CISC 7332X T6

C12a: LAN Switching

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Acknowledgements

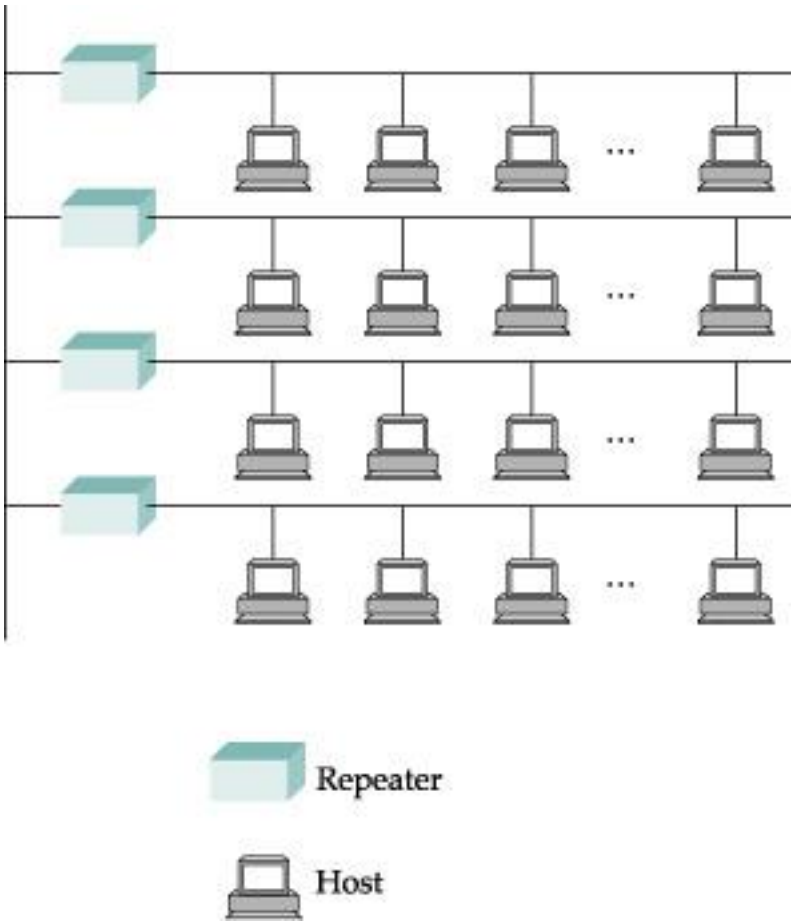
- Some pictures used in this presentation were obtained from the Internet
- The instructor used the following references
  - Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 5th Edition, Elsevier, 2011
  - Andrew S. Tanenbaum, Computer Networks, 5th Edition, Prentice-Hall, 2010
  - James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 5th Ed., Addison Wesley, 2009
  - Larry L. Peterson's (http://www.cs.princeton.edu/~llp/) Computer Networks class web site

Ethernet LAN: How to Expand?

- Expand an Ethernet local area network (LAN)
  - Repeaters
  - Bridges
  - Switches

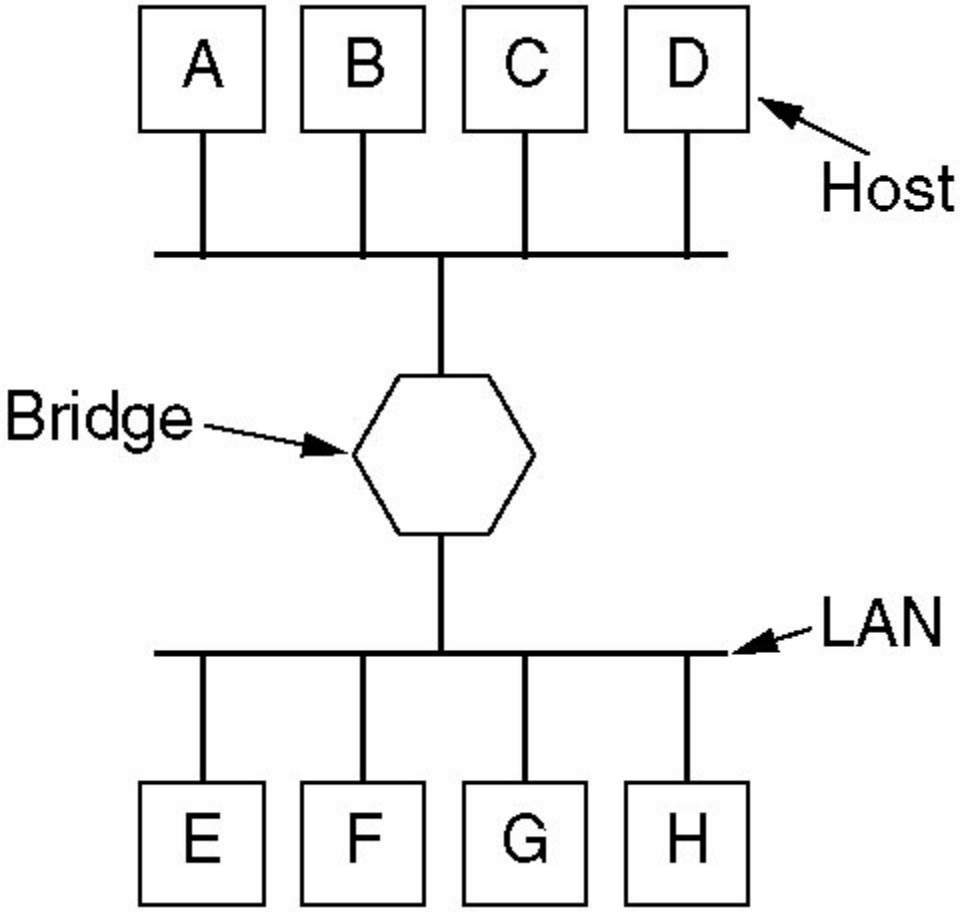
Repeaters

- Devices in physical layer
- Receive, amplify (regenerate), and retransmit signal in both directions.
- Example: Ethernet repeaters



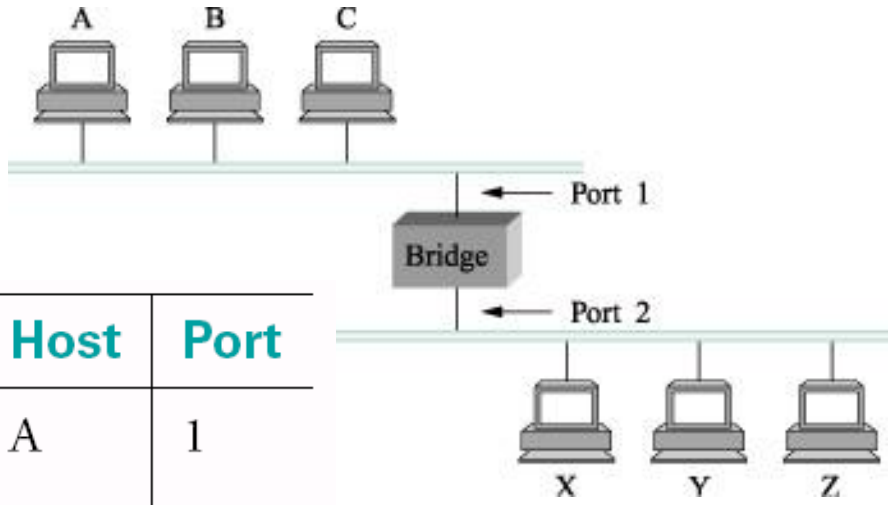
Bridges

- Devices in data link layer
- In promiscuous mode
- Forward packets/frames to either connected networks
- Example: Ethernet bridges



Ethernet Switches: Learning Bridges

- Do you actually need to forward every frames when
  - A → B?
  - A → X?
- Improvement
  - Do not forward unnecessarily
  - Relying on a **forwarding table** at each switch

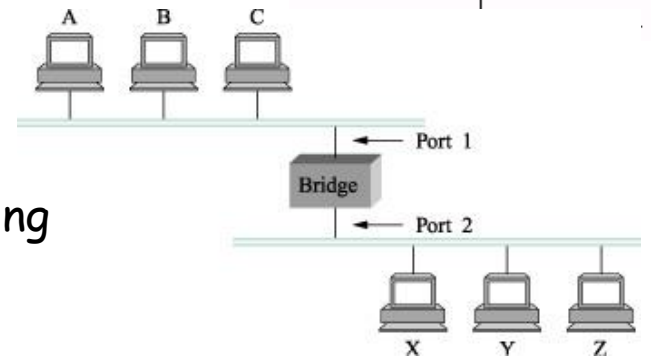


Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

Forwarding Algorithm

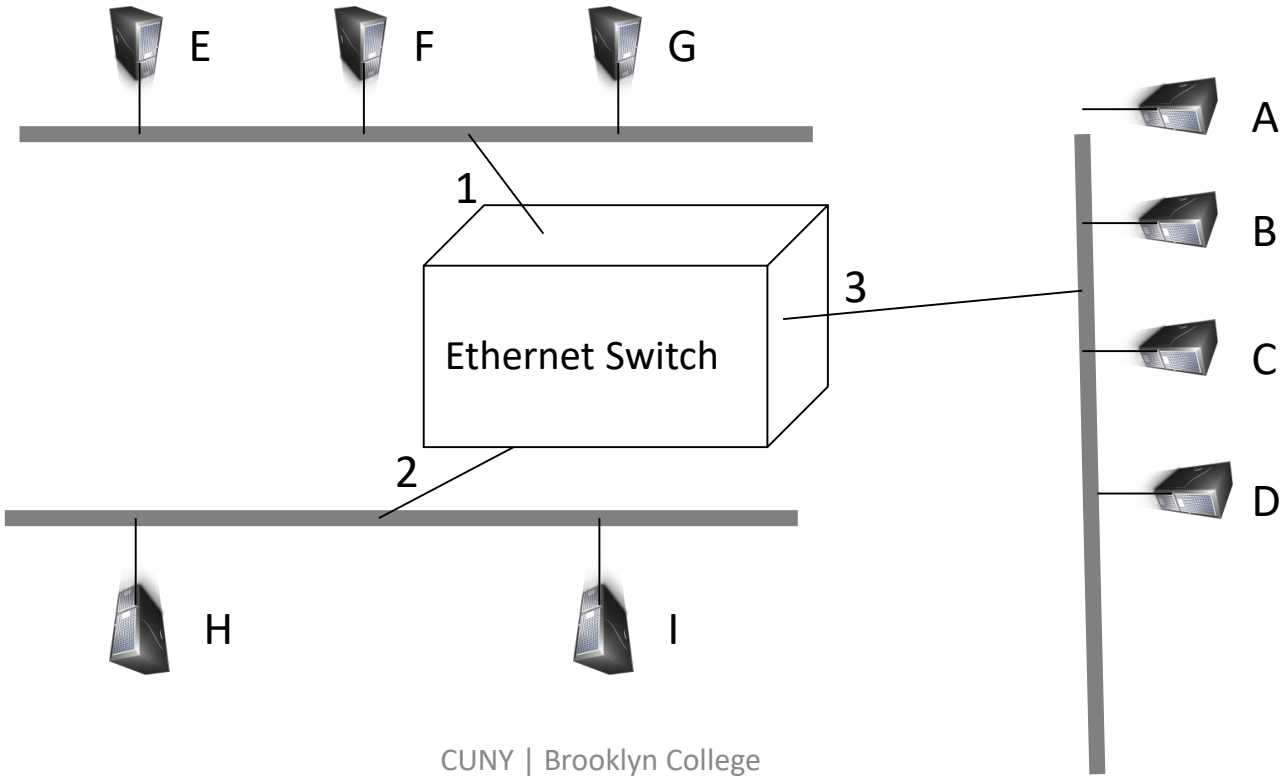
- Destination address in frame header indicates which host a frame is addressed to
- Source address in frame header indicates which host a frame is originated
- Each bridge maintains a "forwarding" table
- Algorithm
  - On receiving a frame *(src, dst, receiving port)*, look up *dst* in the forwarding table
    - If *dst* is found
      - If port in forwarding table = receiving port, do not forward;
      - otherwise, forward to the forwarding port
    - Otherwise, forward to all ports

Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2



Exercise C12a-1

- Build a complete "forwarding" table for the Ethernet switch

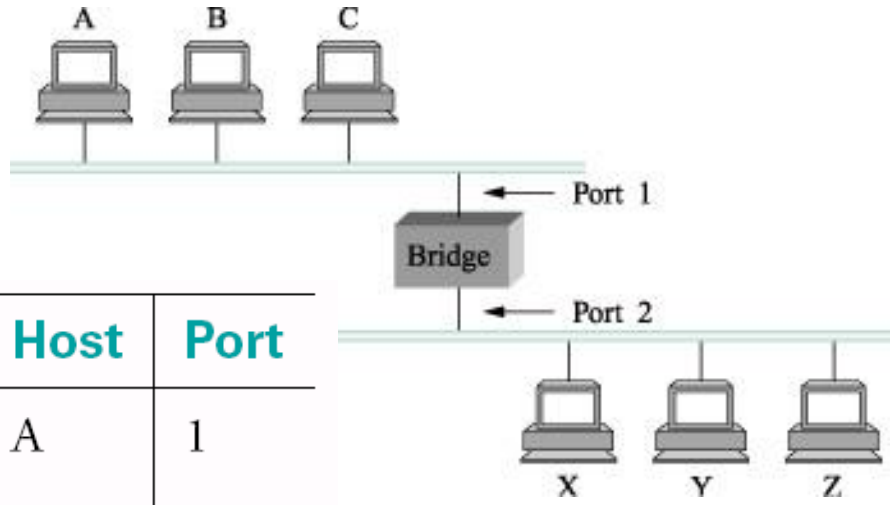


Questions?

- Packet switching in extended LAN
- Forwarding table and forwarding algorithm in extended LAN

Ethernet Switches: Learning Bridges

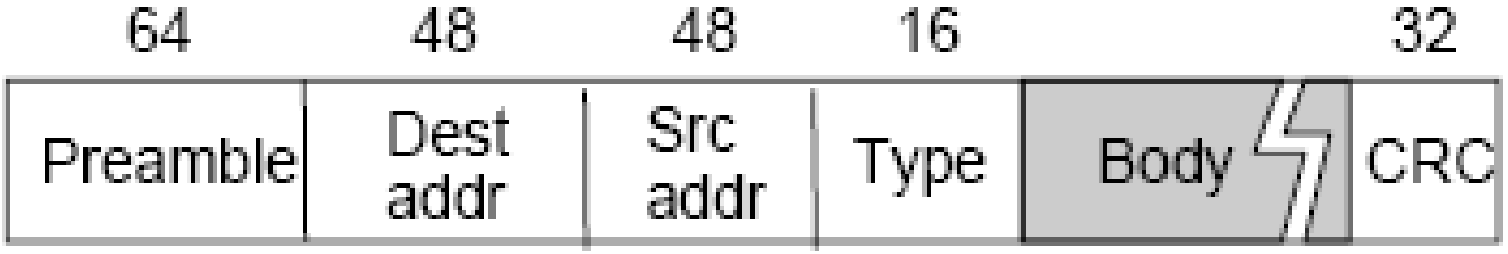
- Improvement
  - Forwarding table
  - Do not forward unnecessarily to receiving port.
- How to maintain the table?
  - Manually?
  - Automatically?
- Learning bridges
  - automatically maintain the table without human intervention → "learning" from received frames → Ethernet switches = Learning bridges
- How does it learn?



Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

Ethernet Switches: Learning from Received Frame

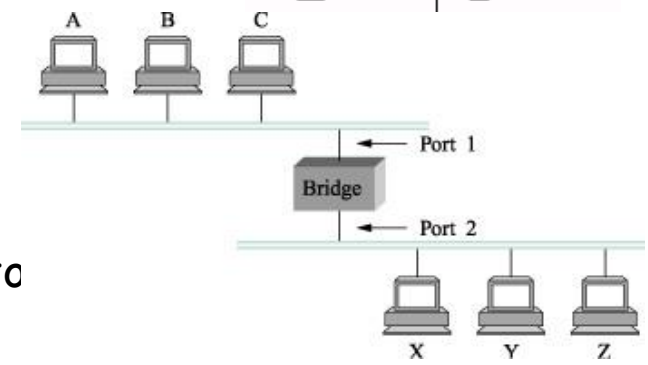
- From a received frame, an Ethernet switch knows
  - Destination address and source address
- Receiving port number on the switch



Learning Bridges: Learning Algorithm

- Destination address in frame header indicates which host a frame is addressed to
- Source address in frame header indicates which host a frame is originated
- Each bridge maintains a "forwarding" table, initially empty
- Algorithm
  - On receiving a frame *(src, dst, receiving port)*, look up *src* in the forwarding table
    - If *src* is not found
      - Insert (src, receiving port number) to the forwarding table

Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

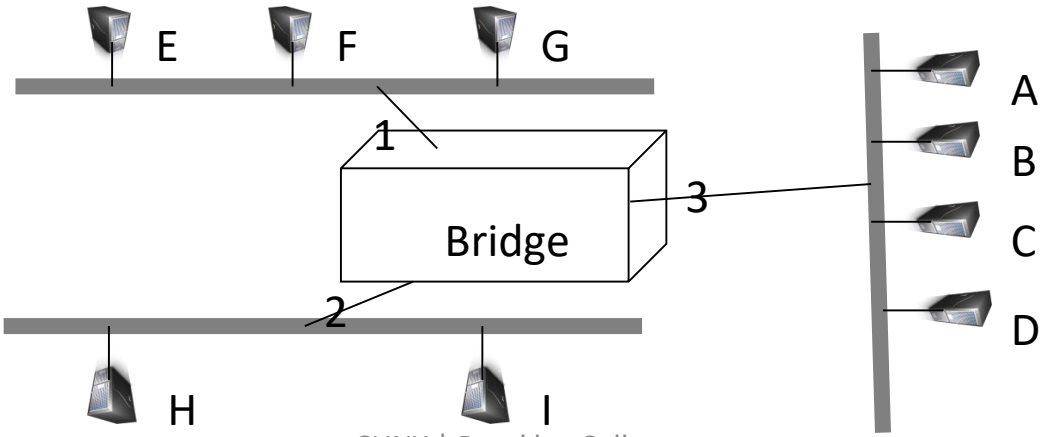


Learning Algorithm: Example

- Describe the table built by the switch as the following frames arrives
  - Starting with the table as follows

Host	Port
B	3

  - The following frames (indicated by sending hosts) are received by the bridge as time goes
    - I, H, B, F (reads, first I, then H, then B, and then F)
    - Please draw four tables to show the resulting table after each frame is processed



Learning Algorithm: Example: Example: Answer

0. Initial table

Host	Port
B	3

1. Frame sent from Host I arrives

Host	Port
B	3
I	2

2. Frame sent from Host H arrives

Host	Port
B	3
I	2
H	2

3. Frame sent from Host B arrives

Host	Port
B	3
I	2
H	2

4. Frame sent from Host F arrives

Host	Port
B	3
I	2
H	2
F	1

Example: Question 1

0. Initial table

Host	Port
B	3

Q: which hosts will see the frame sent from Host I?

Example: Question 2

0. Initial table

Host	Port
B	3

Q: which hosts will see the frame sent from Host B?

1. Frame sent from Host I arrives

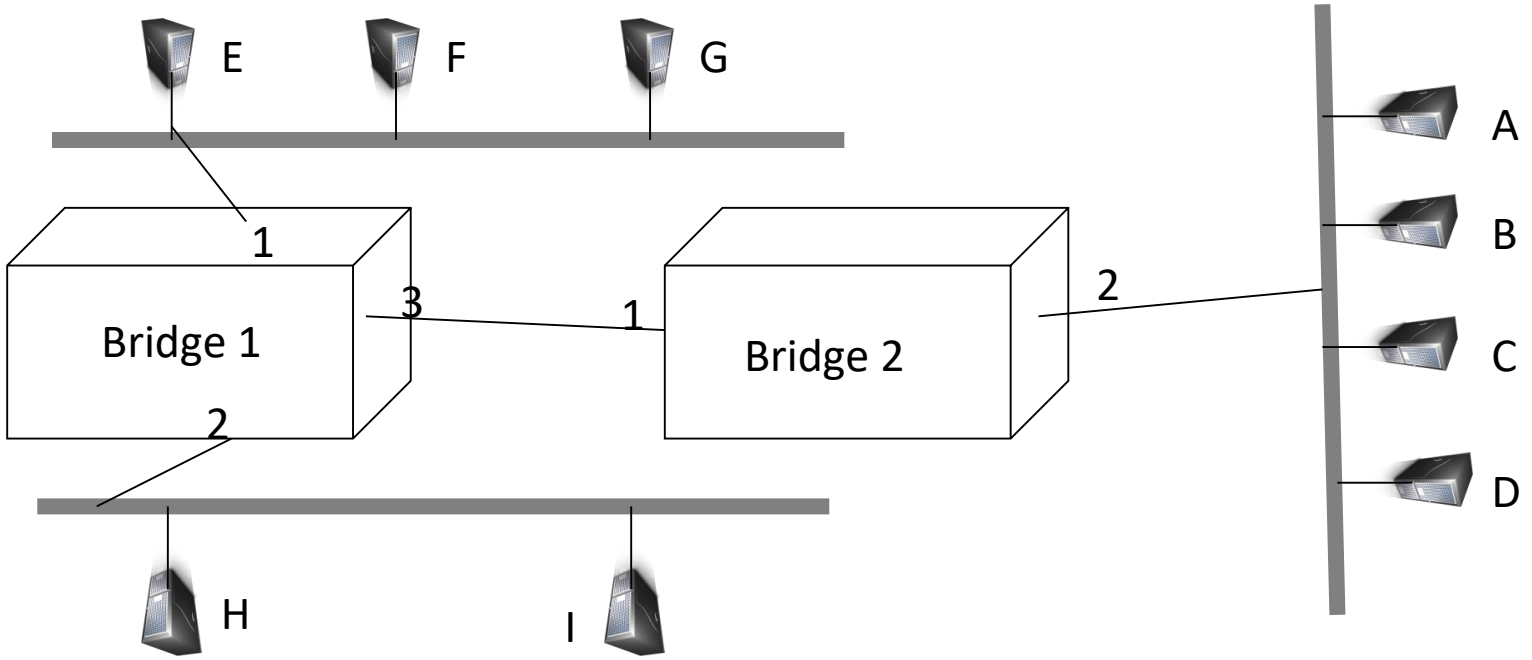
Host	Port
B	3
I	2

2. Frame sent from Host H arrives

Host	Port
B	3
I	2
H	2

Exercise C12a-2

- Starting with an empty forwarding table at each switch, step-by-step build a forwarding table for each switch of the Ethernet shown as the following transmissions happen
  - A sends to C; C sends to A; E sends to I; I sends to E; E sends to B



Questions?

- Learning algorithm of learning bridge/switch in extended LAN