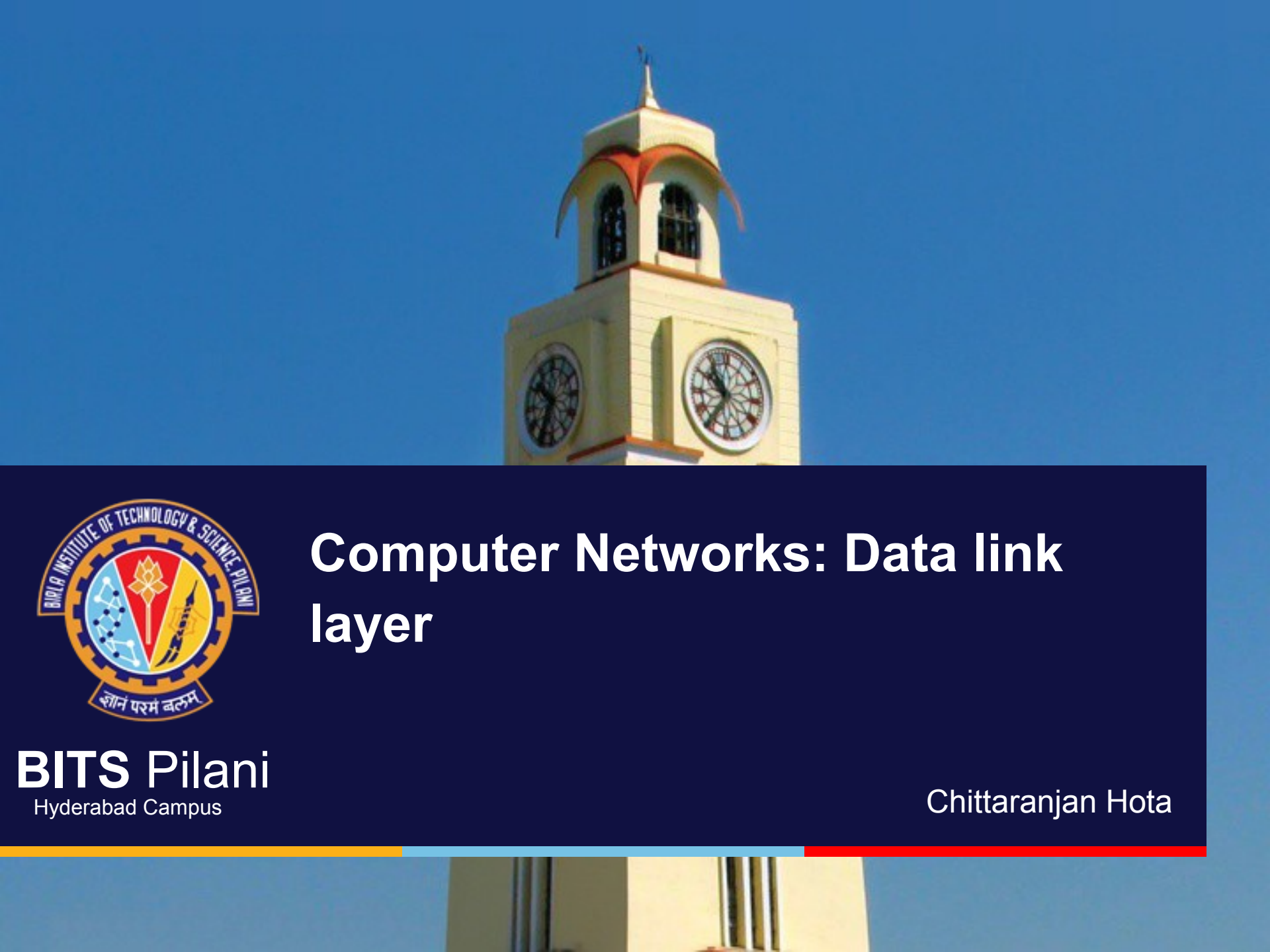


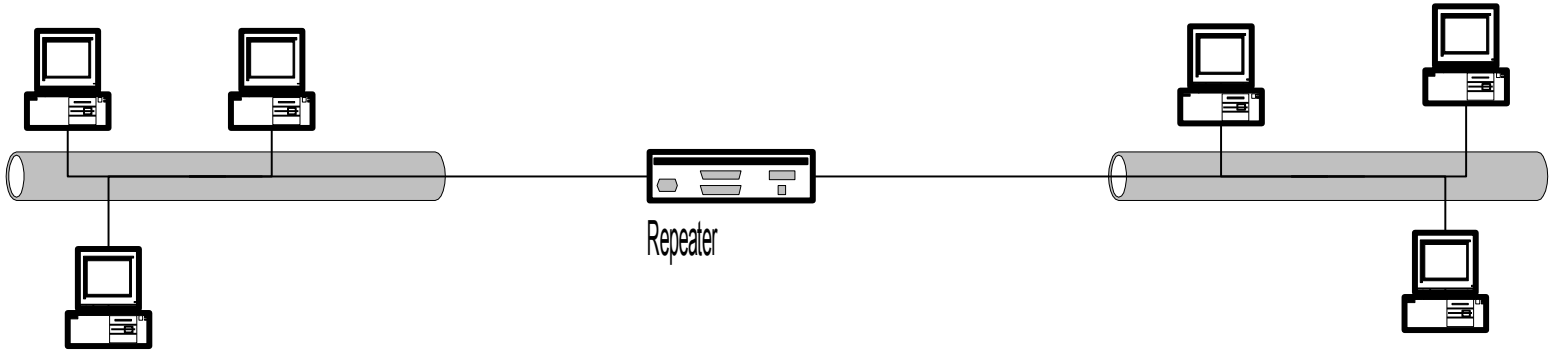
Computer Networks: Data link layer

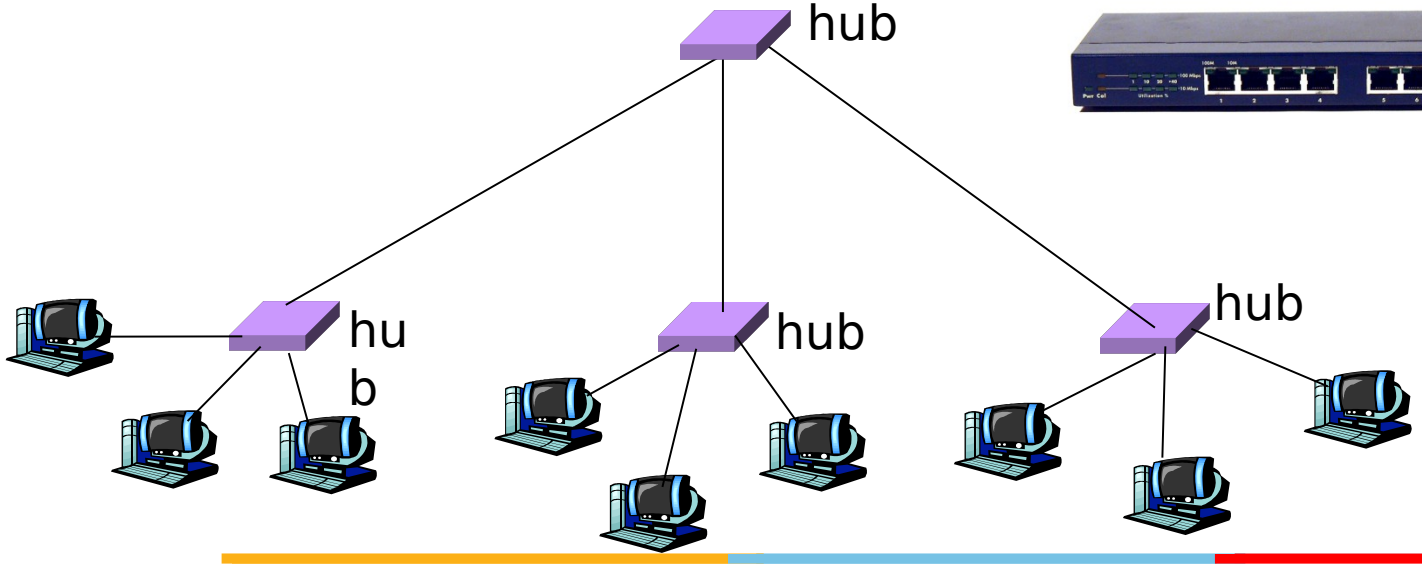
BITS Pilani
Hyderabad Campus

Chittaranjan Hota

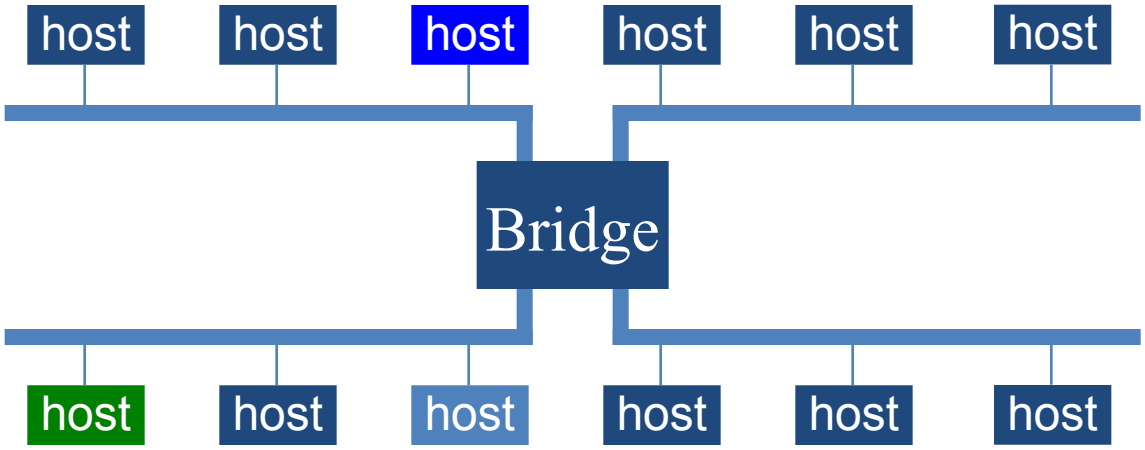
Interconnections

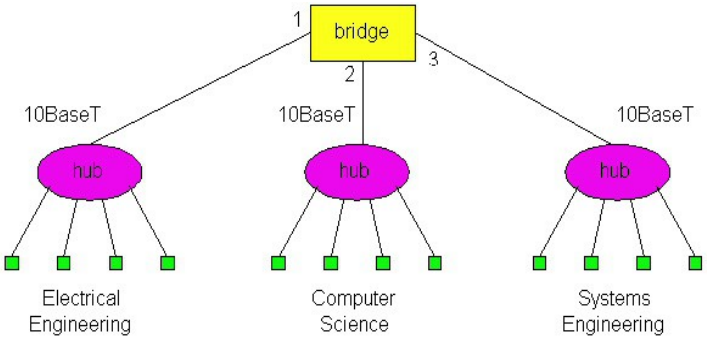
Physical Layer: Repeaters & Hubs

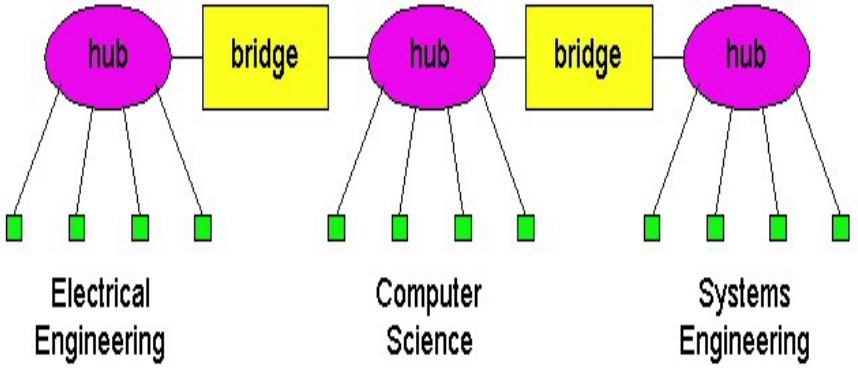




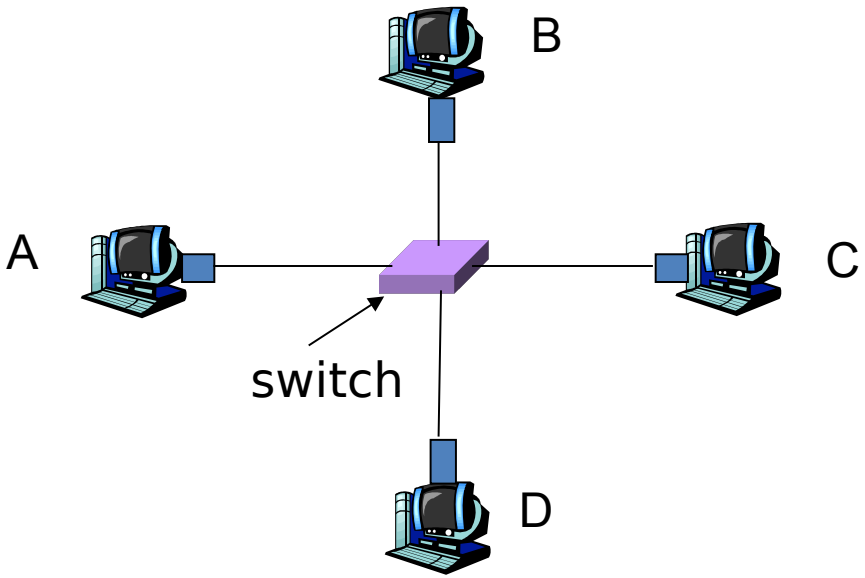
Link layer bridges

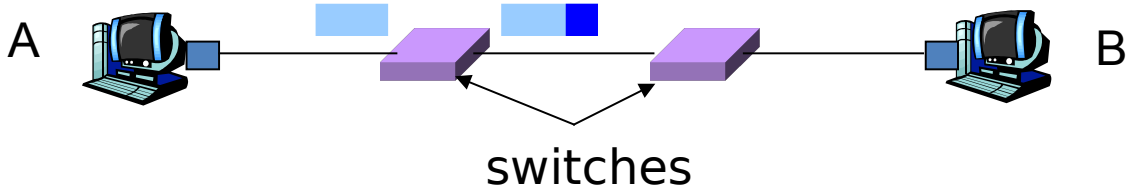




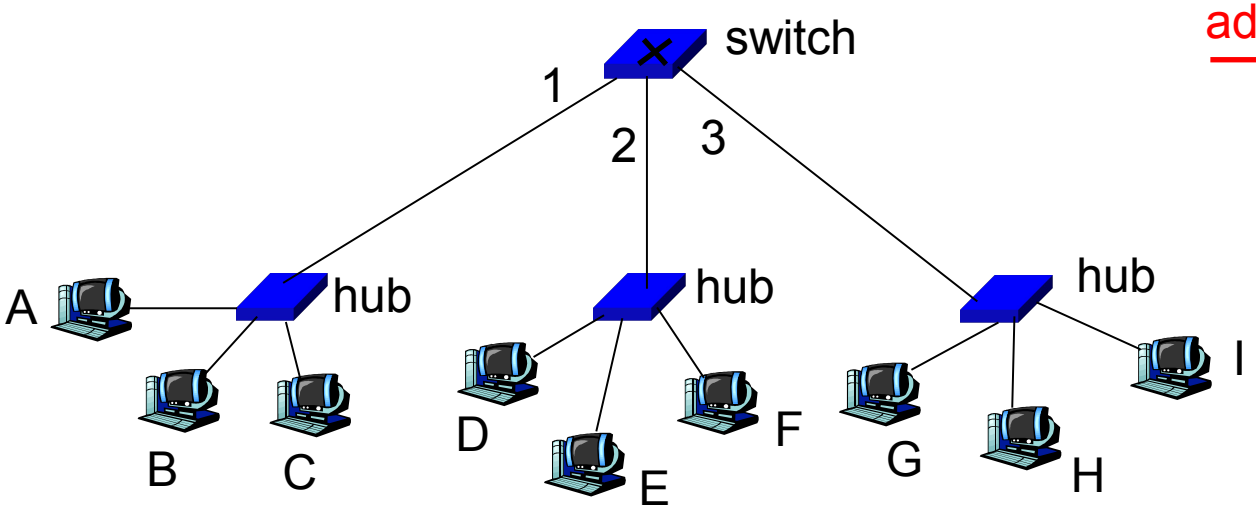


Link layer switches





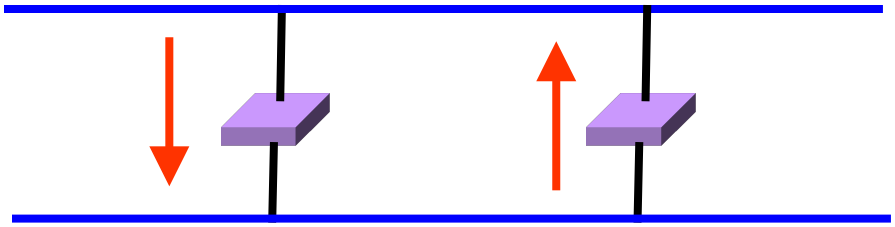
Self learning example



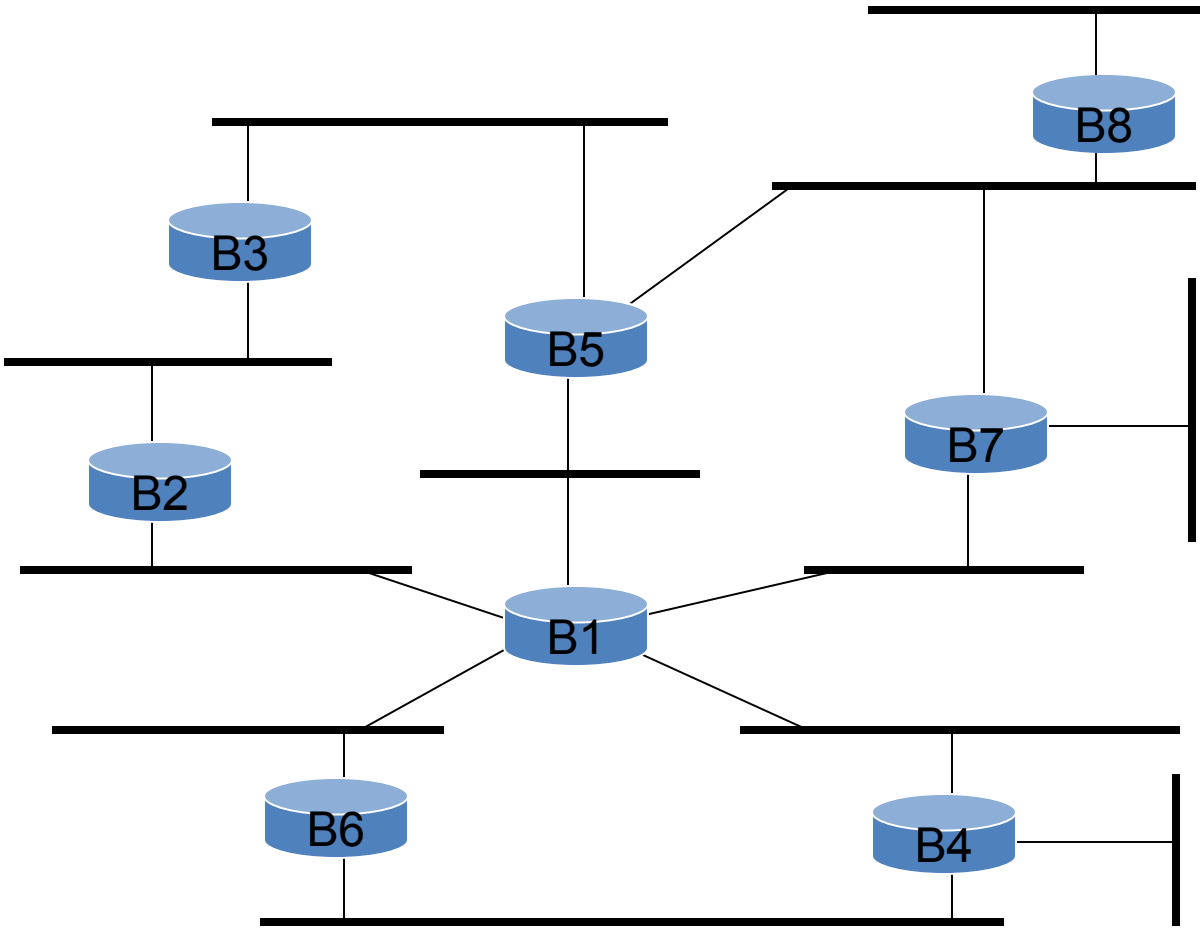
address	interface
A	1
B	1
E	2
G	3

Forwarding loops

- Switches sometimes need to broadcast frames
  - Upon receiving a frame with an unfamiliar destination
  - Upon receiving a frame sent to the broadcast address
- Broadcasting is implemented by flooding
  - Transmitting frame out every interface
  - … except the one where the frame arrived



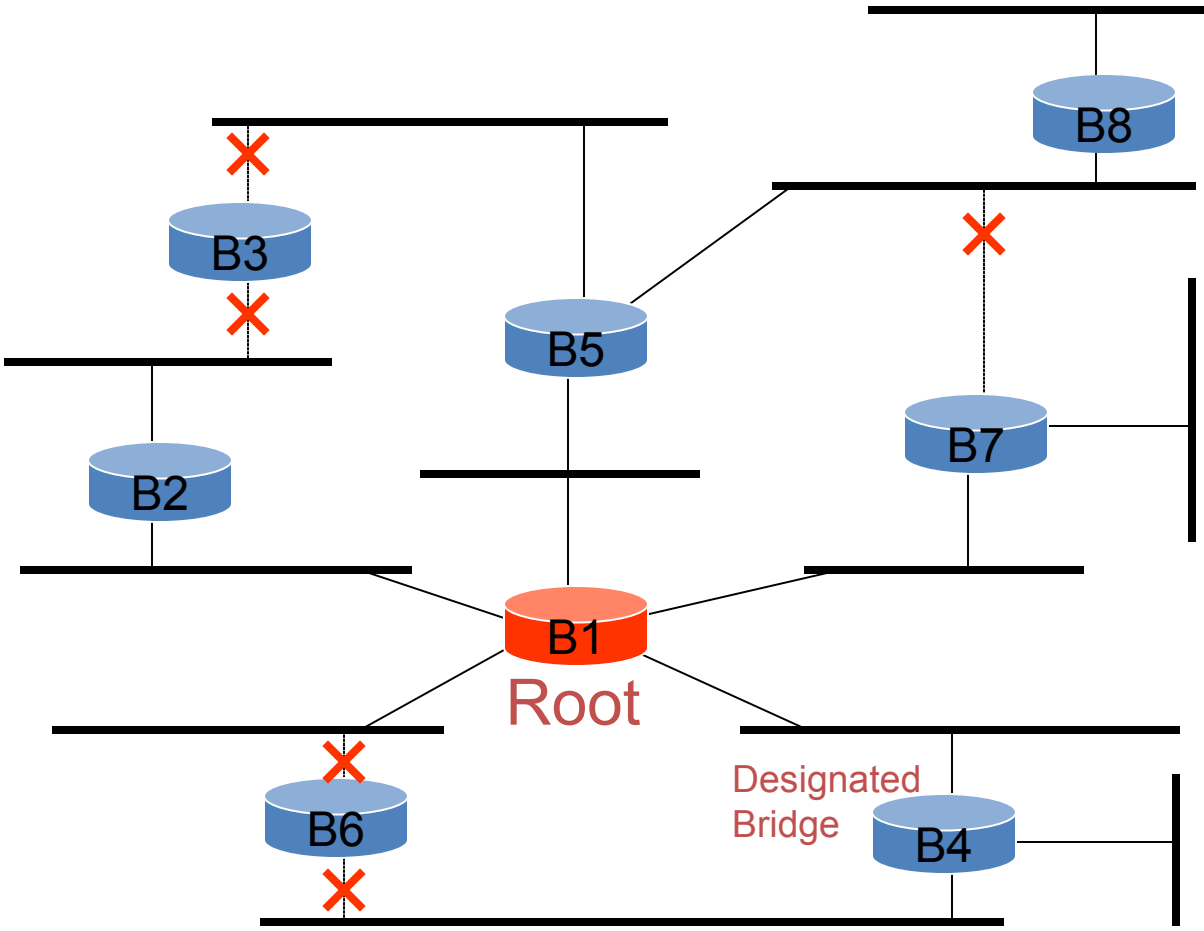
Example spanning tree



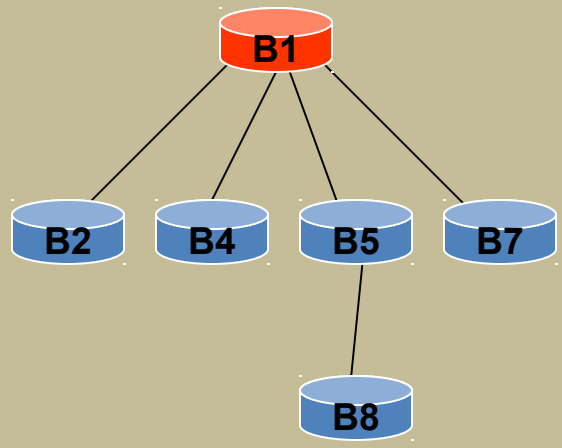
Protocol operation:

1. Picks a root
2. For each LAN, picks a designated bridge that is closest to the root.
3. All bridges on a LAN send packets towards the root via the designated bridge.

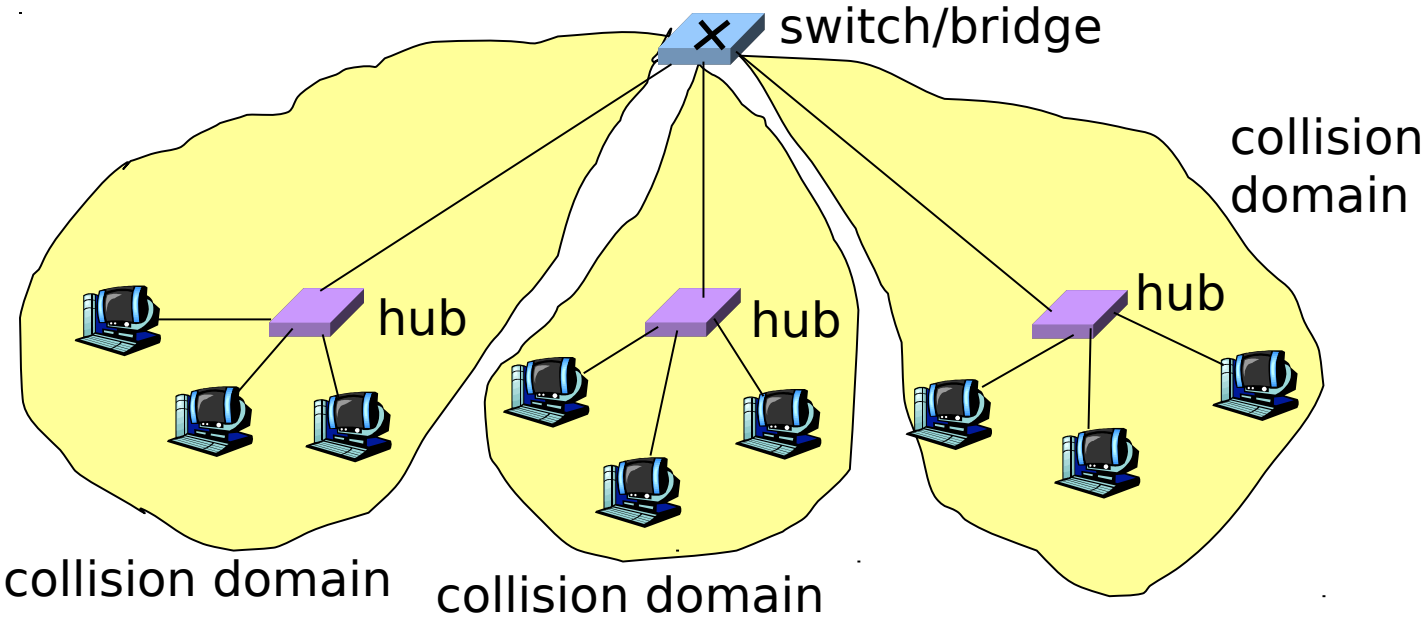
Continued…



Spanning Tree:



Traffic Isolation

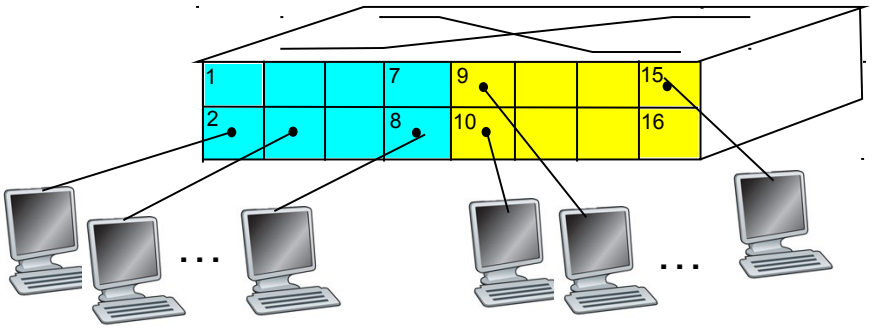


People move, roles change

- Organizational changes are frequent
  - E.g., faculty office becomes a PhD scholar office
  - E.g., faculty office becomes a store room
- Physical rewiring is a major pain
  - Requires unplugging the cable from one port
  - … and plugging it into another
  - … and hoping the cable is long enough to reach

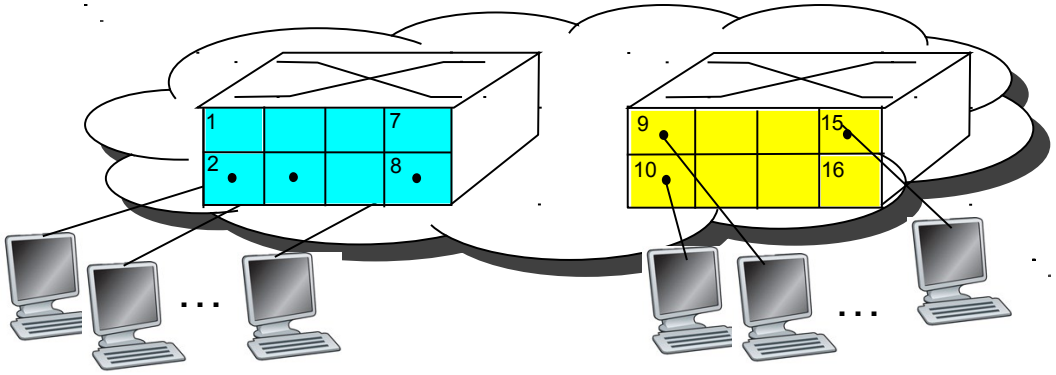
- Would like to “rewire” the building in software
  - The resulting concept is a Virtual LAN (VLAN)

Virtual LANs



Electrical Engineering
(VLAN ports 1-8)

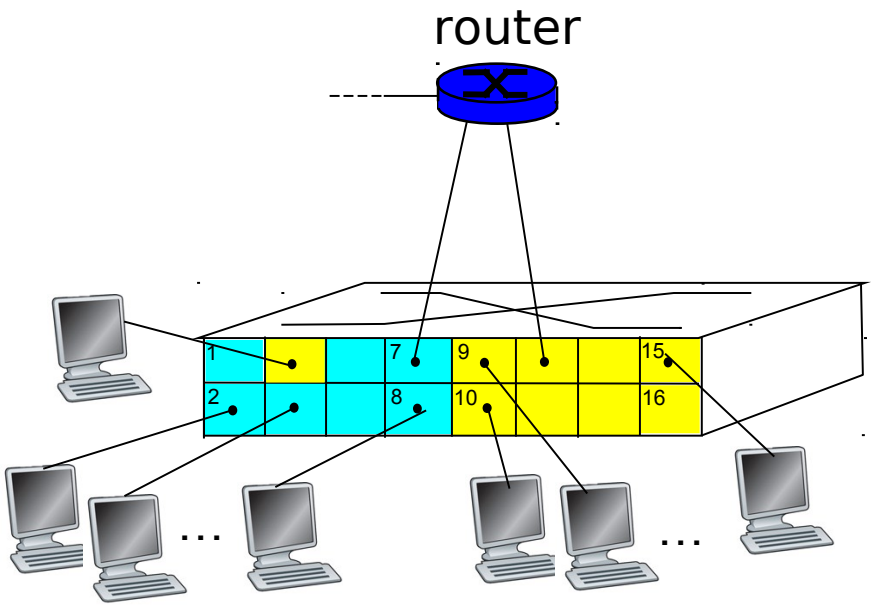
Computer Science
(VLAN ports 9-15)



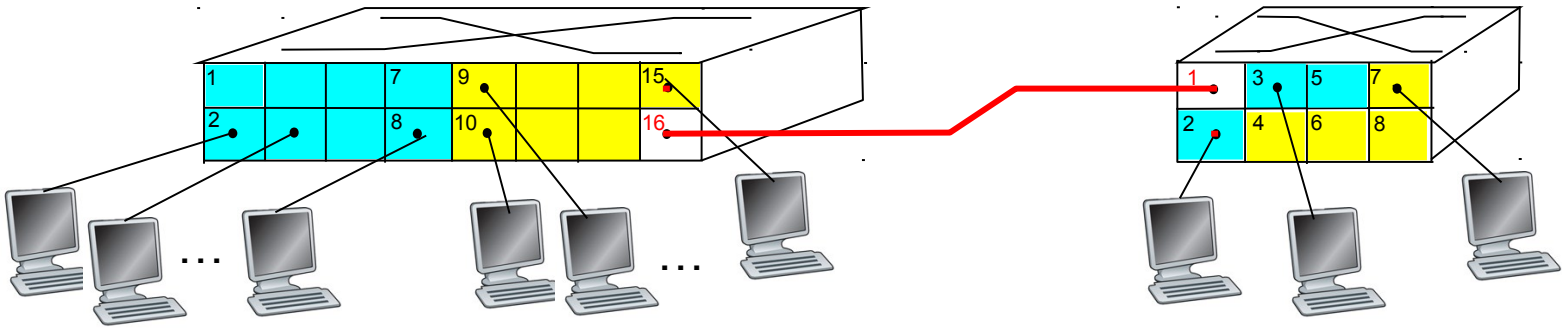
Electrical Engineering
(VLAN ports 1-8)

Computer Science
(VLAN ports 9-16)

Port-based VLAN: Dynamic membership and forwarding



VLANs spanning multiple switches

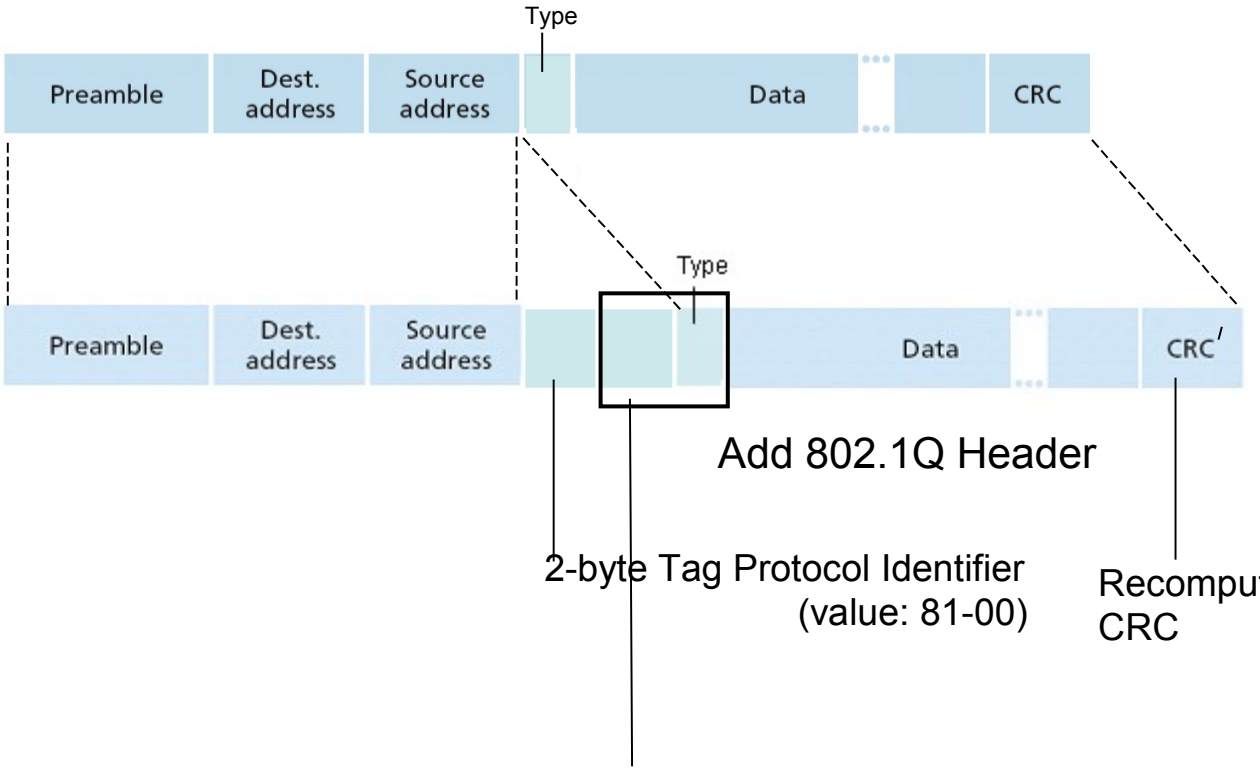


Electrical Engineering
(VLAN ports 1-8)

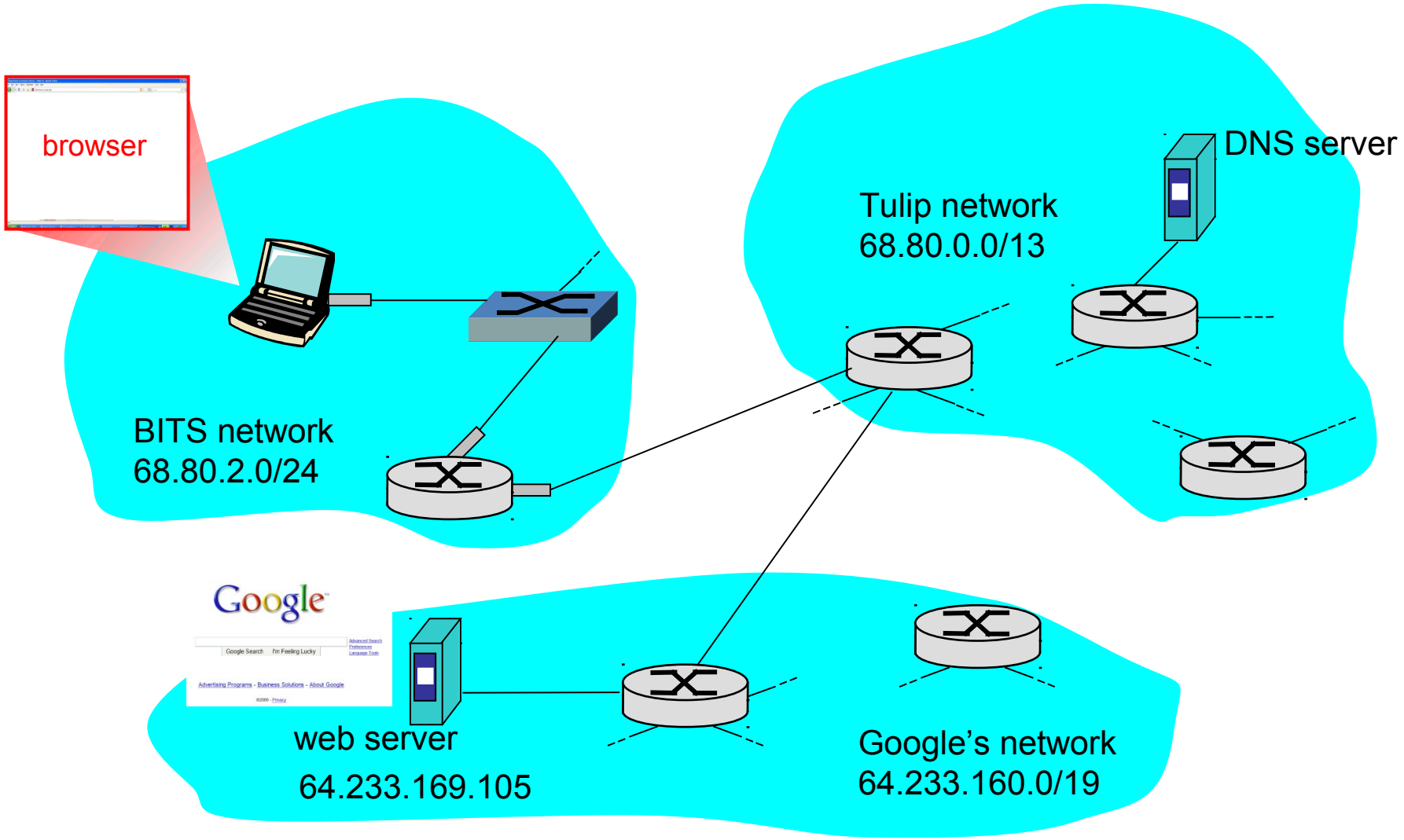
Computer Science
(VLAN ports 9-15)

Ports 2,3,5 belong to EE VLAN
Ports 4,6,7,8 belong to CS VLAN

VLAN Frame format



Journey from Application to Datalink



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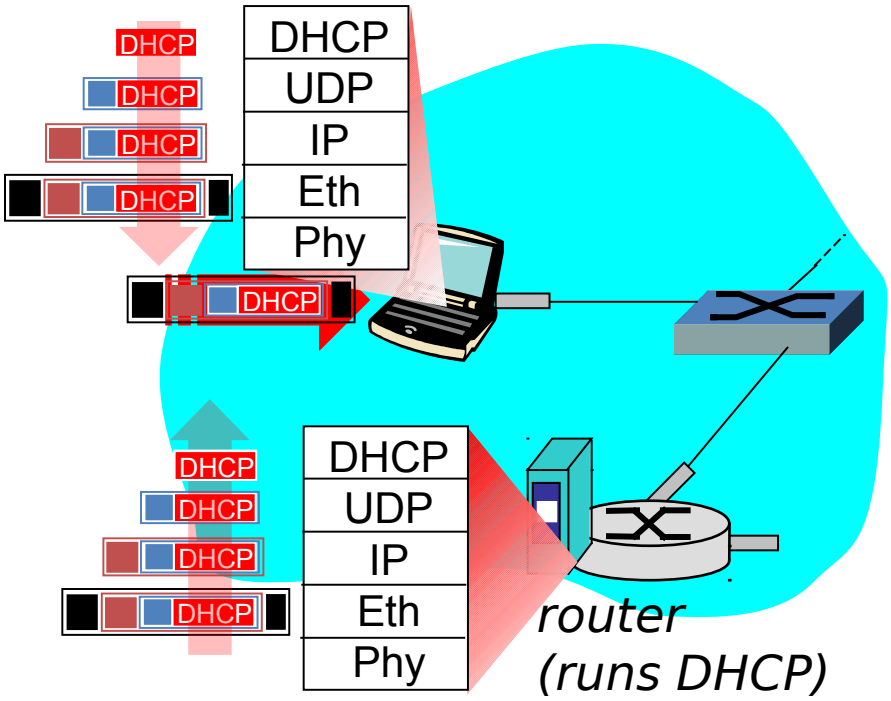
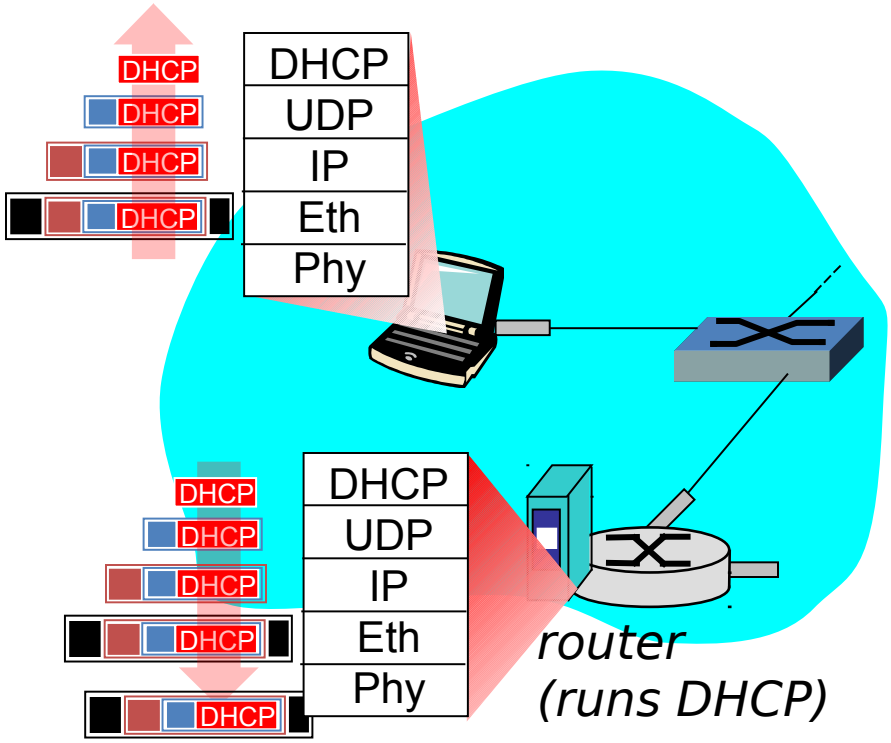
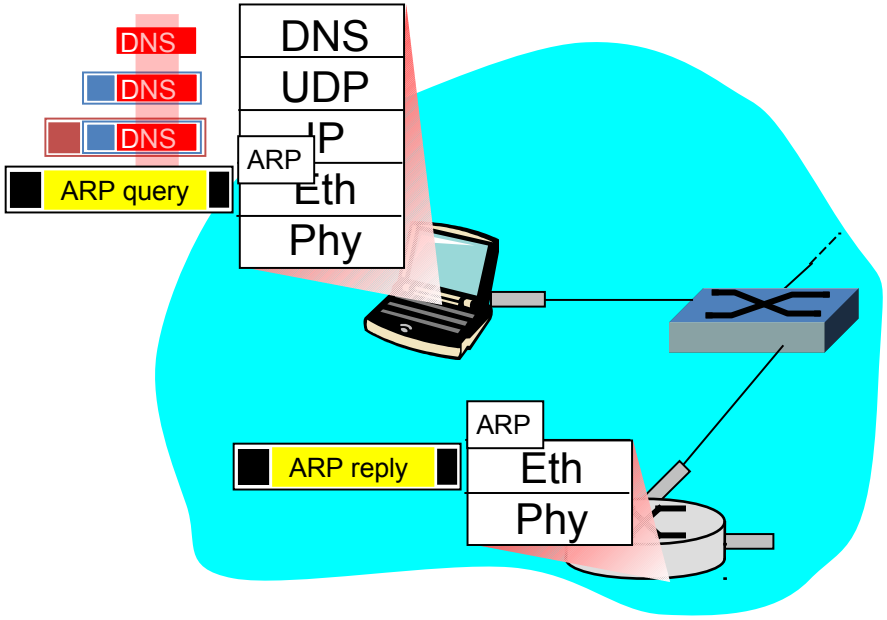

DHCP
DHCP
DHCP
DHCP
DHCP
DHCP
UDP
IP
Eth
Phy
DHCP
DHCP
DHCP
DHCP
DHCP
UDP
IP
Eth
Phy
router
(runs DHCP)

Continued…

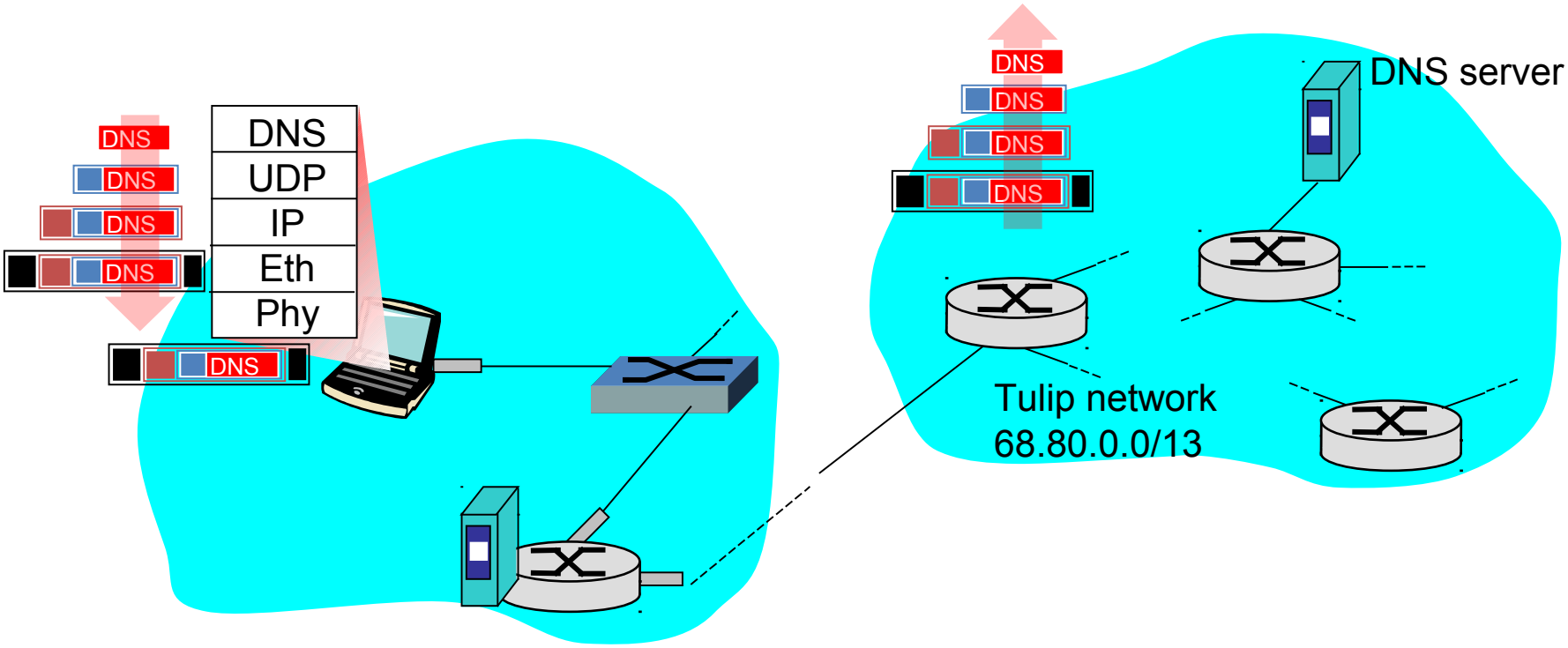


Client now has IP address, knows name & addres of DNS server, IP address of its first-hop router

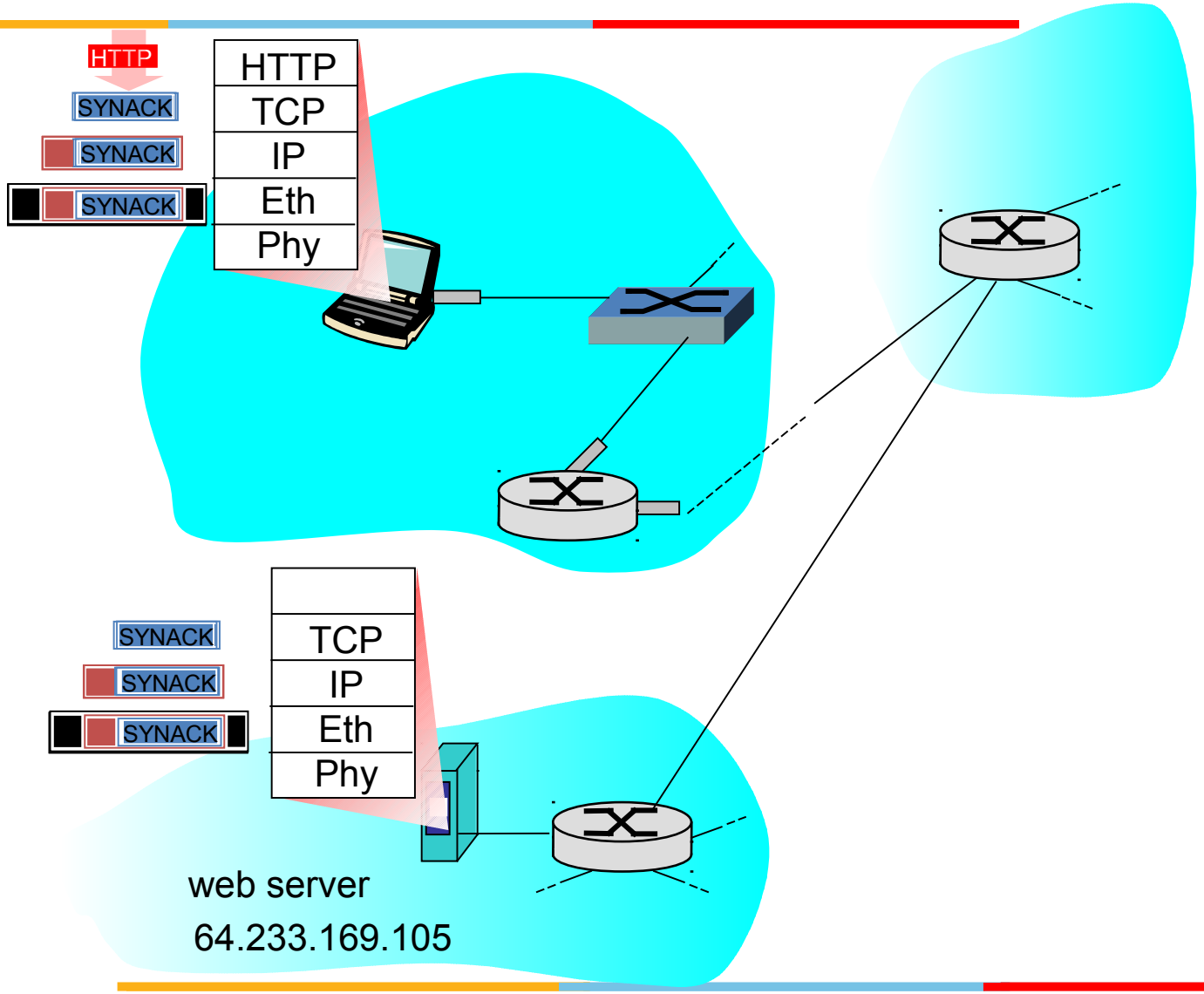
Continued…


DNS
DNS
DNS
ARP query
DNS
UDP
IP
ARP
Eth
Phy
ARP reply
ARP
Eth
Phy

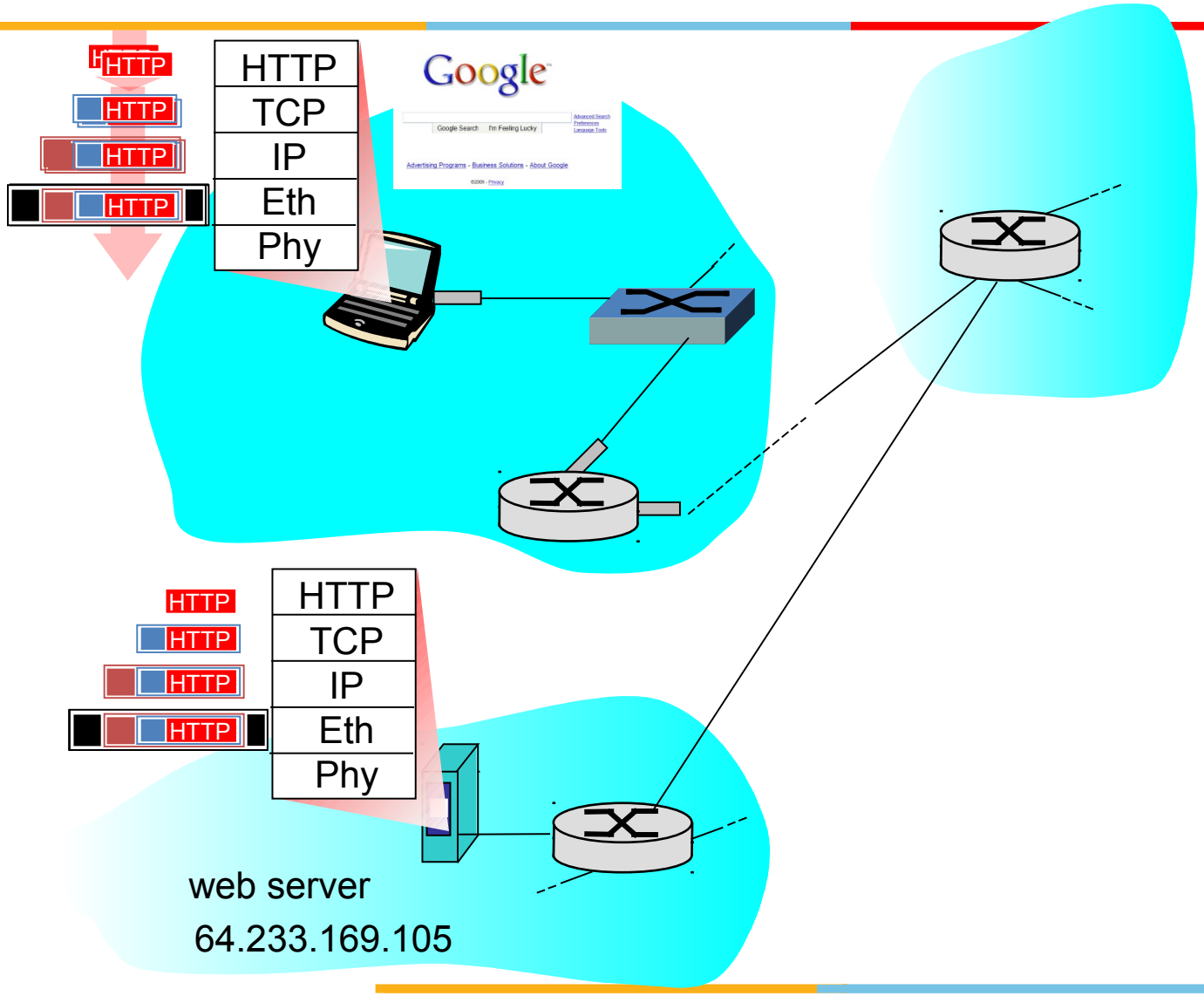
Continued…


DNS
DNS
DNS
DNS
DNS
DNS
UDP
IP
Eth
Phy
DNS
DNS
DNS
DNS
DNS
DNS server
Tulip network
68.80.0.0/13

Continued…


HTTP
SYNACK
SYNACK
SYNACK
HTTP
TCP
IP
Eth
Phy
SYNACK
SYNACK
SYNACK
TCP
IP
Eth
Phy
web server
64.233.169.105

Continued…


HTTP
HTTP
HTTP
HTTP
HTTP
TCP
IP
Eth
Phy
Google
HTTP
HTTP
HTTP
HTTP
HTTP
TCP
IP
Eth
Phy
web server
64.233.169.105