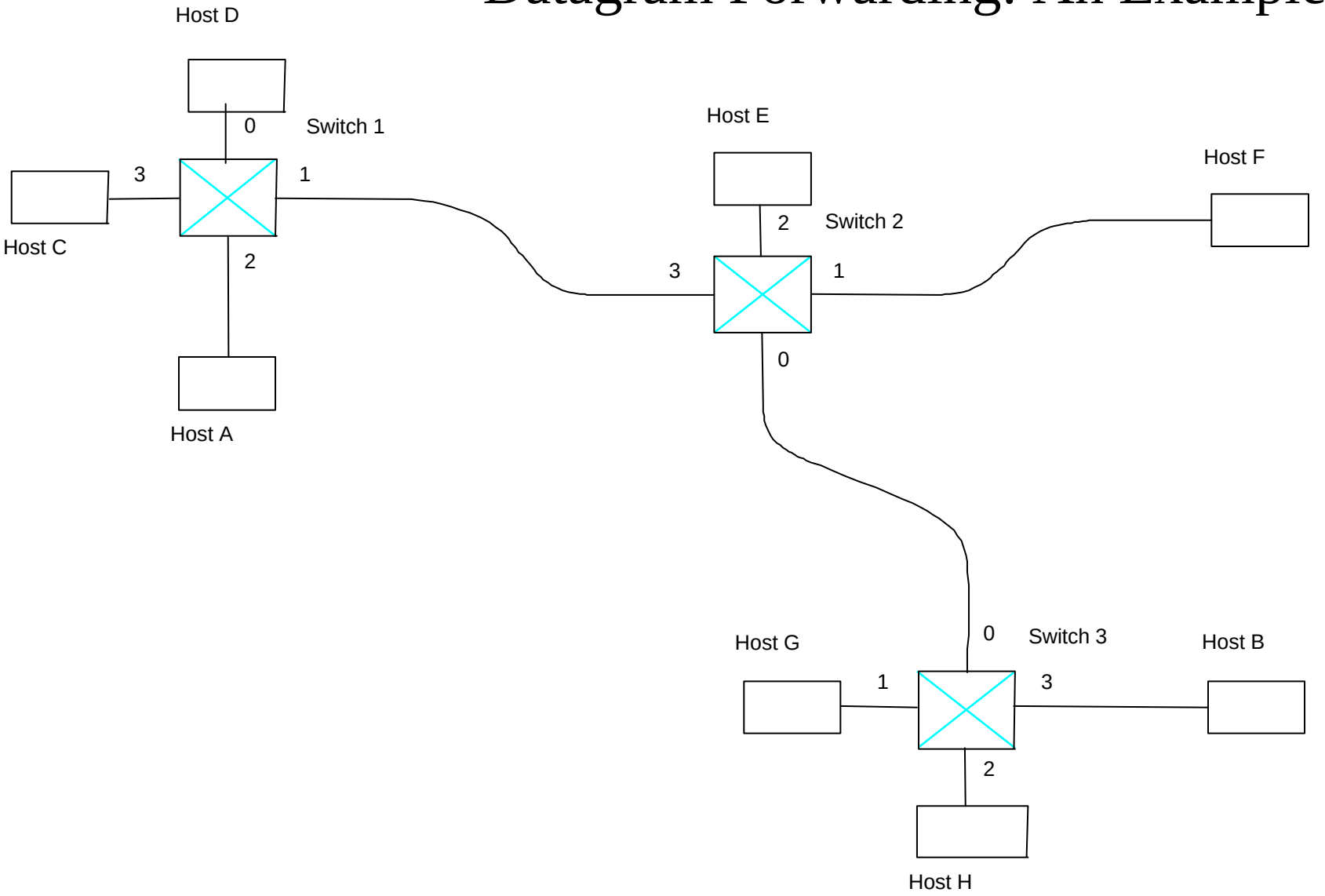
Virtual Circuit Model

- Signalling is used to setup the connection, i.e. to reserve resources, to setup VCI table entries.
- Typically wait full RTT for connection setup before sending the first data packet.
- While the connection request contains the full address for destination, each data packet contains only a small identifier, making the per-packet header overhead small.
- If a switch or a link in a connection fails, the connection is broken and a new one needs to be established.
- Connection setup provides an opportunity to reserve resources. Can provide quality of service (QoS)

Datagram Switching

- No connection setup phase
- Each packet forwarded independently
  Sometimes called *connectionless* model
- Buffers could be managed in a better way; Better performance
- Every node keeps a forwarding table (or routing table)
- Table entry : <d,p>; this means that the packets destined for host d need to be switched to port p

Datagram Forwarding: An Example



Forwarding (Routing) Table at Switch 2

Destination	Port
A	3
B	0
C	3
D	3
E	2
F	1
G	0
H	0

Datagram Model

- There is no round trip time delay waiting for connection setup; a host can send data as soon as it is ready.
- Source host has no way of knowing if the network is capable of delivering a packet or if the destination host is alive.
- Since packets are treated independently, it is possible to route around link and node failures. They may be received out of order at the destination.
- Since every packet must carry the full address of the destination, the overhead per packet is higher than for the connection-oriented model.