Hubs and Switches

Chapter 6

Repeaters and Hubs

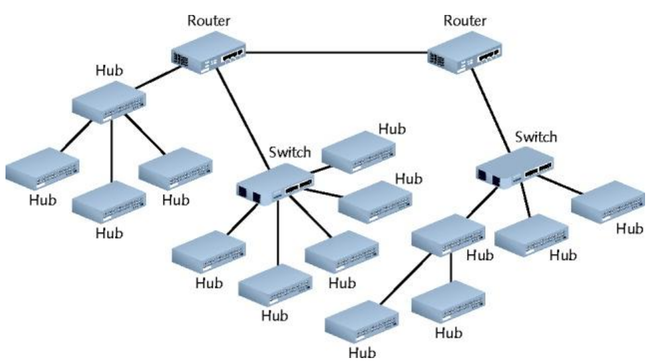
- Repeater
  - Simplest connectivity device regenerating signals
  - Operates at Physical layer
    - Has no means to interpret data
  - Limited scope
    - One input port, one output port
    - Receives and repeats single data stream
  - Suitable for bus topology networks
  - Extend network inexpensively
  - Rarely used on modern networks
    - Limitations; other devices decreasing costs

Repeaters and Hubs (cont'd.)

A stand-alone hub

- Hub
  - Repeater with more than one output port
    - — Multiple data ports, uplink port
  - Repeats signal in broadcast fashion
  - Operates at Physical layer
  - Ethernet network hub
    - — Star or star-based hybrid central connection point
  - Connect workstations, print servers, switches, file servers, other devices

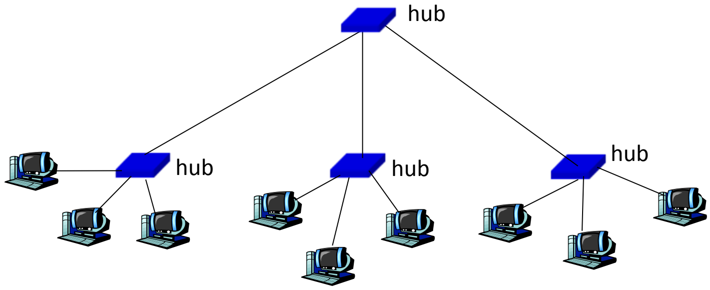
Repeaters and Hubs (cont'd)



Hubs in a network design

Interconnecting with hubs

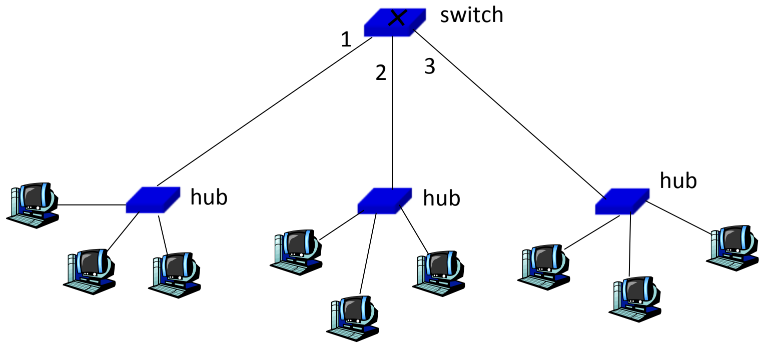
- Backbone hub interconnects LAN segments
- Extends max distance between nodes
- But individual segment collision domains become one large collision domain
- Can't interconnect 10BaseT & 100BaseT



Switch

- Link layer device
  - stores and forwards Ethernet frames
  - examines frame header and selectively forwards frame based on MAC dest address
  - when frame is to be forwarded on segment, uses CSMA/CD to access segment
- Transparent
  - hosts are unaware of presence of switches
- plug-and-play, self-learning
  - switches do not need to be configured

Forwarding



- How do determine onto which LAN segment to forward frame?
- Looks like a routing problem...

Self learning

- A switch has a switch table
- entry in switch table:
  - (MAC Address, Interface, Time Stamp)
  - stale entries in table dropped (TTL can be 60 min)
- switch *learns* which hosts can be reached through which interfaces
  - when frame received, switch “learns” location of sender: incoming LAN segment
  - records sender/location pair in switch table

Filtering/Forwarding

When switch receives a frame:

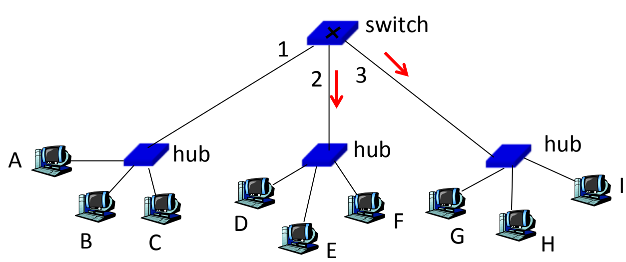
index switch table using MAC dest address

if entry found for destination
then{
if dest on segment from which frame arrived
then drop the frame
else forward the frame on interface indicated
}
else flood

forward on all but the interface on which the frame arrived

Switch example

Suppose C sends frame to D

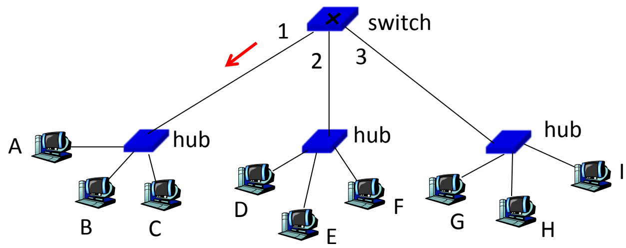


address	interface
A	1
B	1
E	2
G	3
C	**1**

- Switch receives frame from C
  - notes in switch table that C is on interface 1
  - because D is not in table, switch forwards frame into interfaces 2 and 3
- frame received by D

Switch example

Suppose D replies back with frame to C.

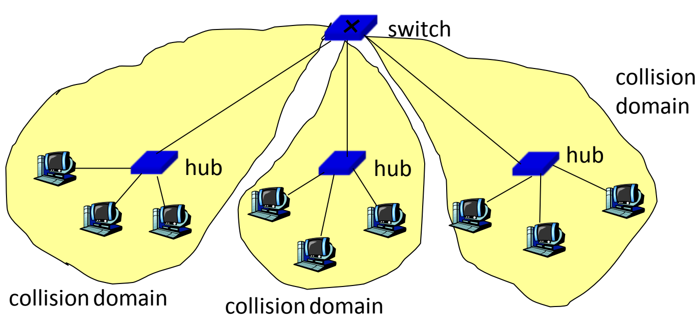


address	interface
A	1
B	1
E	2
G	3
C	1
D	**2**

- Switch receives frame from D
  - notes in switch table that D is on interface 2
  - because C is in table, switch forwards frame only to interface 1
- frame received by C

Switch: traffic isolation

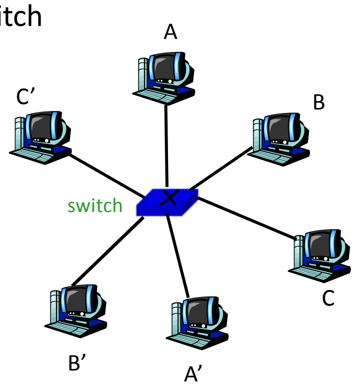
- Switch installation breaks subnet into LAN segments
- Switch filters packets:
  - same-LAN-segment frames not usually forwarded onto other LAN segments
  - segments become separate collision domains



Switches: dedicated access

- Switch with many interfaces
- Hosts have direct connection to switch
- No collisions; full duplex

Switching: A-to-A’ and B-to-B’ simultaneously, no collisions



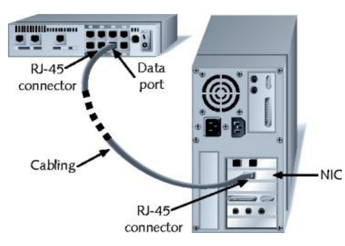
More on Switches

- Cut-through switching: frame forwarded from input to output port without first collecting entire frame
  - slight reduction in latency
- Combinations of shared/dedicated, 10/100/1000 Mbps interfaces

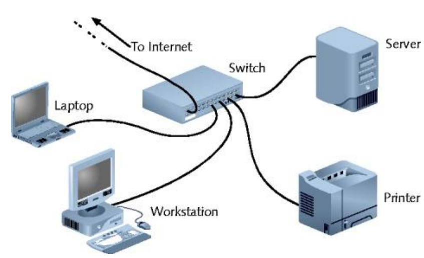
Installing a Switch

- Follow manufacturer's guidelines
- General steps (assume Cat 5 or better UTP)
  1. Verify switch placement
  2. Turn on switch
  3. Verify lights, self power tests
  4. Configure (if necessary)
  5. Connect NIC to a switch port (repeat for all nodes)
  6. After all nodes connected, turn on nodes
  7. Connect switch to larger network (optional)

Installing a Switch (cont'd.)

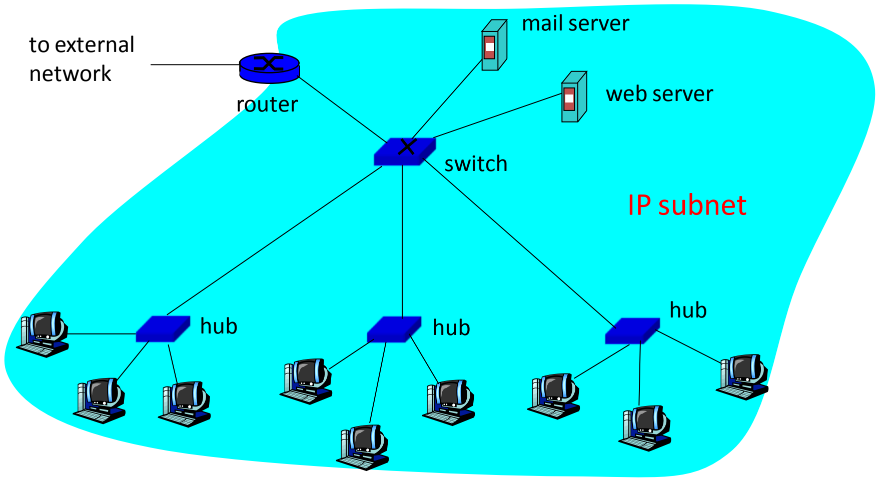


Connecting a workstation to a switch



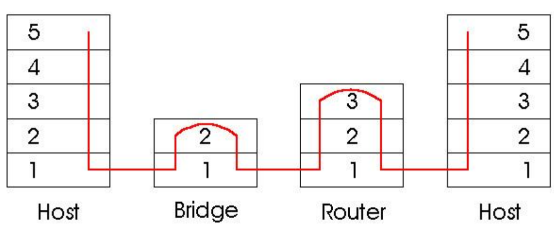
A switch on a small network

Institutional network



Switches vs. Routers

- both store-and-forward devices
  - routers: network layer devices (examine network layer headers)
  - switches are link layer devices
- routers maintain routing tables, implement routing algorithms
- switches maintain switch tables, implement filtering, learning algorithms



Summary comparison

	hubs	routers	switches
Traffic isolation	no	yes	yes
plug & play	yes	no	yes
Optimal routing	no	yes	no
Cut through	yes	no	yes