CSC411: Advanced Networks

Spring 2021 Course Delivery

Note: **This class lecture will be recorded!**
If you do not consent to this recording, please do not ask questions via your video, audio or public chat; send your question to the instructor using the private chat.

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KUTZTOWN UNIVERSITY

PROTECT YOUR GOLDEN BEAR FAMILY

Remember To

PRACTICE ⟷ PHYSICAL ⟷ DISTANCING

Stay 6 Feet Apart

Wash/Sanitize Hands

Wear Face Coverings

Sick? Stay Home

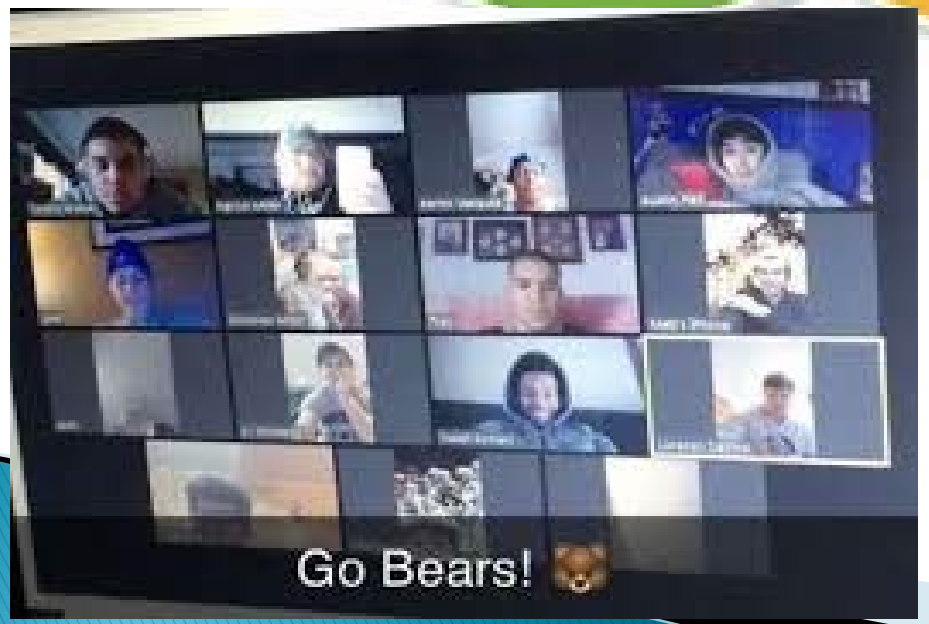
Stay Healthy. Stay Safe.

kutztown.edu/fall2020


LEHIGH VALLEY ZOO
Smart Fun!
HOW TO (AND HOW NOT TO) WEAR A FACE MASK
MOUTH NOT COVERED
NOSE NOT COVERED
MOUTH AND NOSE NOT COVERED
MOUTH AND NOSE COVERED
Visit CDC.gov/coronavirus for more information.

YouTube

ASYNCHRONOUS LEARNING



Cohorts

- F2F – attend in-class both days
- Mon – attend in-class Monday and synchronously via Zoom Wednesday
- Wed – attend in-class Wednesday and synchronously via Zoom Monday
- Online – attend synchronously via Zoom both days

Zoom Attendance

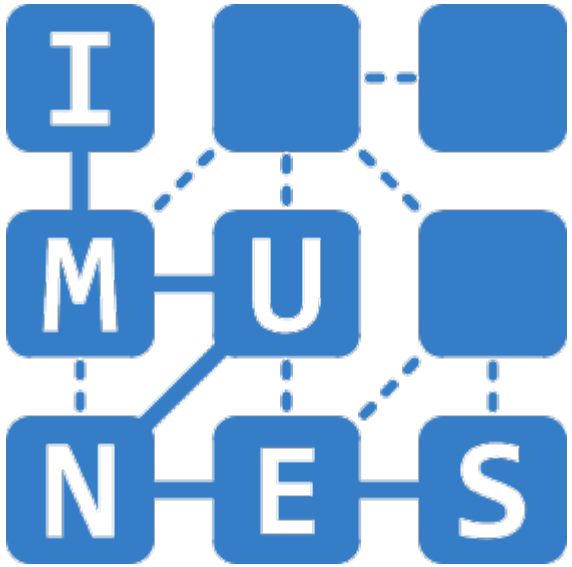
- **Synchronously**

- *** Class recordings
  - Will be done – consent
  - Not meant to replace synchronous attendance!!

- Etiquette – Respect and Common Sense

TOOLS

Course Web Page:
https://faculty.kutztown.edu/frye/secure/CSC411/index.shtml



CSC411: Advanced Networks

Network Topologies

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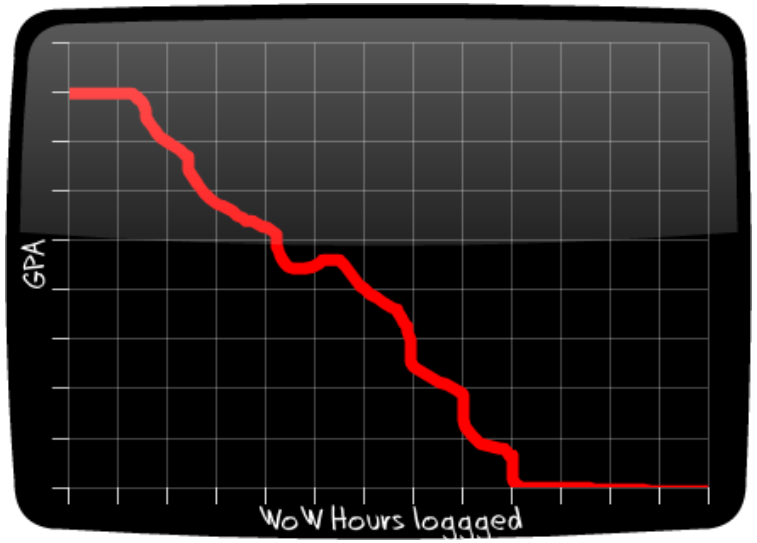
Course Introduction

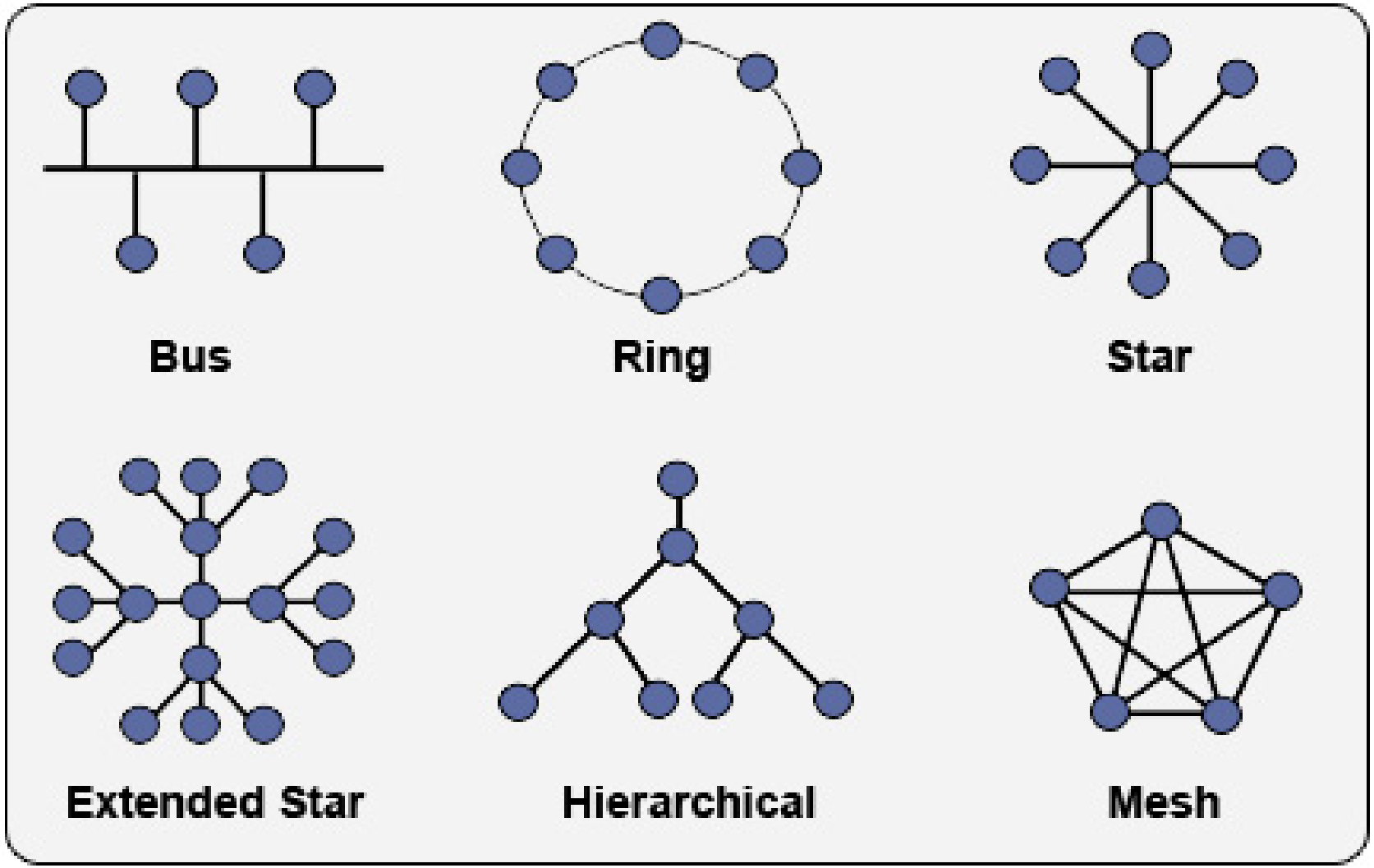
- First Day Handout
- Expectations
  - Mine
  - Yours



http://crappygraphs.com

- Guidance
  - Discussion posts application?
  - Posting content (D2L, web page)?
- Computer Networks → What do you know?

Network Topologies



Layer-2 Switches

- Filtering
- Forwarding

- Multiple switching paths

Link-layer Switch Table

MAC address	port	age
a0:e1:34:82:ca:34	1	10
45:6d:20:23:fe:2e	2	20

Self-Learning

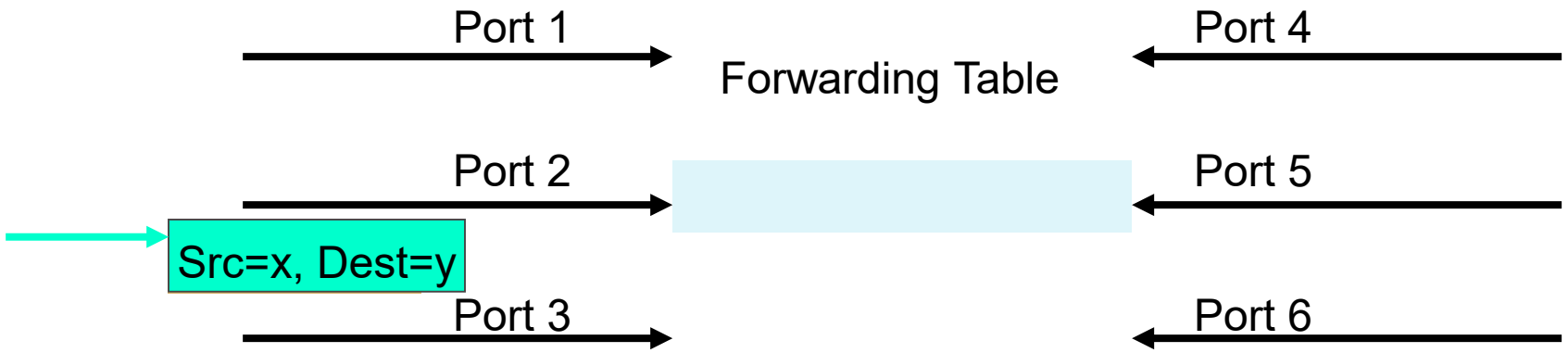
- Switch table is initially empty
- For each incoming frame, add an entry to the table for the frame's source address
- An entry is deleted from the table if the switch does not receive a frame from the address in the entry in a certain time period (***aging time***)

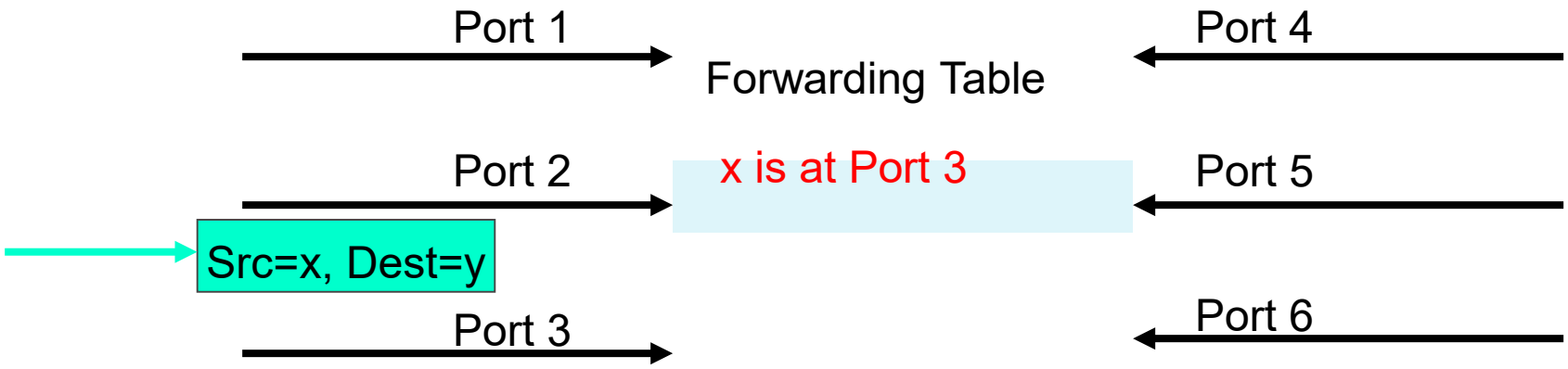
Switch Table Algorithm

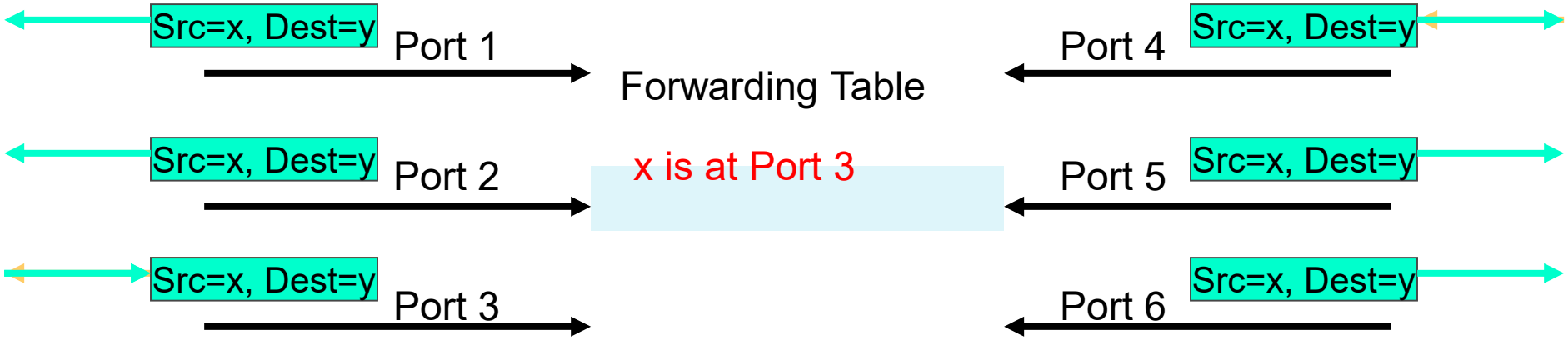
when frame received at switch:

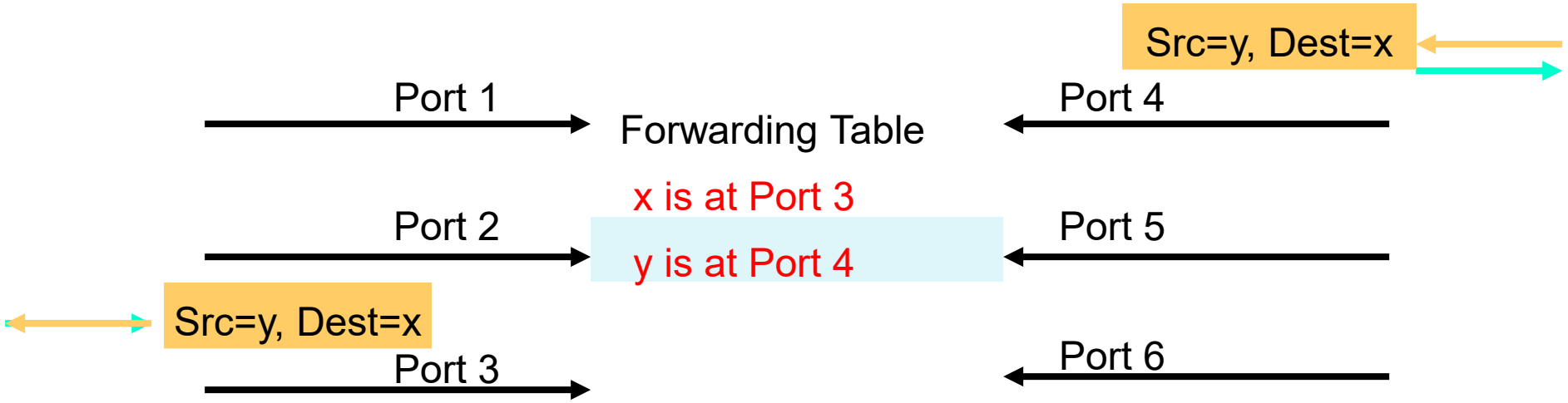
1. record incoming link, MAC address of sending host
2. index switch table using MAC destination address
3. if entry found for destination
   then {
   if destination on segment from which frame arrived
   then drop frame
   else forward frame on interface indicated by entry
   }
   else flood /* forward on all interfaces except arriving interface */

Learning Algorithm Example



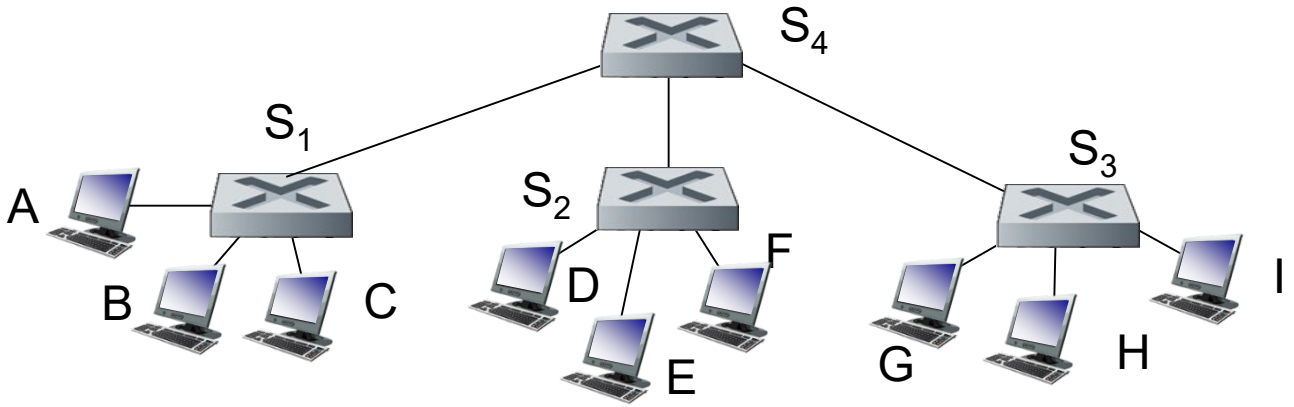

Port 1
Port 4
Forwarding Table
Port 2
x is at Port 3
Port 5
Src=x, Dest=y
Port 3
Port 6


Src=x, Dest=y
Port 1
Forwarding Table
Port 4
Src=x, Dest=y
Src=x, Dest=y
Port 2
x is at Port 3
Port 5
Src=x, Dest=y
Src=x, Dest=y
Port 3
Port 6
Src=x, Dest=y


Src=y, Dest=x
Port 1
Port 4
Forwarding Table
x is at Port 3
Port 2
Port 5
y is at Port 4
Src=y, Dest=x
Port 3
Port 6

Self-learning multi-switch example

Suppose C sends frame to I, I responds to C

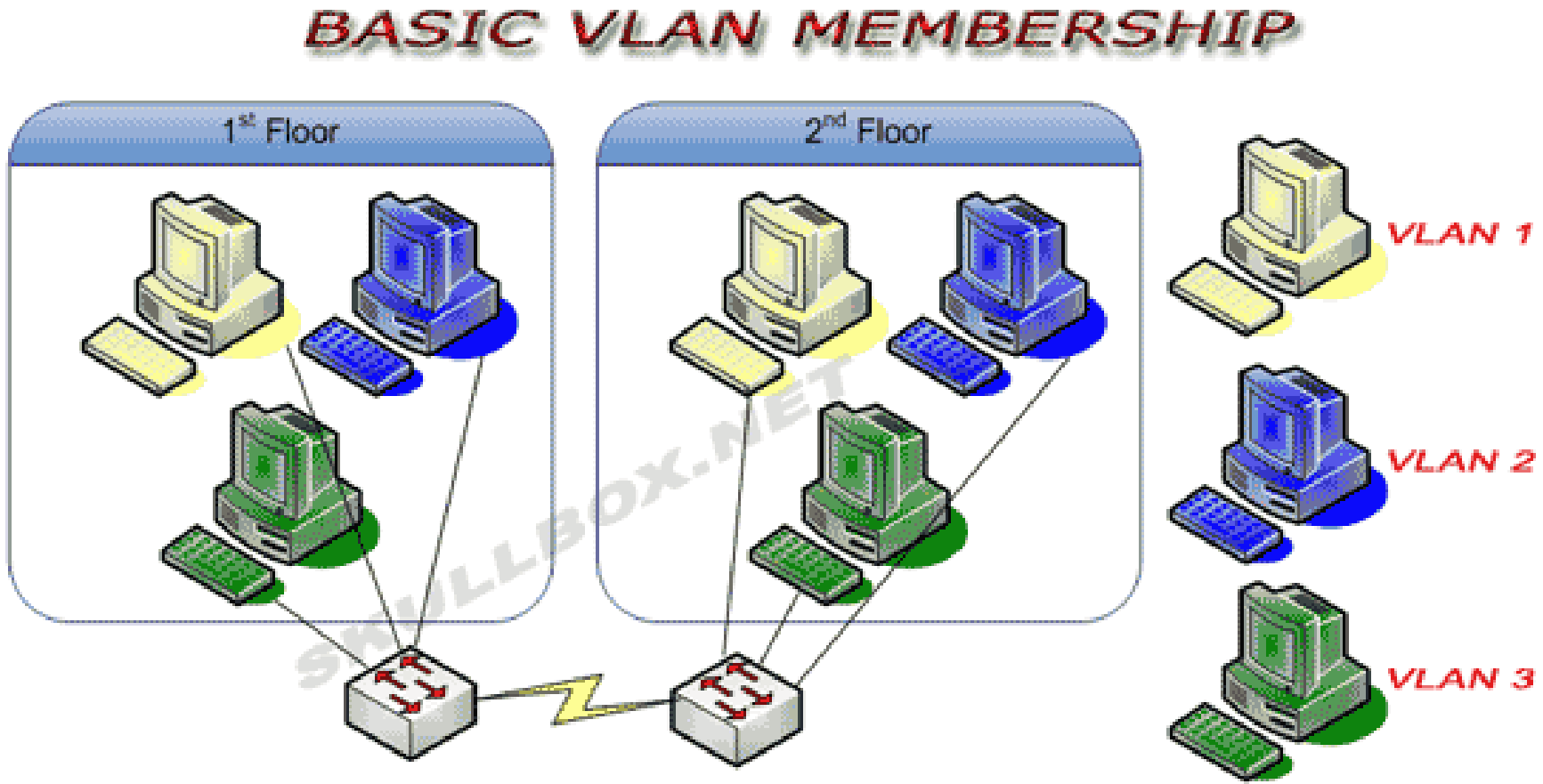


- Q: show switch tables and packet forwarding in S_1, S_2, S_3, S_4

Switched LAN Drawbacks

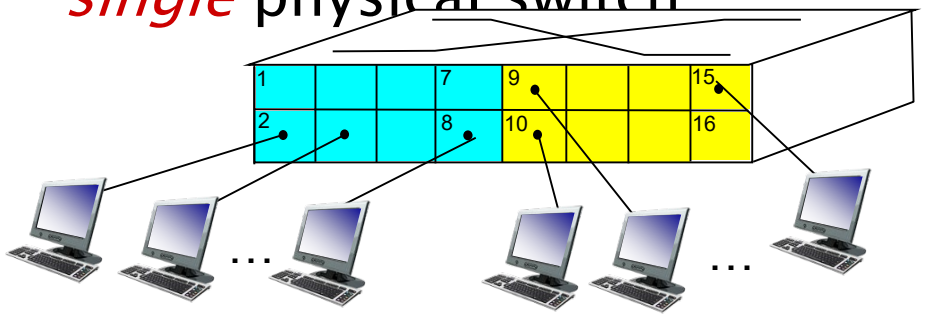
- Lack of traffic isolation
- Inefficient use of switches
- Managing users
- Security/privacy

VLANs


BASIC VLAN MEMBERSHIP
1st Floor
2nd Floor
VLAN 1
VLAN 2
VLAN 3
SKULLBOX.NET

Port-based VLAN

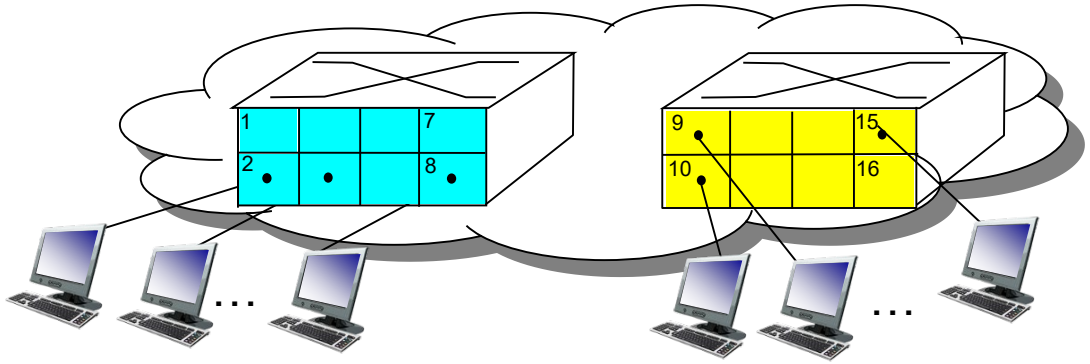
port-based VLAN: switch ports grouped (by switch management software) so that *single* physical switch



Electrical Engineering
(VLAN ports 1-8)

Computer Science
(VLAN ports 9-15)

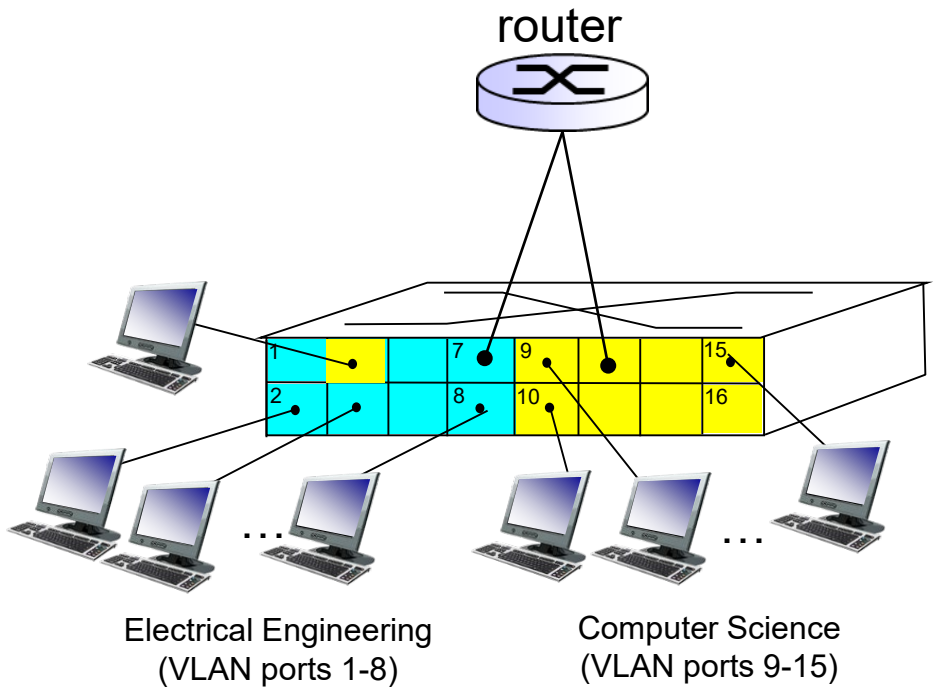
… operates as *multiple* virtual switches



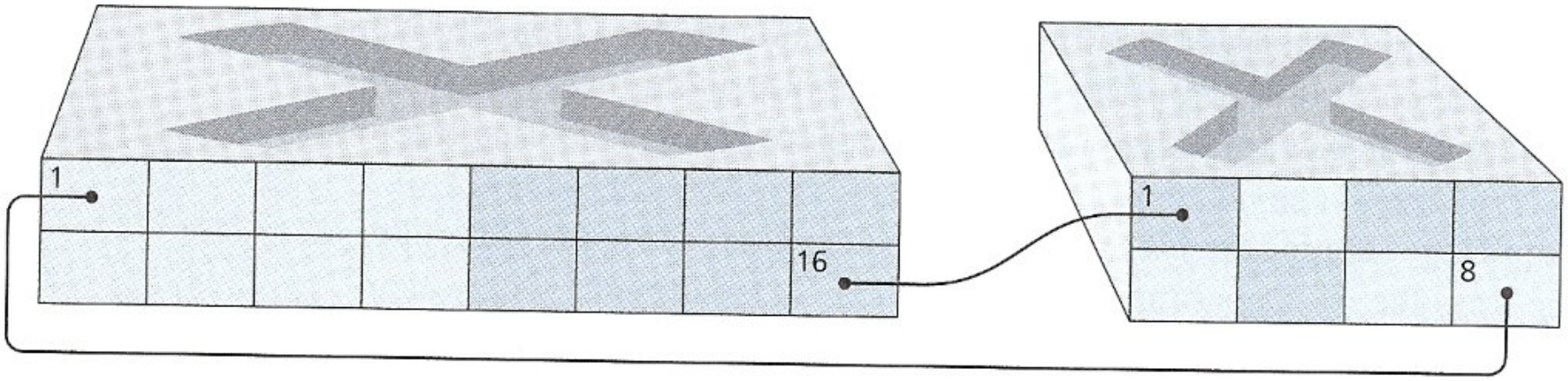
Electrical Engineering
(VLAN ports 1-8)

Computer Science
(VLAN ports 9-16)

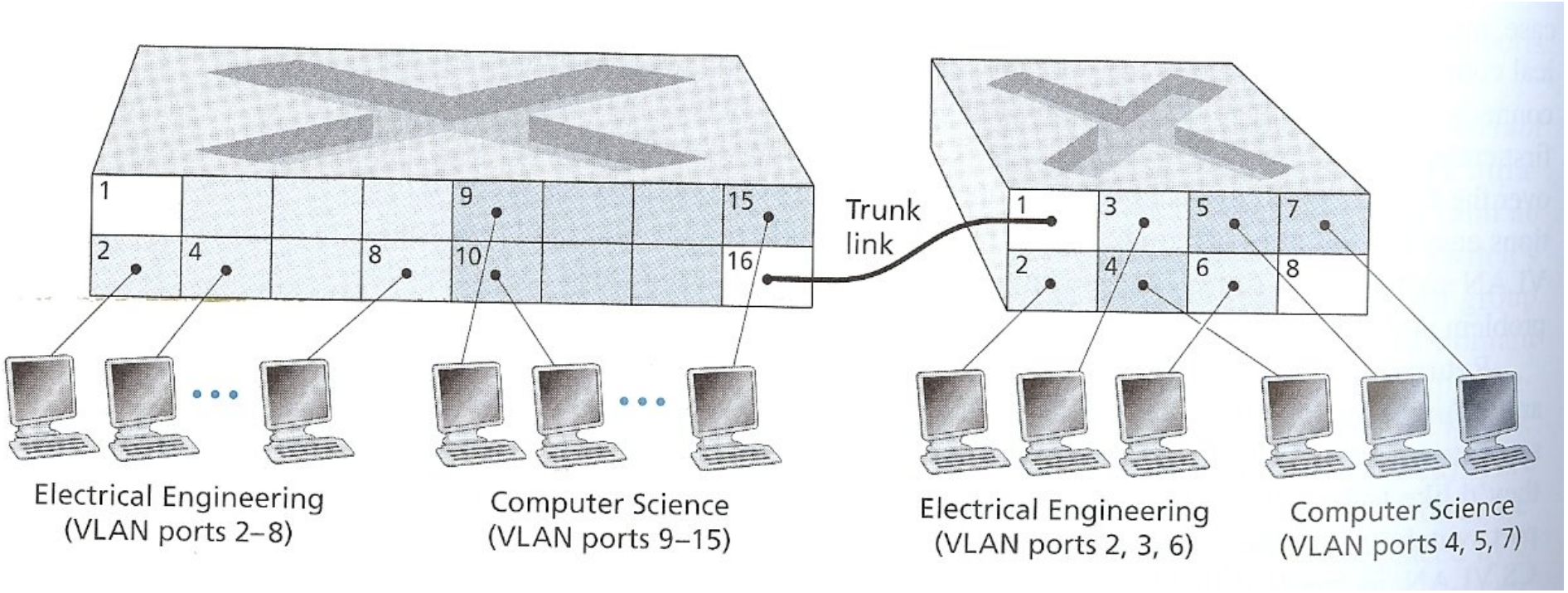
Port-based VLAN



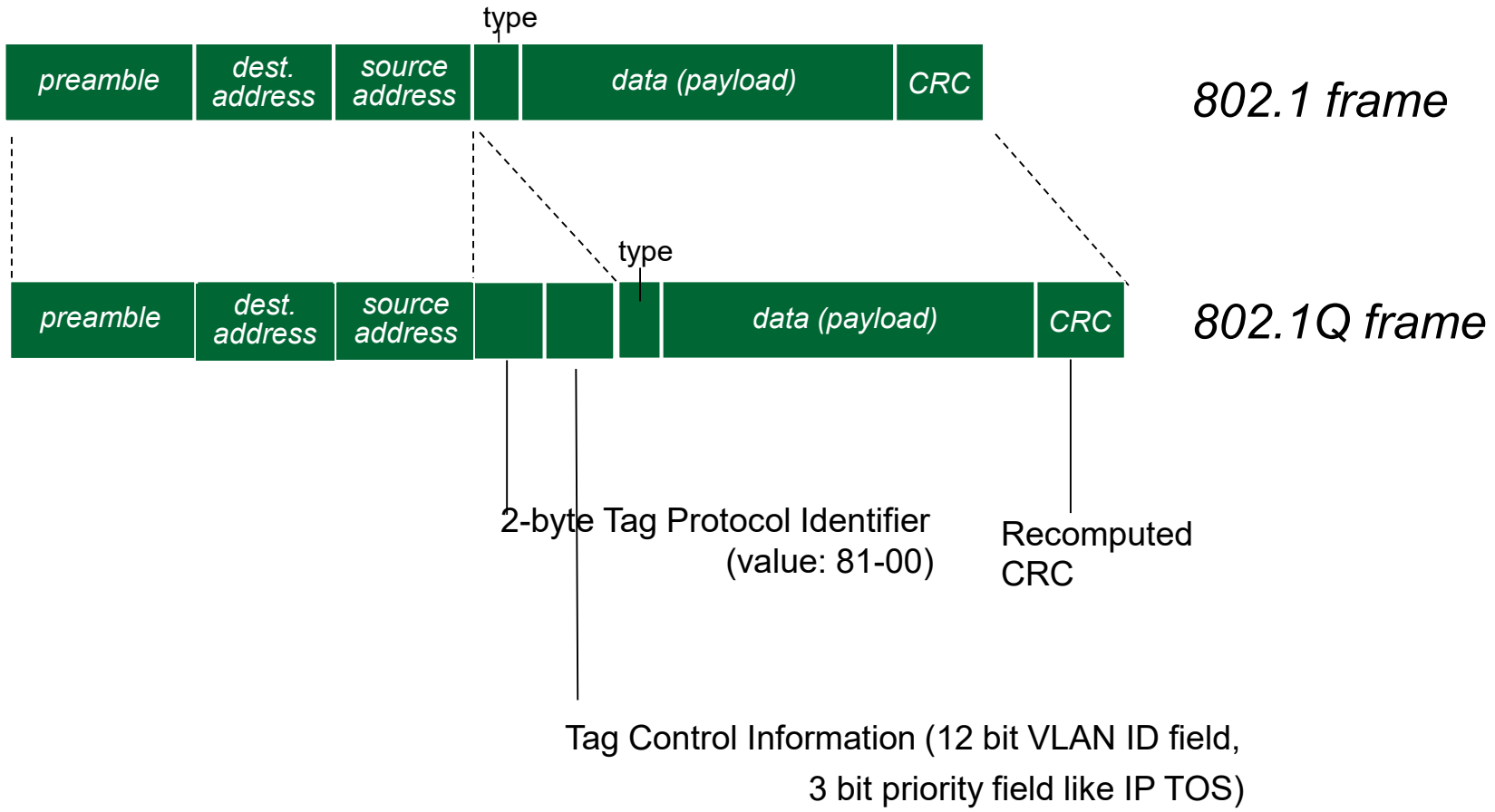
Connect two VLAN switches – two cables



Connect two VLAN switches – VLAN trunking



802.1Q VLAN frame format



Layer-3 Switches

- Fast IP routing

- Fast path decision – hardware
- What processing would be in the fast path?

Network Devices

	Hubs	Bridges	Switches	Routers
traffic isolation	no	yes	yes	yes
plug & play	yes	yes	yes	no
optimal routing	no	no	no	yes
cut-through	yes	no	yes	no

Speed Measures

- Data rate, bit rate
- Packet rate

- Interface rate
- Aggregate rate

Aggregate Data Rate

- Describe IP Forwarding
- Does processing for IP forwarding depend on packet size?
- Per-bit processing
- Per-packet processing

Aggregate Data Rate Example

- If a router has an aggregate data rate of 400 Mbps, how many 100 Mbps networks can this router support?

Data Rates

Technology	Network Data Rate In Gbps	Packet Rate For Small Packets In Kpps	Packet Rate For Large Packets In Kpps
10Base-T	0.010	19.5	0.8
100Base-T	0.100	195.3	8.2
OC-3	0.156	303.8	12.8
OC-12	0.622	1,214.8	51.2
1000Base-T	1.000	1,953.1	82.3
OC-48	2.488	4,860.0	204.9
OC-192	9.953	19,440.0	819.6
OC-768	39.813	77,760.0	3,278.4