

Session #2276: ProLiant BL Switch User Interface Lab

Switch Technology Overview

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Industry Standard Servers



Objectives

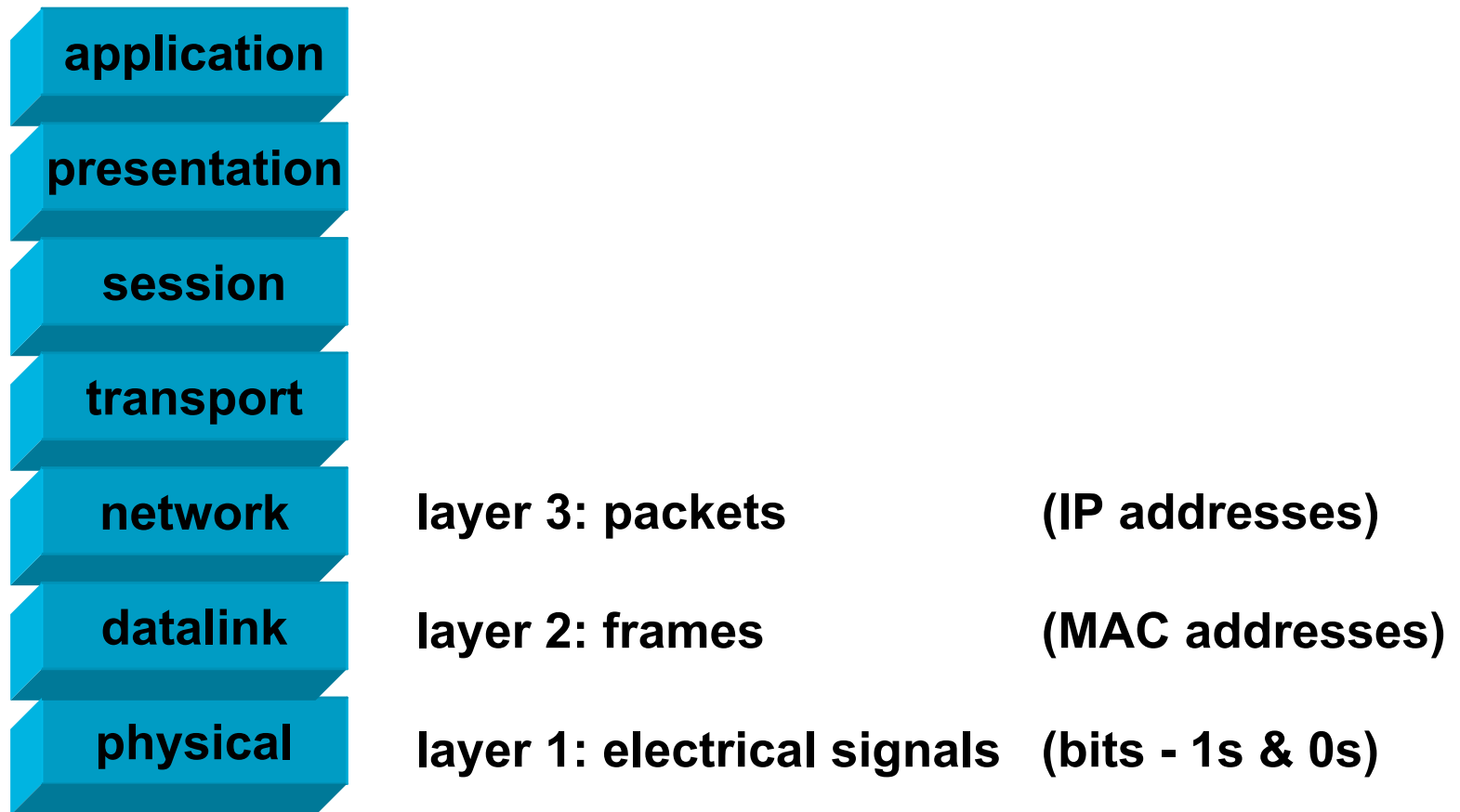
- General networking overview
- Switch technologies for controlling LAN traffic
- Switch Lab (Hands On)

Objectives

- General networking overview
 - OSI model
 - addressing
 - hub vs. switch vs. router
 - LAN vs. WAN

General networking overview

OSI Model



General networking overview

■ Addressing

– MAC (Layer 2)

48 bit address that is assigned to a piece of hardware; typically permanent

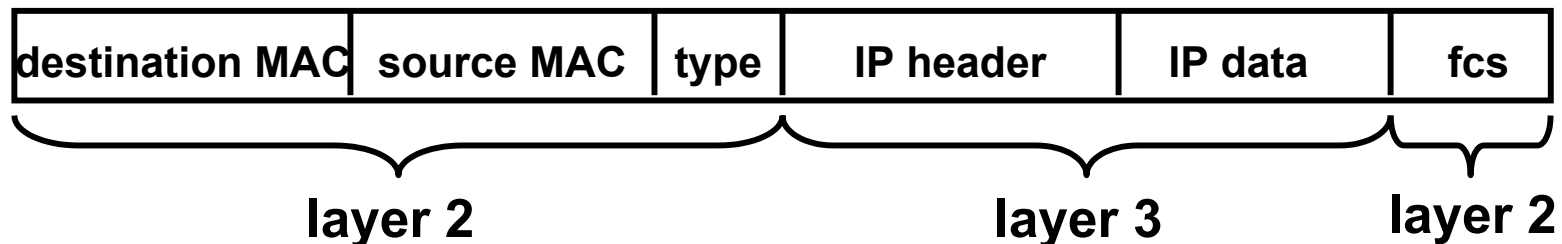
example: 00:02:A5:04:BF:5C or 00-02-A5-04-BF-5C

– IP (Layer 3)

32 bit address that is assigned to a computer system; typically temporary

example: 192.168.1.1

ethernet frame carrying an IP payload



Addressing

■ Unicast (one to one)

A MAC or IP address used by one device to transmit to one device

- Unicast MAC: 02-A5-00-D0-B5-4E
- Unicast IP: 192.68.1.1

Addressing

■ Broadcast (one to all)

A MAC or IP address used by one device to transmit to all other devices

- Broadcast MAC: FF-FF-FF-FF-FF-FF
- Broadcast IP: 192.168.1.255

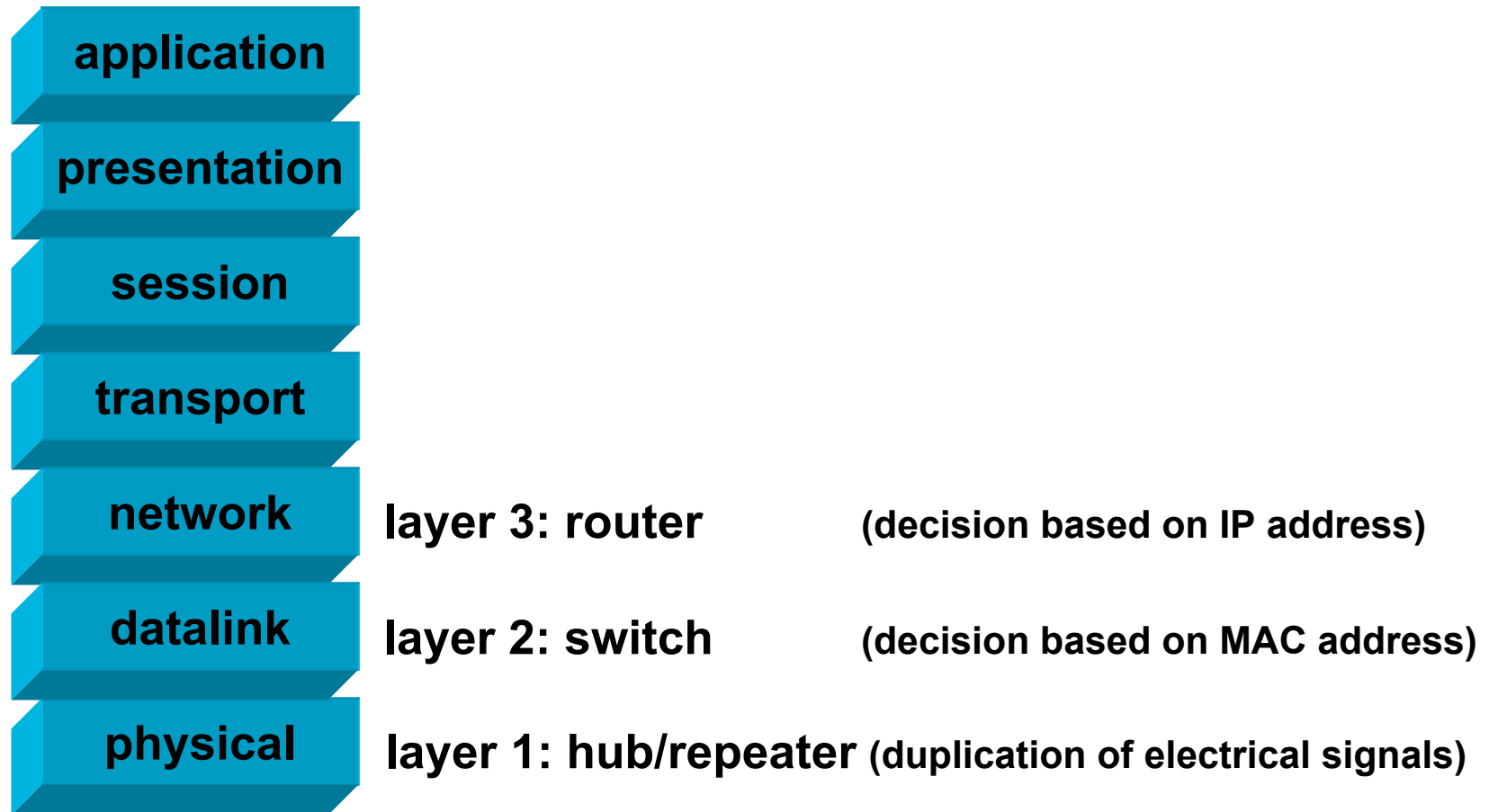
Addressing

■ Multicast (one to many)

A MAC or IP address used by one device to transmit to many other devices

- Multicast MAC: 01-80-C0-00-00-01
- Multicast IP : 224.0.0.1

General networking overview – Hub vs. Switch vs. Router



General networking Overview

Hub vs. Switch vs. Router

- Hubs “repeat” the electrical signal from one port to all other ports
 - No intelligence
 - All hubs connected together belong to the same collision domain
 - Operates at Layer 1 (i.e., repeats electrical signals)
 - Protocol independent

General networking Overview

Hub vs. Switch vs. Router

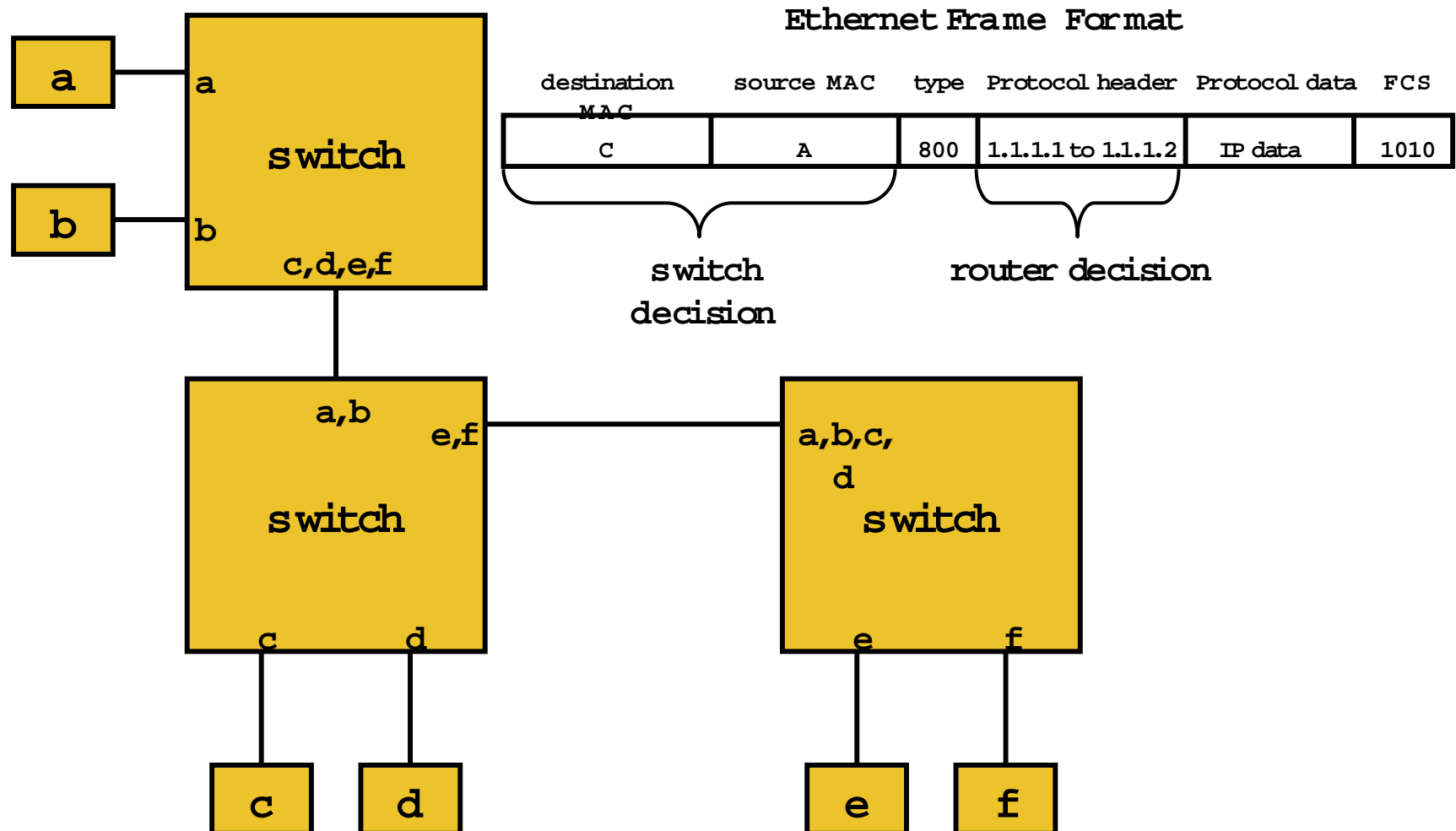
- Switches move frames from one port to another
 - Provides intelligence for how frames are moved (switched) between ports
 - Each switch port provides for a separate collision domain
 - All ports on any switch on the same LAN belong to the same broadcast domain (unless using VLANs)
 - Operates at Layer 2 (i.e., makes decisions based on MAC addresses)
 - Protocol independent

General networking Overview

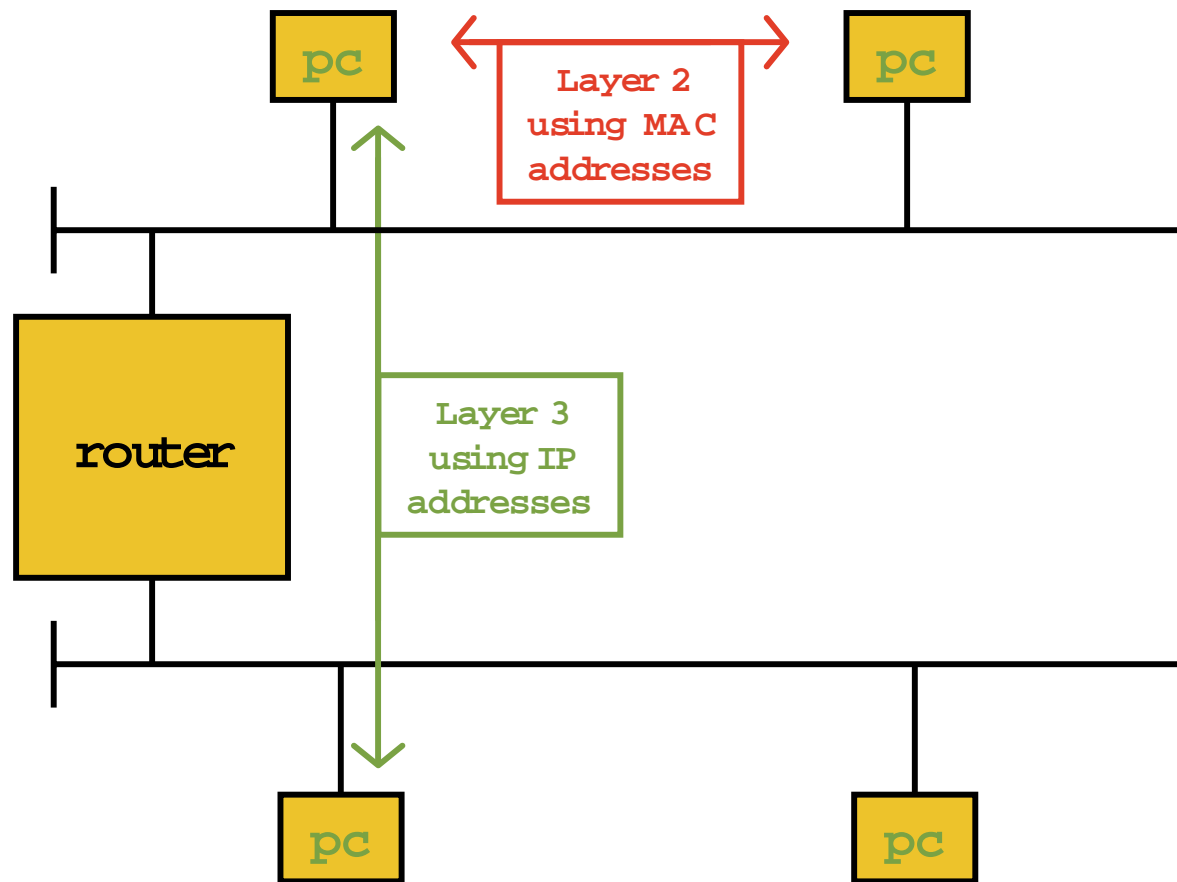
Hub vs. Switch vs. Router

- Routers move packets from one network to another
 - Provides intelligence for how packets are moved (routed) between networks
 - Each router port provides for a separate broadcast domain
 - Operates at Layer 3 (i.e., makes decisions based on IP addresses, IPX addresses, etc.)
 - Protocol dependent

General networking overview



General networking overview



Switch technologies for controlling LAN traffic

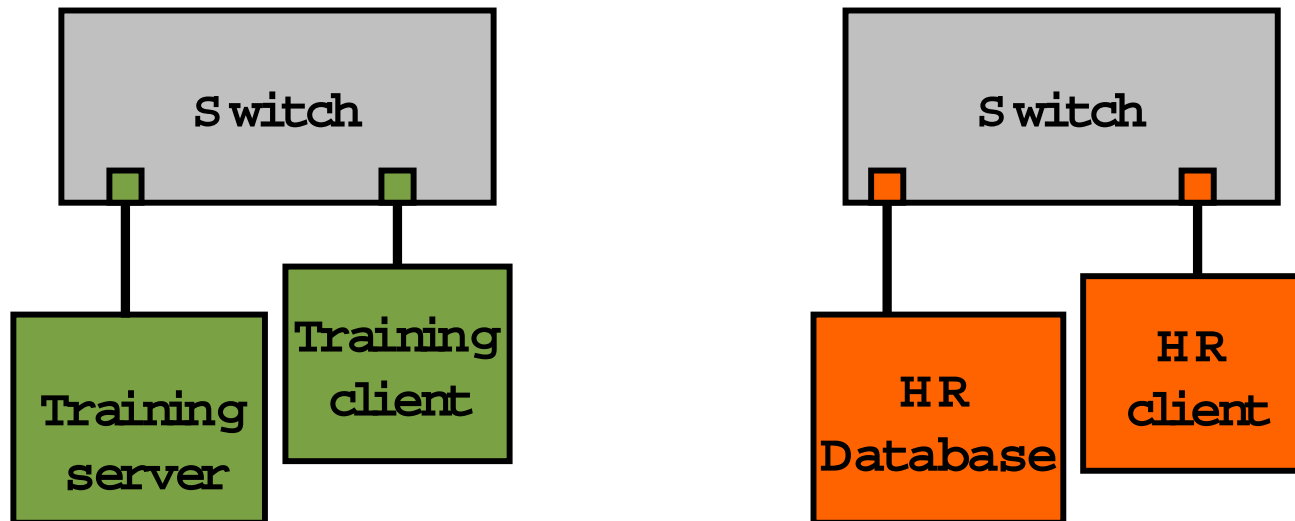
- General networking overview
- Switch technologies for controlling LAN traffic
 - Security
 - Redundancy
 - Bandwidth

Switch technologies for controlling LAN traffic

- Security
 - Virtual Local Area Networks (VLANs)

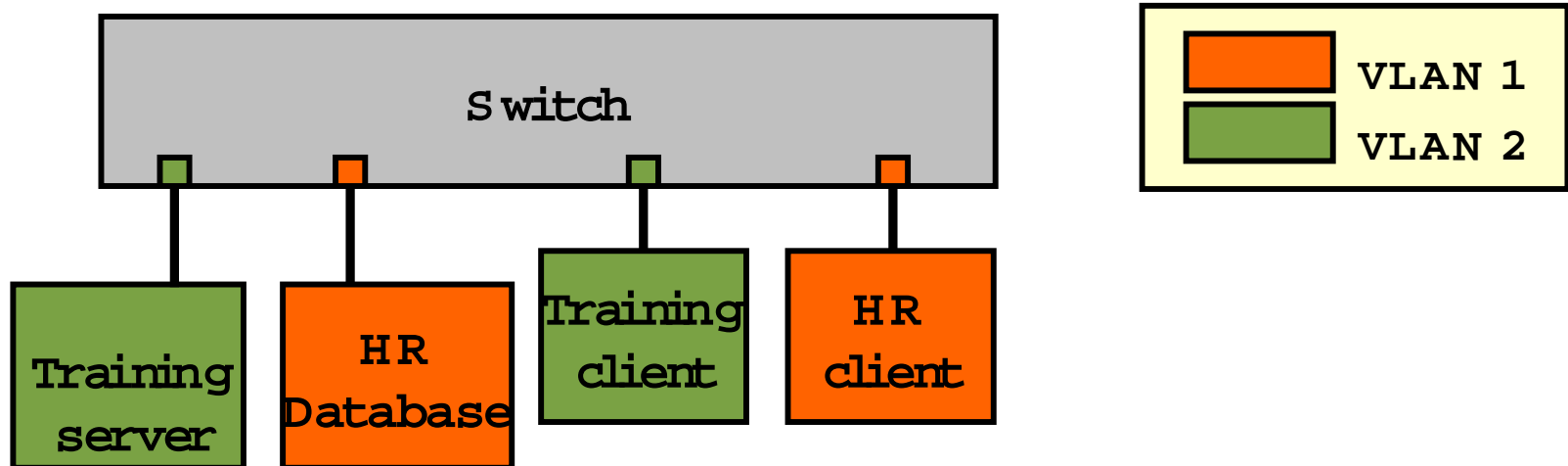
Two physically segregated networks

- HR clients and training clients segregated
- Separate, secure physical networks



Two logically segregated networks using VLANs

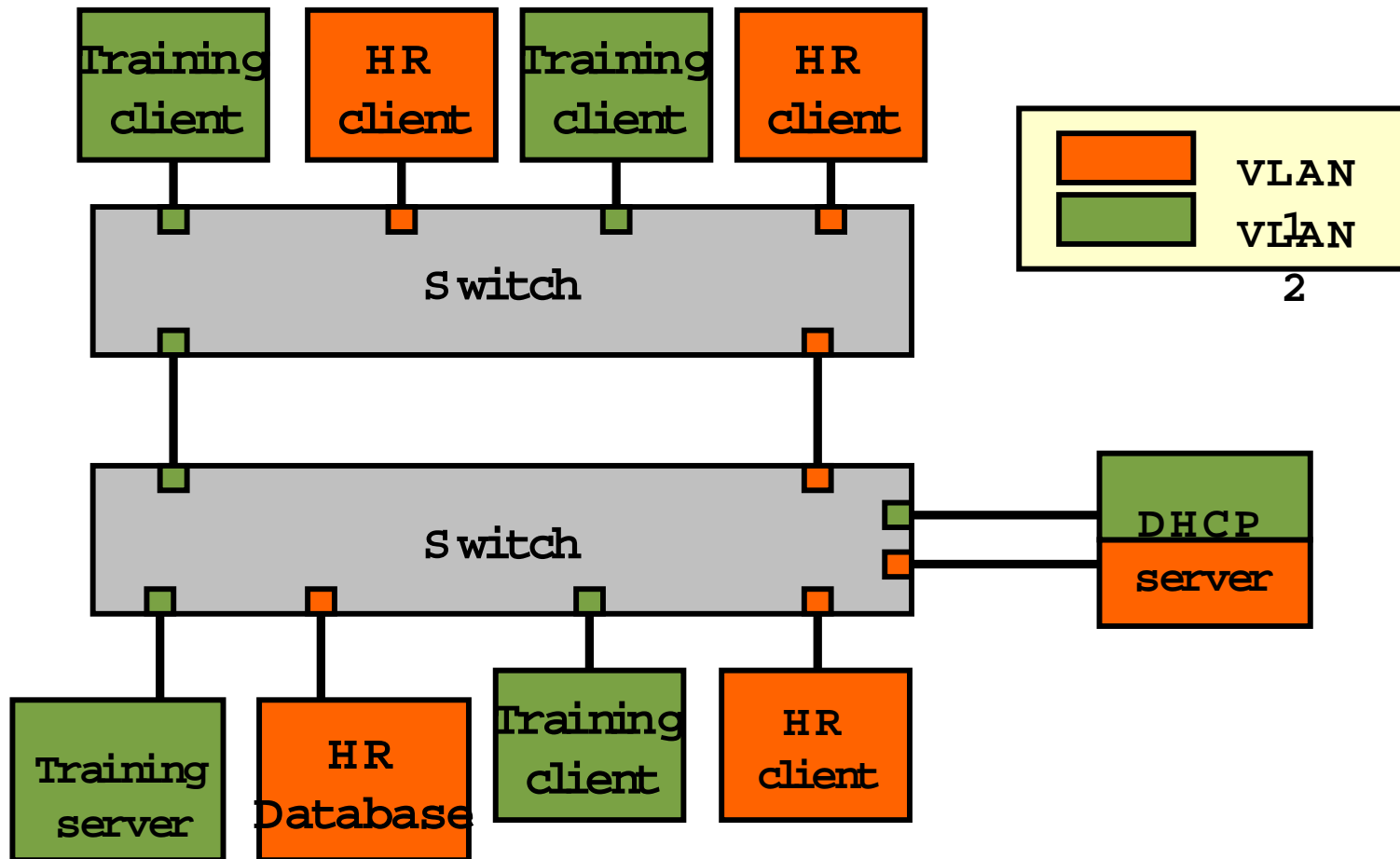
- HR clients and training clients segregated
- Separate, secure logical networks on same physical network



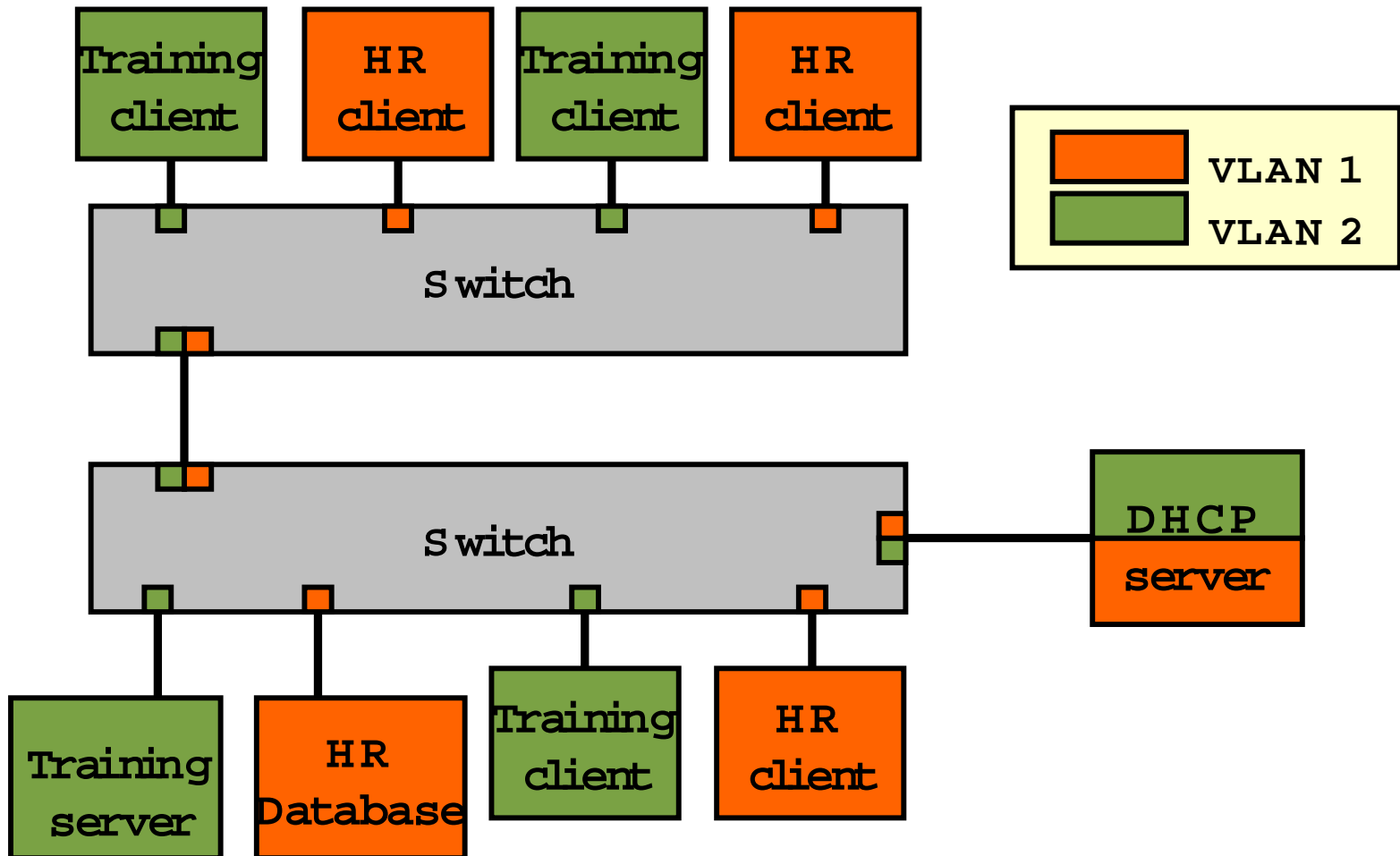
Virtual local area network (VLAN)

- A logical network topology configured in top of a physical network topology
- Logically segments a single Layer 2 network into multiple broadcast domains
- Conserves bandwidth and improves security by limiting traffic to specific groups of devices
- IEEE specification 802.1Q

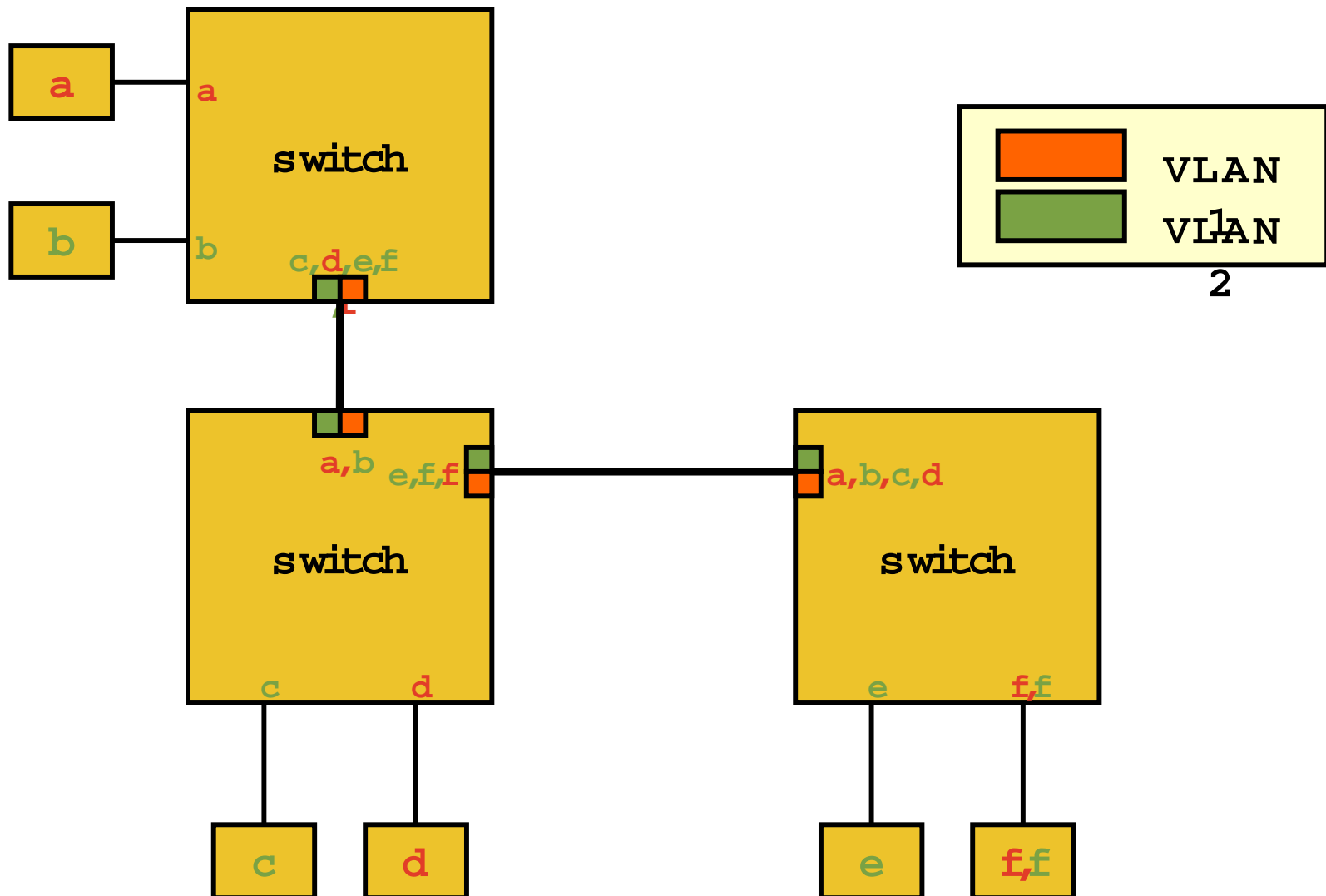
VLANs between two switches



VLANs between two switches using VLAN Tagging



VLANs between three switches



Virtual Local Area Network (VLAN)

- VLAN configuration on switch/server
 - Manual or GVRP (GARP VLAN Registration Protocol)
 - Port can be a member of more than one VLAN (VLAN trunking / VLAN tagging)
- VLAN identification inside each frame
 - VLANs are identified by a number called a VLAN ID
 - 802.1Q VLAN ID added to the Ethernet frame

Dest. MAC address	Src. MAC address	<u>VLAN ID</u>	Type	Data..
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- Receiving device (switch, server, router) knows which VLAN a frame belongs to by looking at the VLAN ID in the frame

VLAN trunking methods

VLAN Management	VLAN Tagging Protocol	Vendor Support
VTP	ISL 802.1Q	Cisco
GVRP	802.1Q	Multi-vendor Industry standard

(GVRP = GARP VLAN Registration Protocol, VTP = VLAN Trunking Protocol, ISL = Inter-Switch Link)

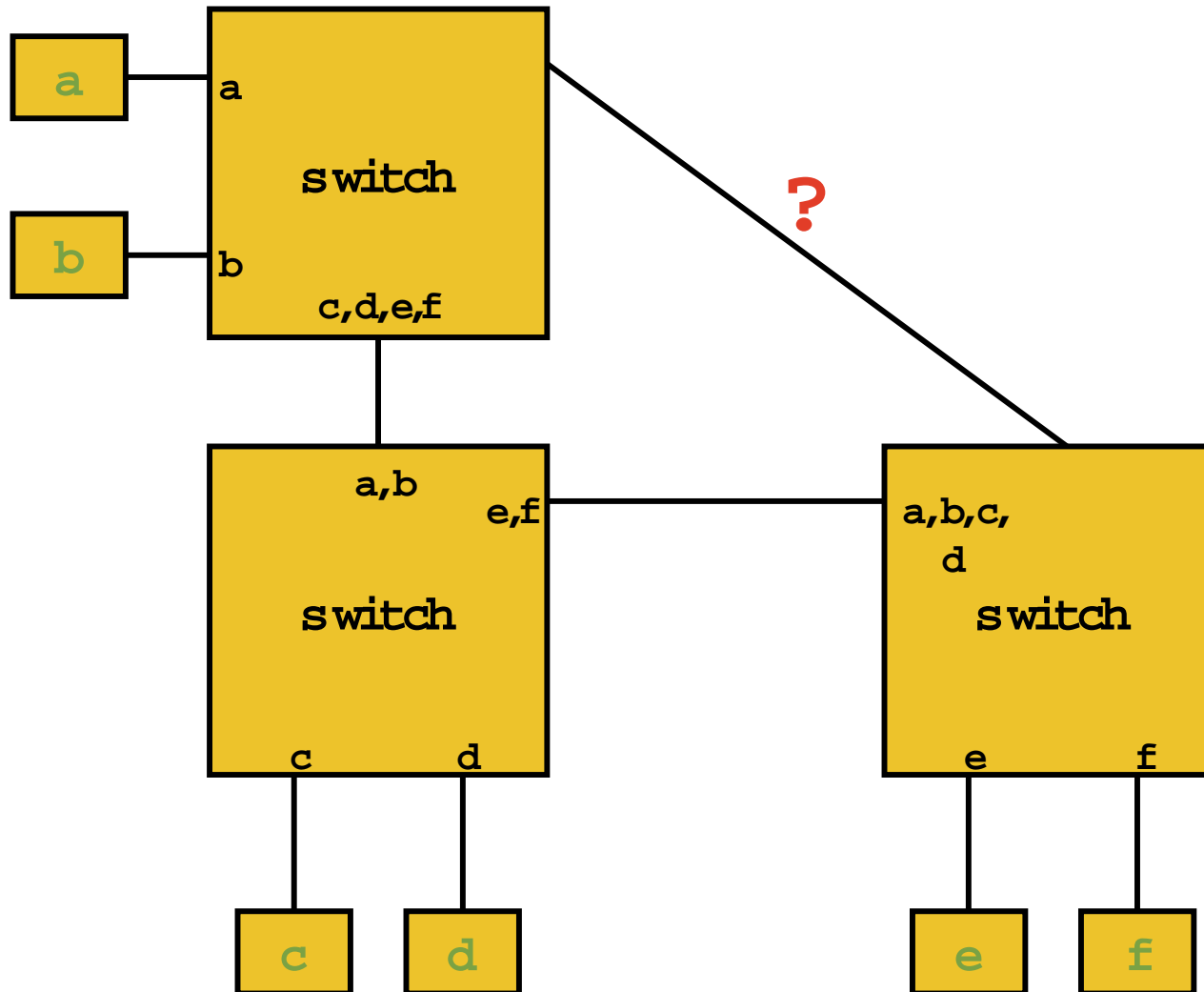
- Inter-Switch Link (ISL and 802.1Q VLAN tags are incompatible)
- VTP and GVRP are incompatible

Switch technologies for controlling LAN traffic

- Security
 - Virtual Local Area Networks (VLANs)

- Redundancy
 - Spanning Tree Protocol (STP)
 - Port trunking

Switch link redundancy?



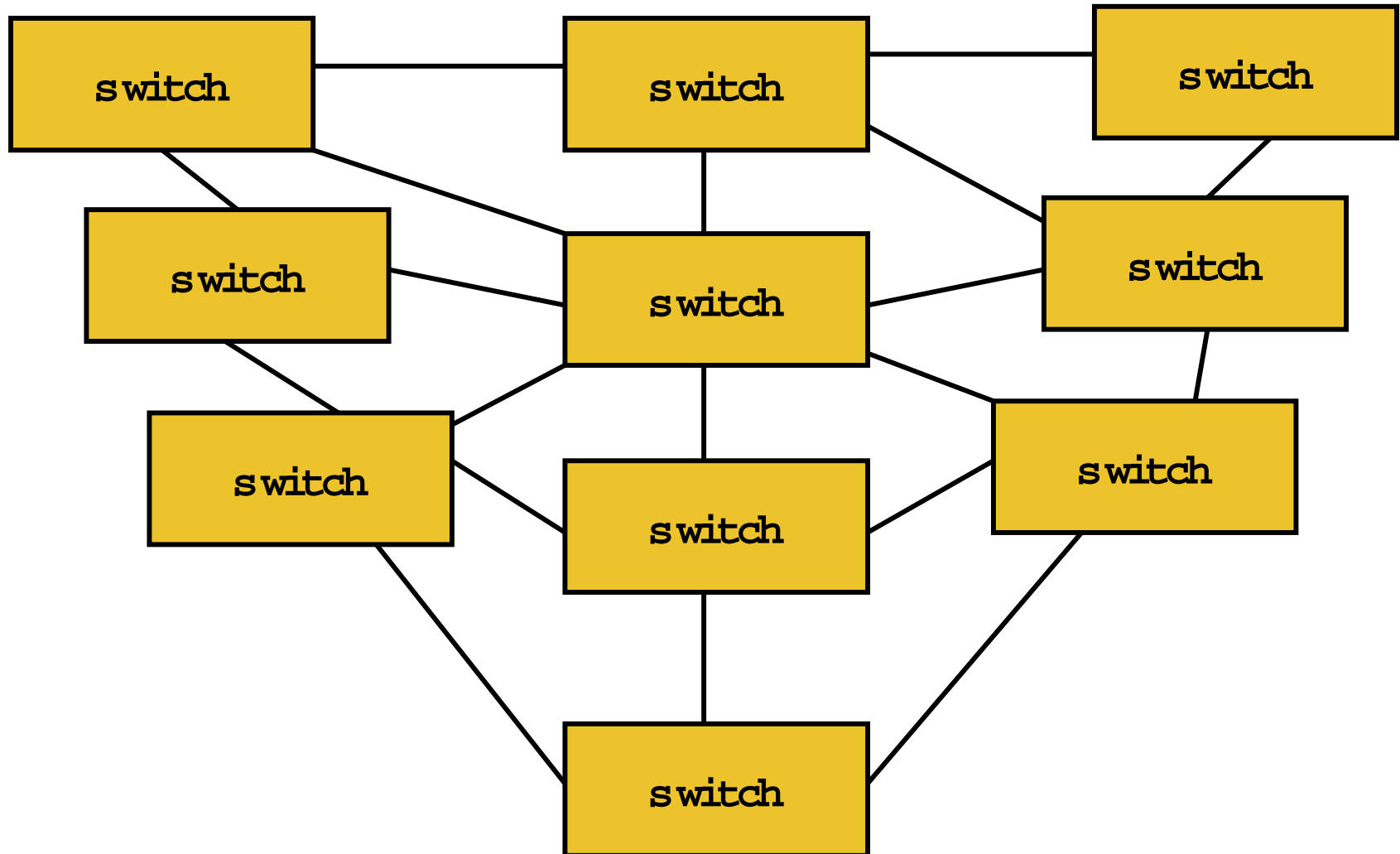
Spanning Tree Protocol (STP)



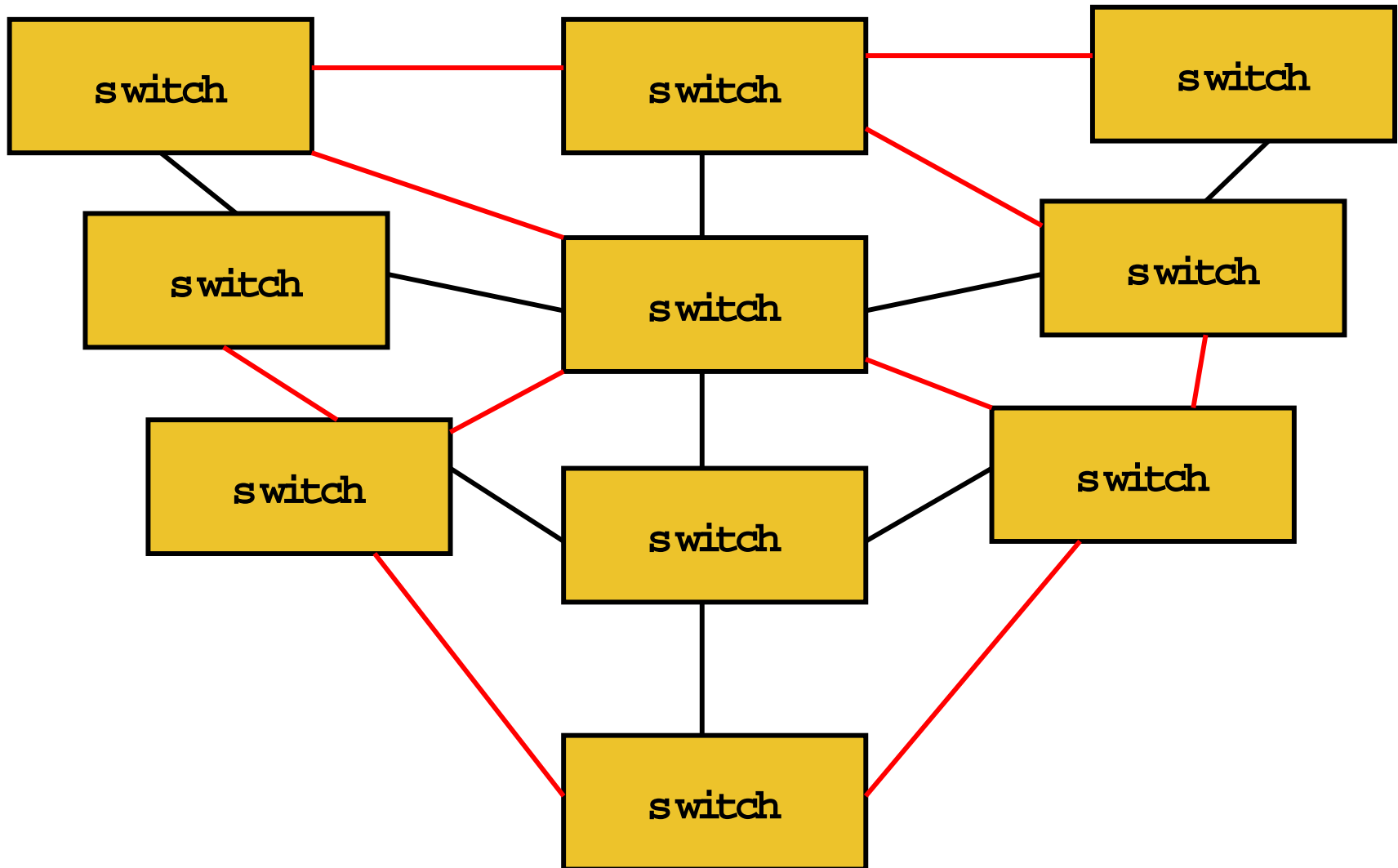
I think that I shall never see
A graph more lovely than a tree.
A tree whose crucial property
Is loop-free connectivity.
A tree that must be sure to span
So packets can reach every LAN.
First, the root must be selected
By ID, it is elected.
Least cost paths from root are
traced.
In the tree, these paths are placed.
A mesh is made by folks like me,
Then bridges find a spanning tree.

- Radia Perlman
(spanning tree inventor)

Without STP



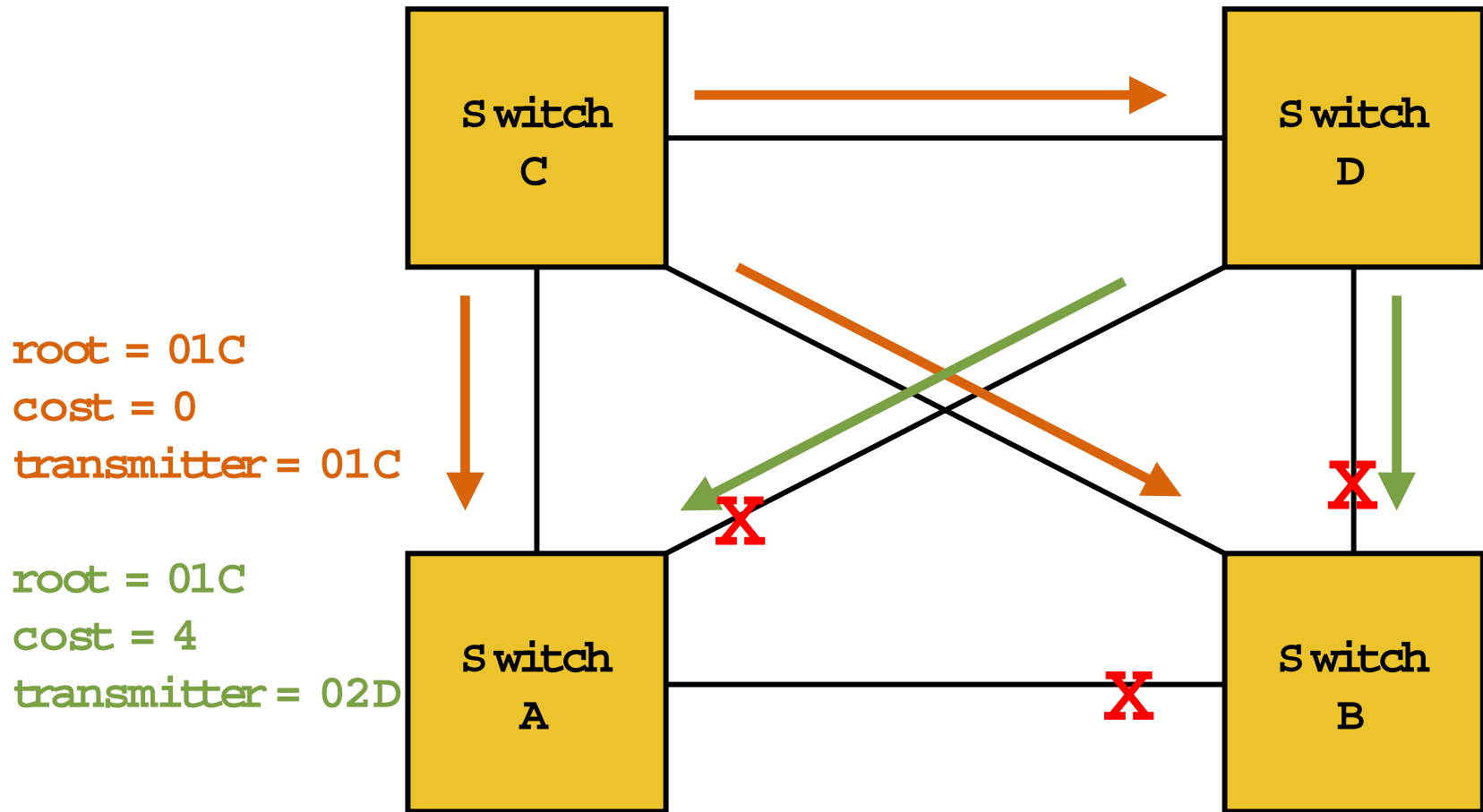
With STP (no loops)



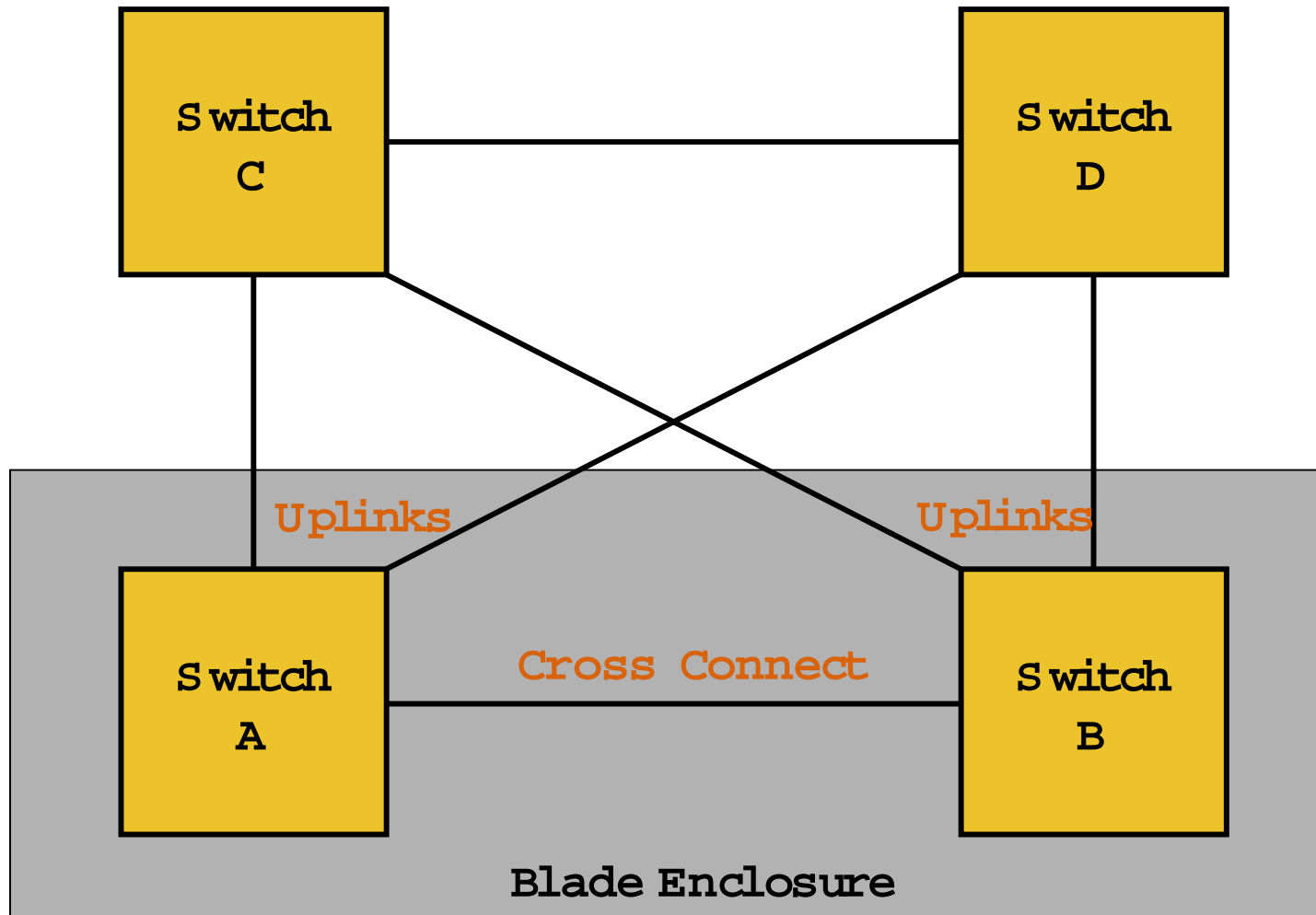
Spanning Tree Protocol (STP)

- Allows blocking of links that form loops between switches
- All switches establish a primary link
- Blocks duplicate links (become standby links)
- Will negatively affect switching functions on the network if duplicate links exist between switches
- IEEE specification 802.1D

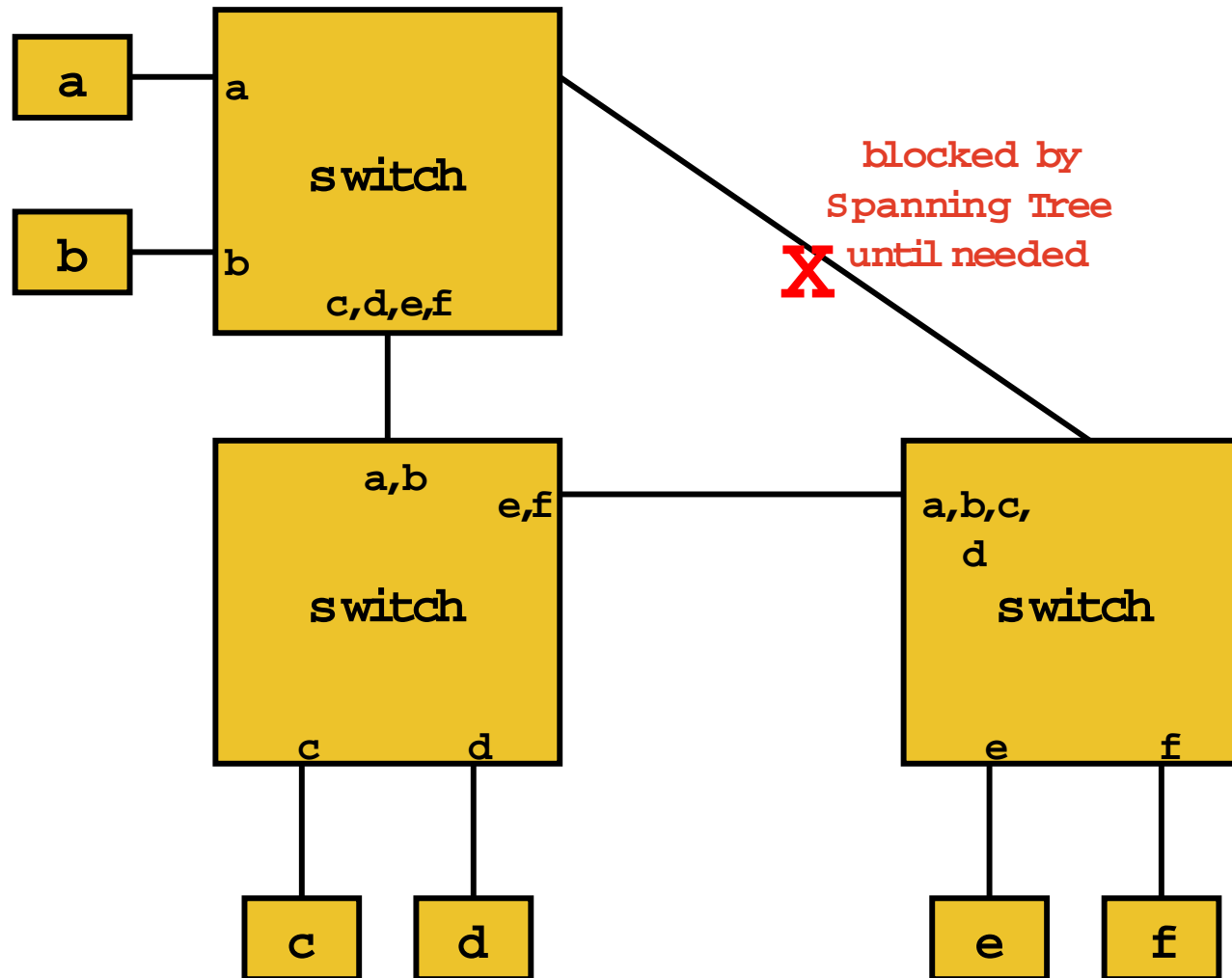
Spanning Tree Protocol (STP)



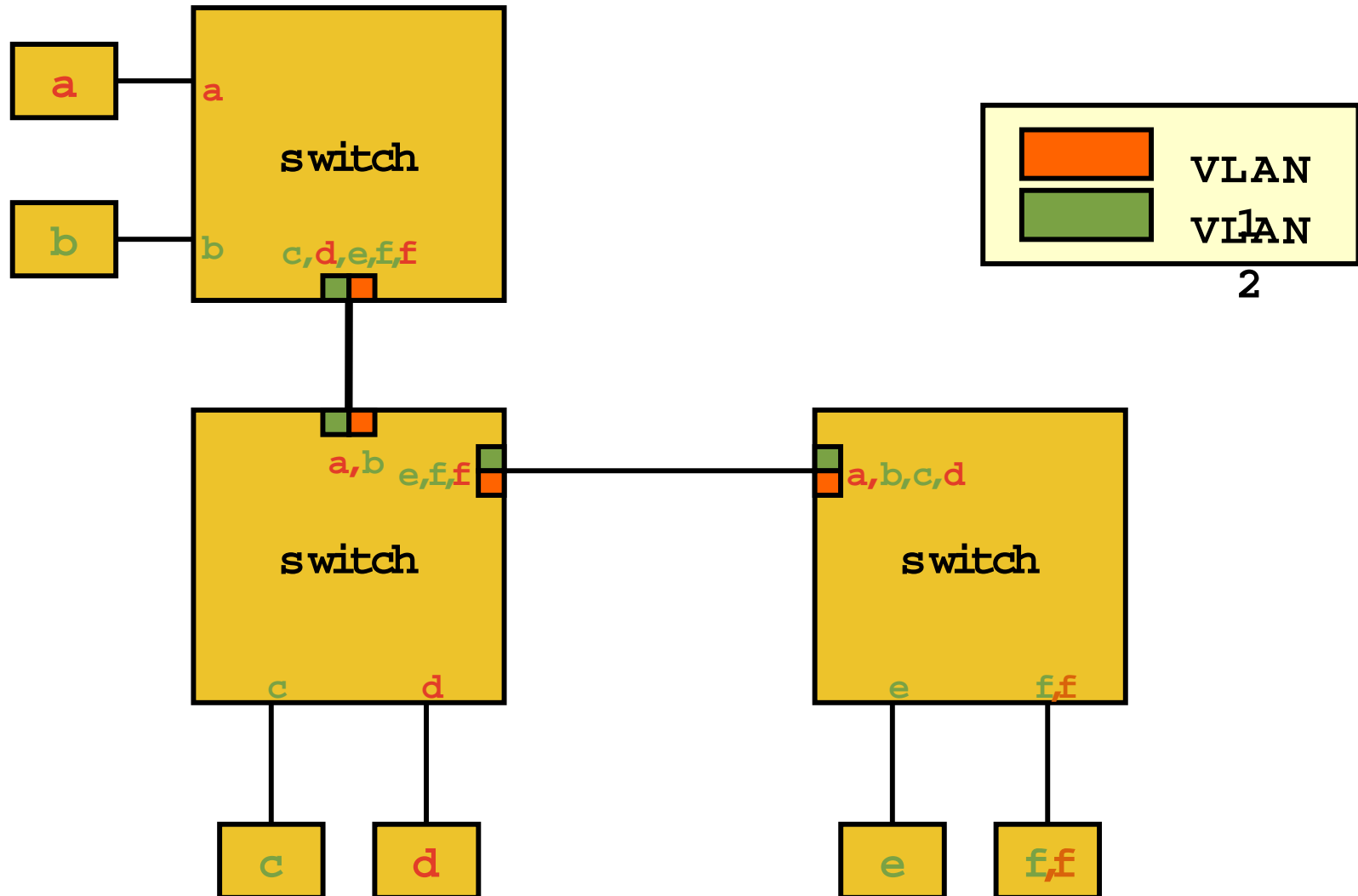
Spanning Tree Protocol (STP)



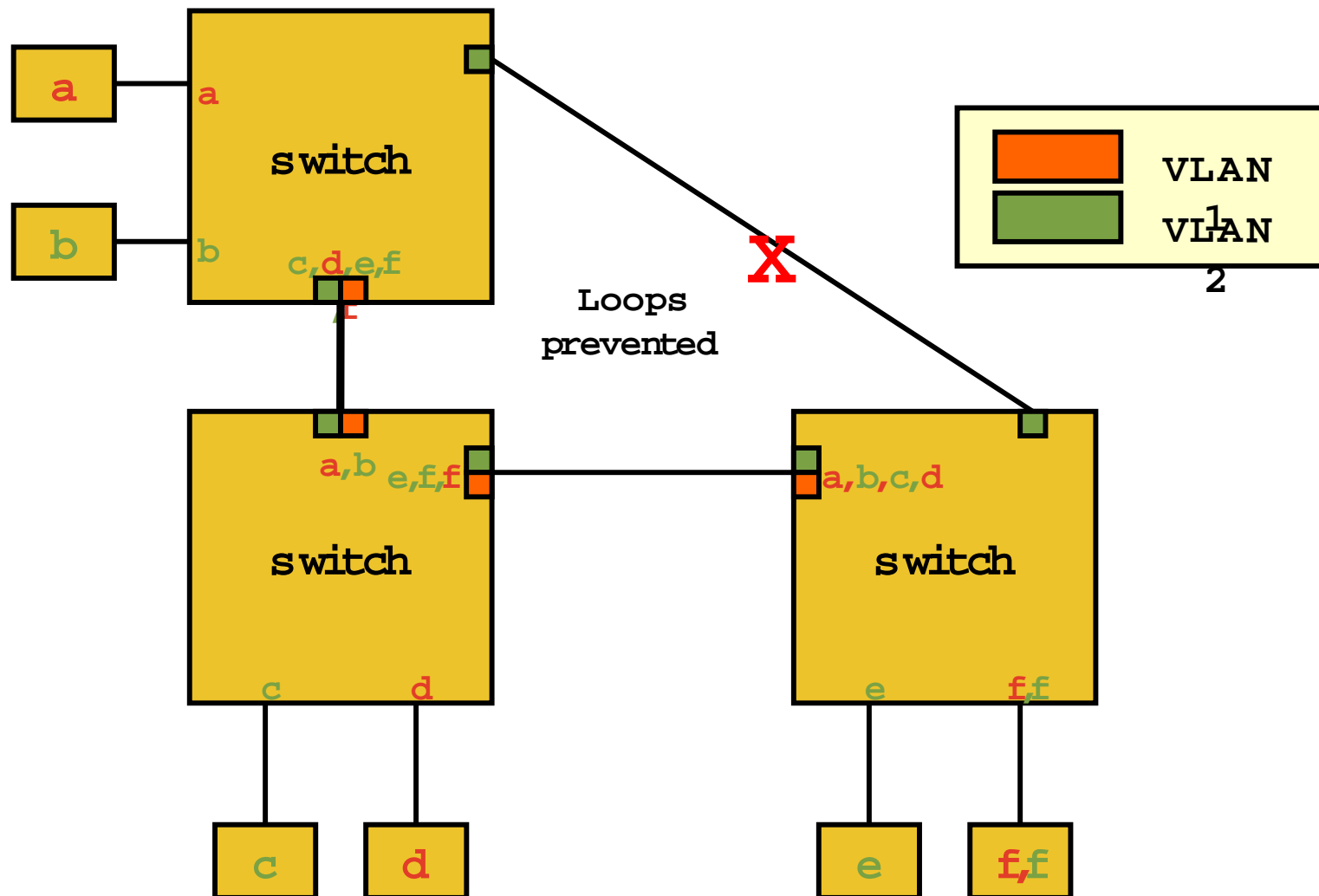
Spanning Tree Protocol (STP)



VLANs between three switches (review)

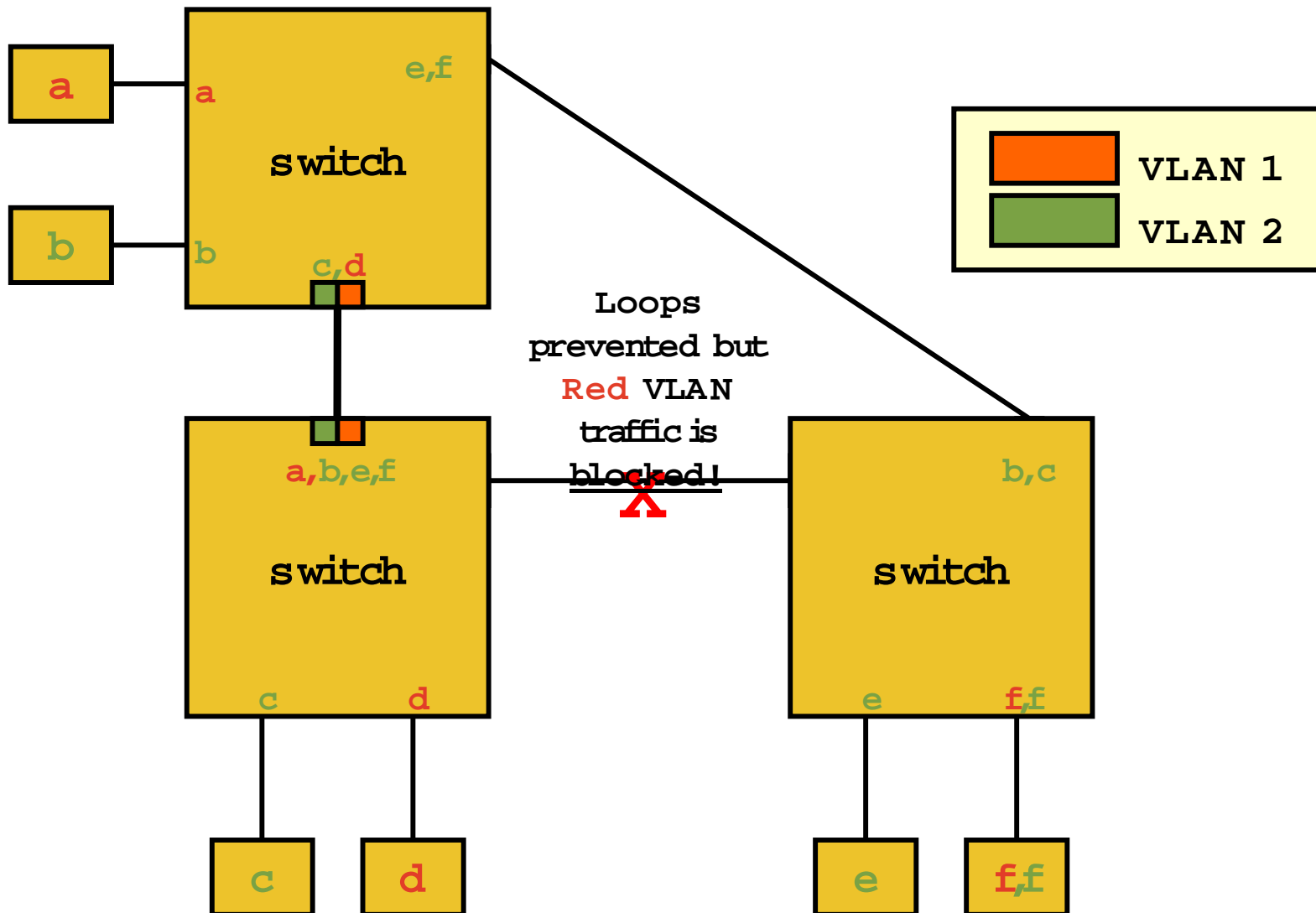


VLANs and STP combined...



VLANs and STP...

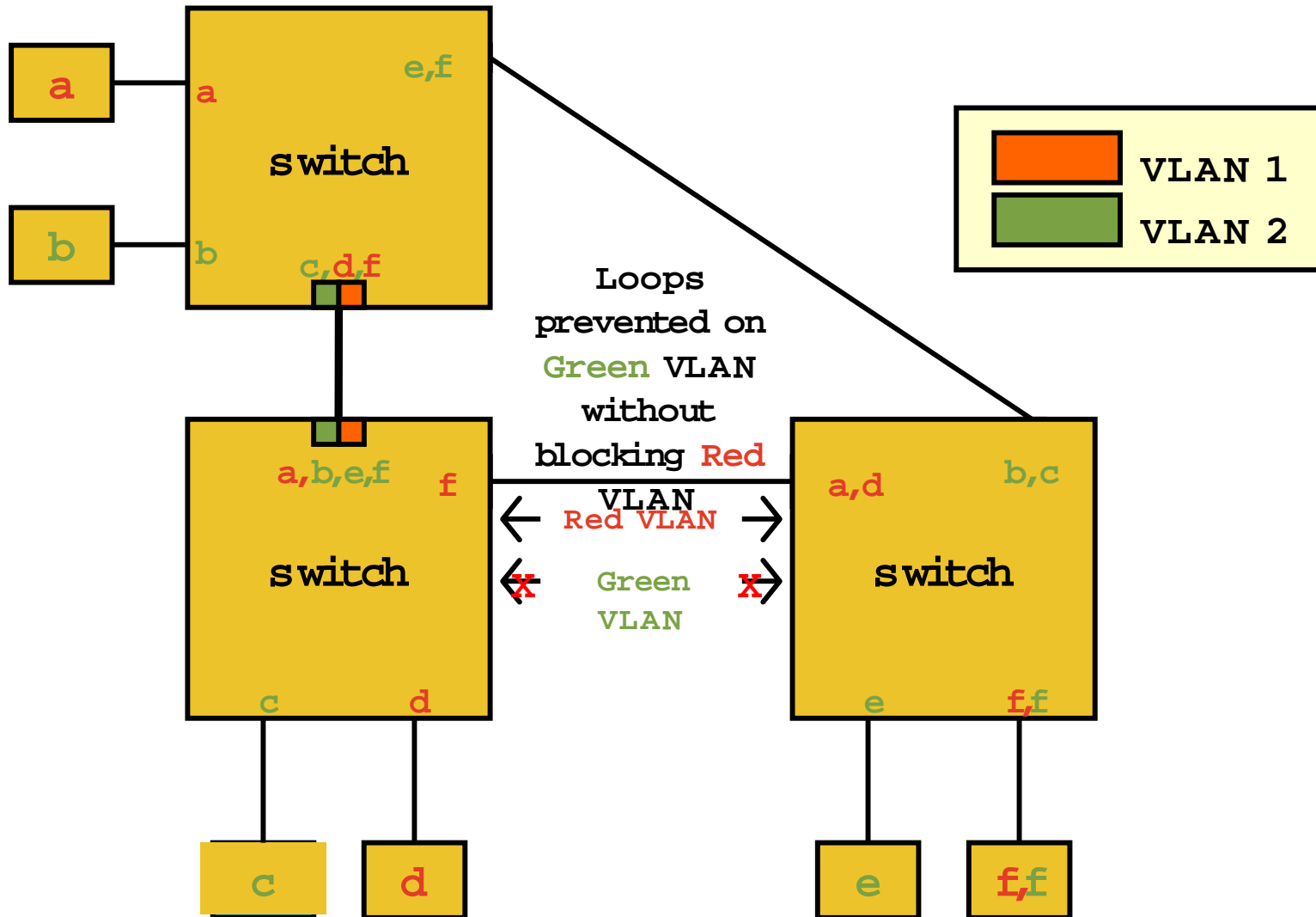
(STP unaware of VLANs)



Multiple Spanning Trees (i.e. per-VLAN STP)

- Blocks loops at the VLAN level instead of the port level
- Allows for a separate spanning tree per VLAN
- IEEE specification is 802.1S (extension to 802.1D)
- Cisco methods include PVST, PVST+, MISTP, and MST.

802.1s and VLANs combined...



Switch technologies for controlling LAN traffic

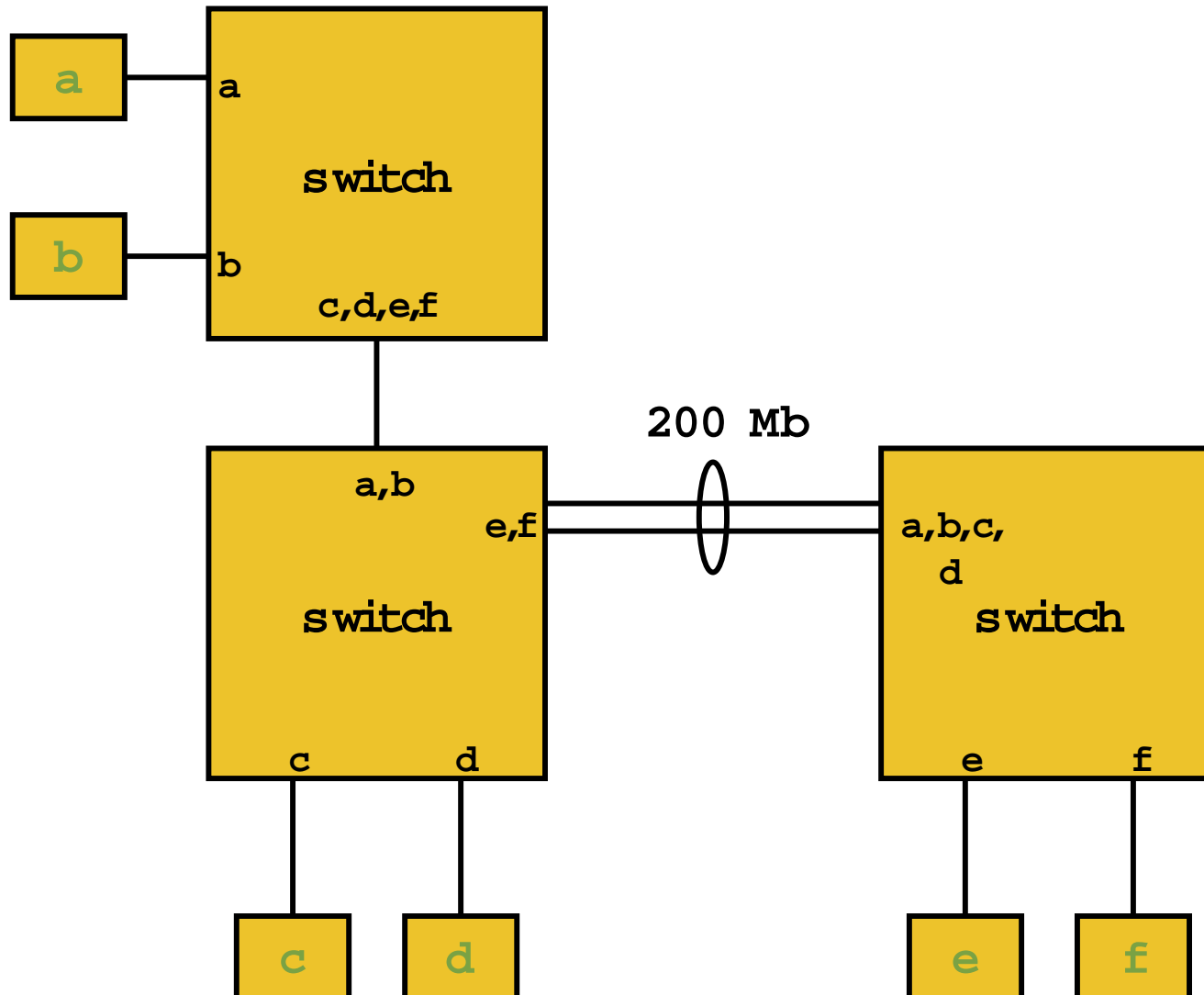
- Security

- Virtual Local Area Networks (VLANs)

- Redundancy

- STP
 - Port Trunking

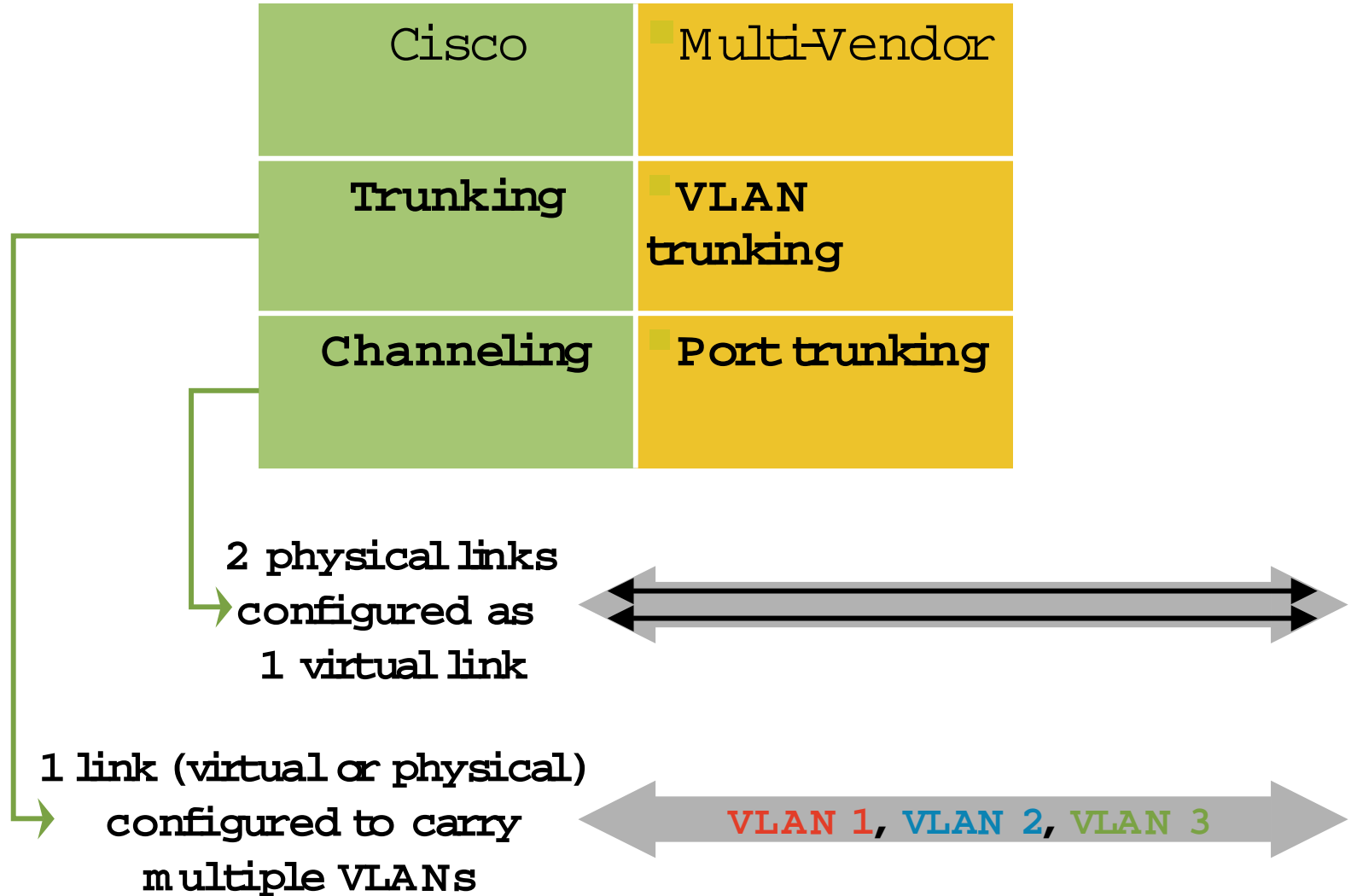
Port trunking for redundancy



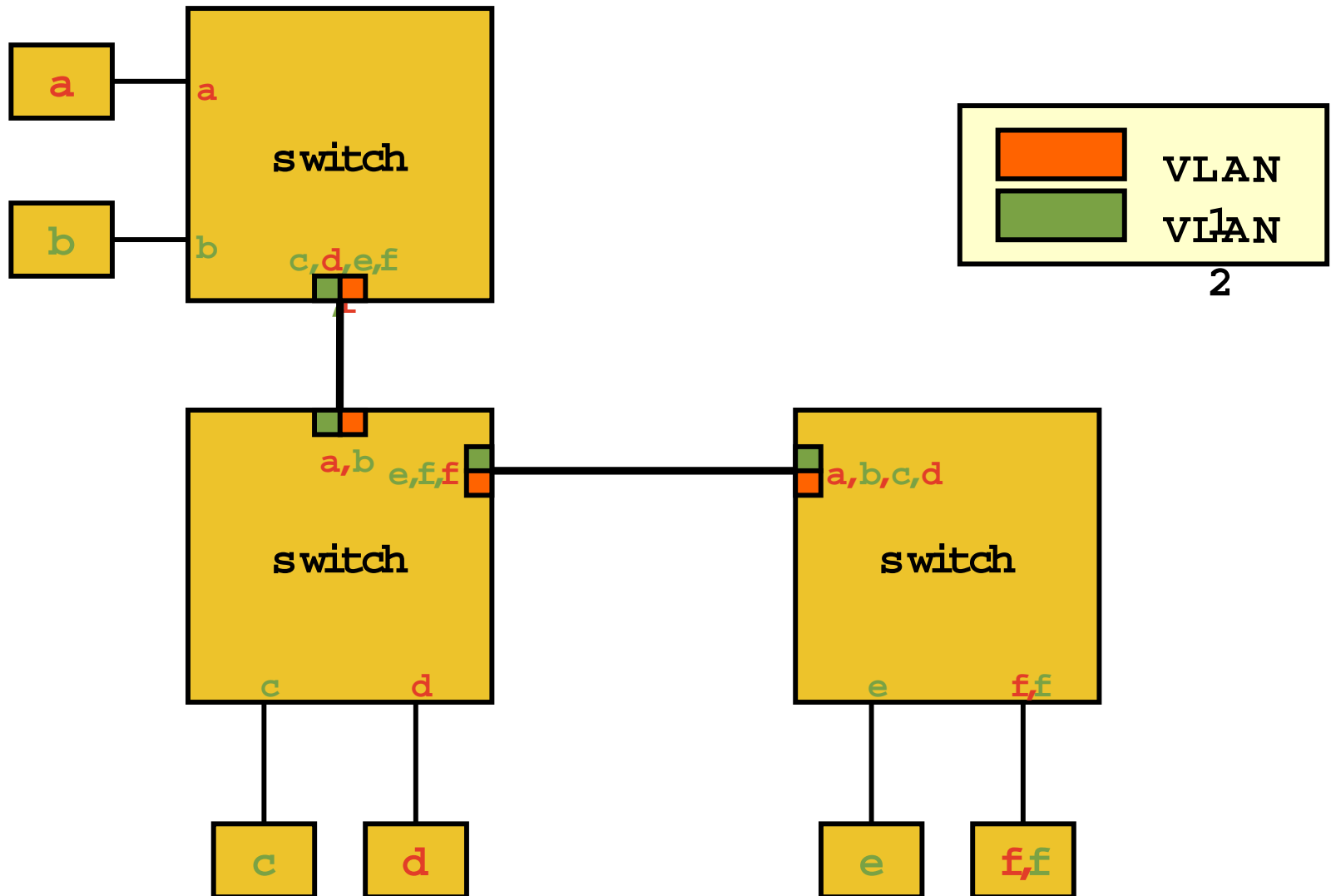
Port trunking

- Creates a single virtual port out of many physical ports
- Treated as a single port by the network (i.e. STP)
- Special algorithms are used to load balance traffic across each port in the port trunk
- Frames are not modified in any way for port trunking (unlike VLAN trunking)
- IEEE specification is 802.3ad
- Switch vendors use proprietary names for port trunking:
 - Called EtherChannel by Cisco
 - Called MLT (MultiLink Trunking) by Nortel

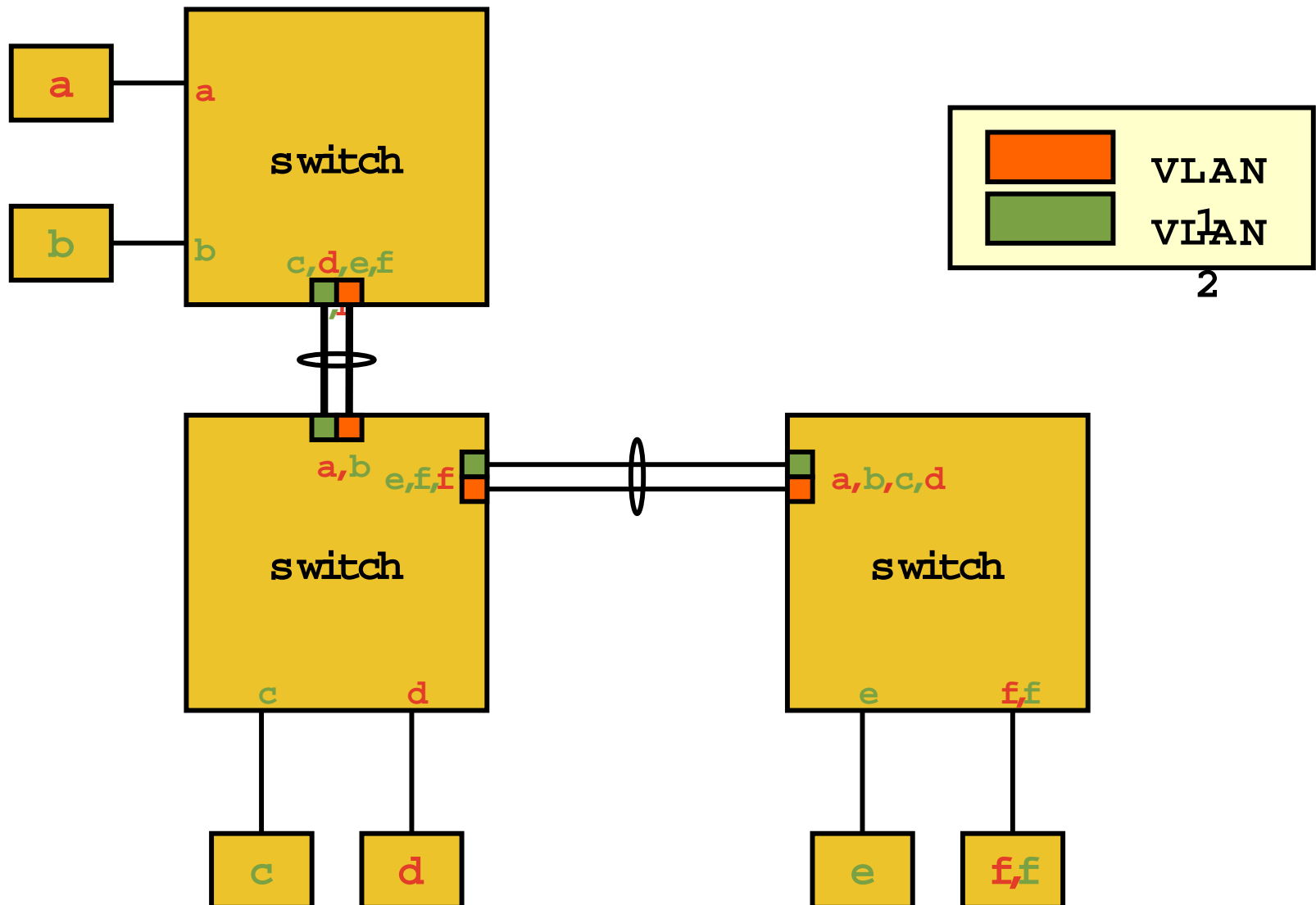
Trunking Terminology



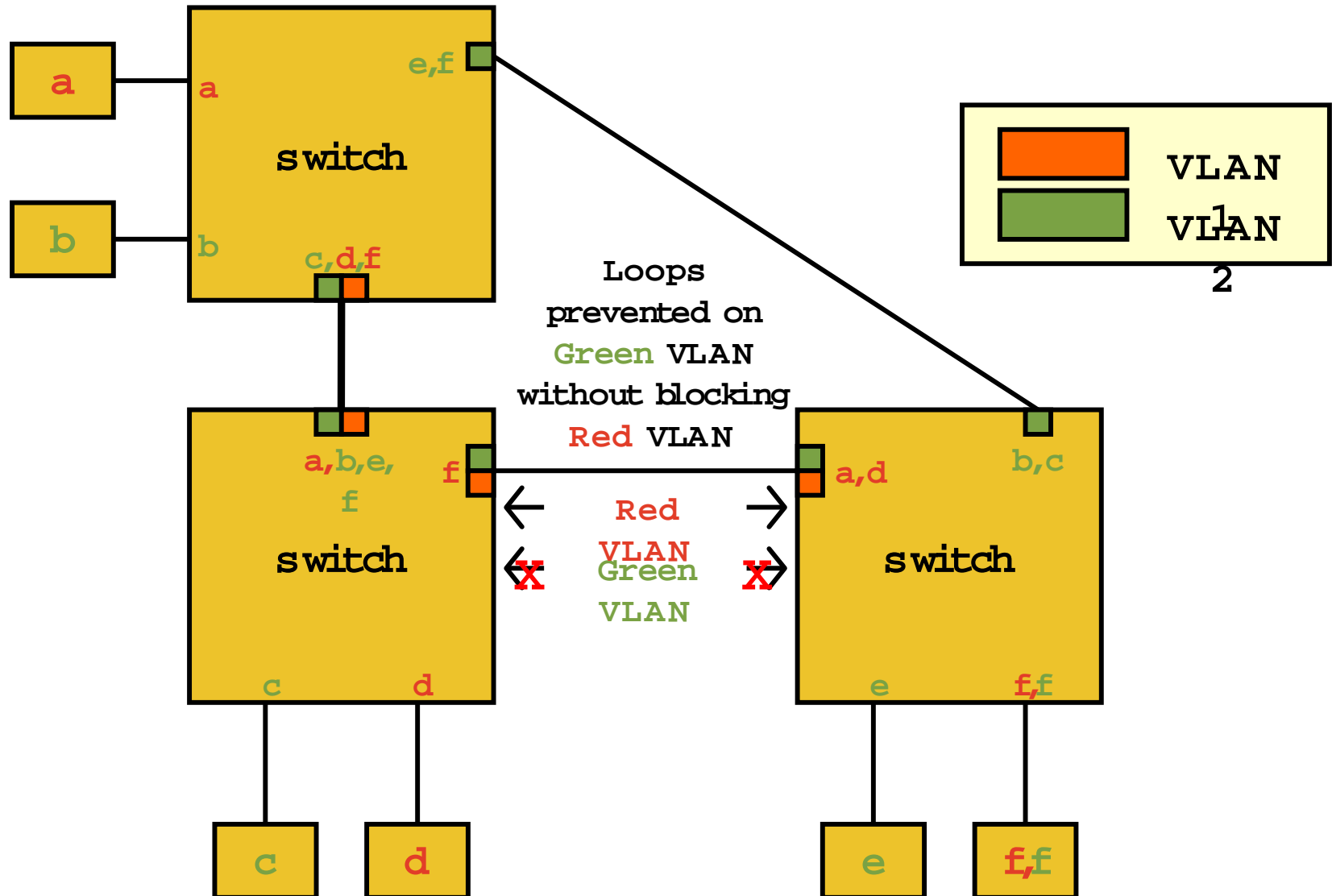
VLANs between three switches (review)



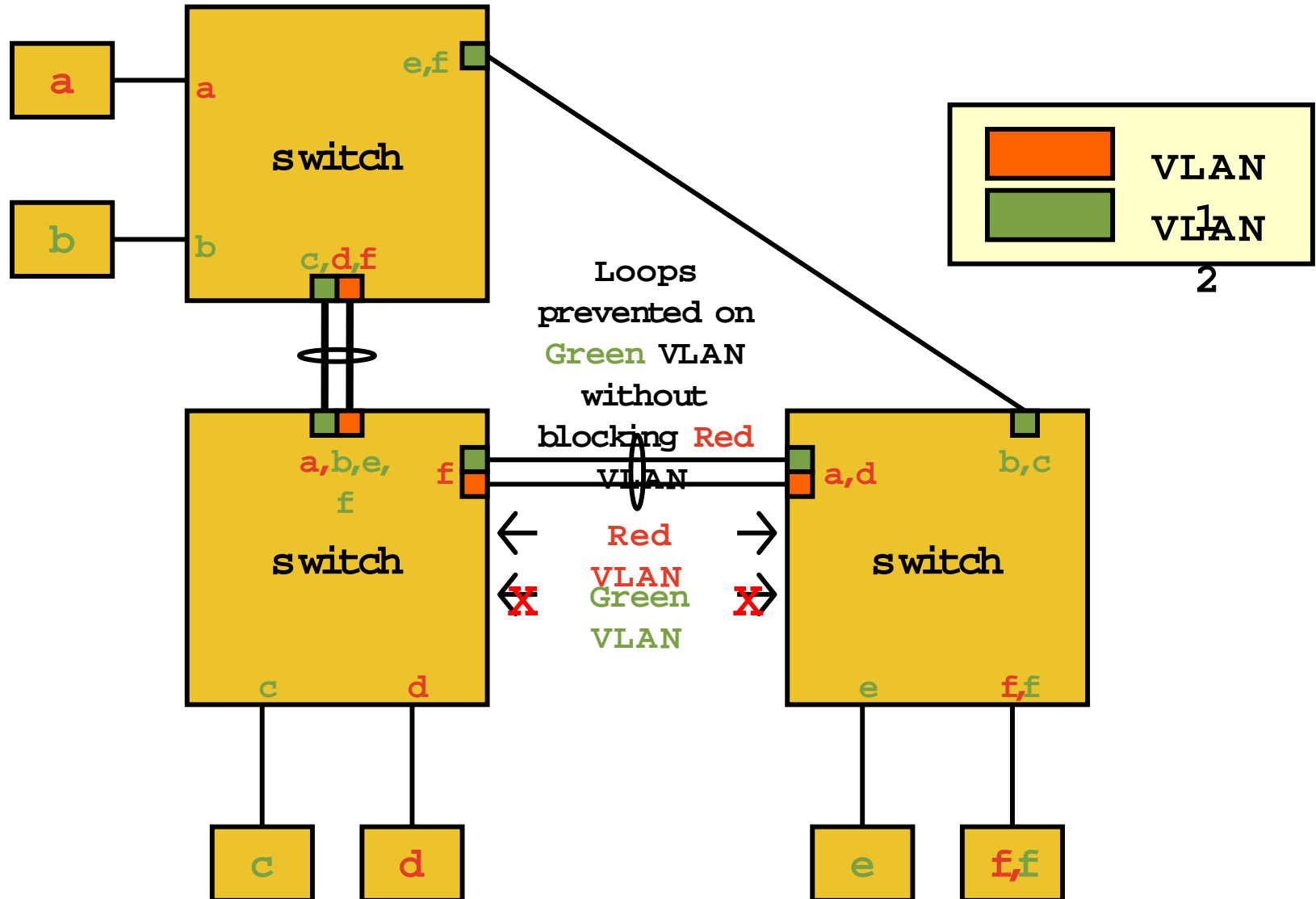
VLAN trunking and port trunking combined...



802.1s and VLANs combined... (review)



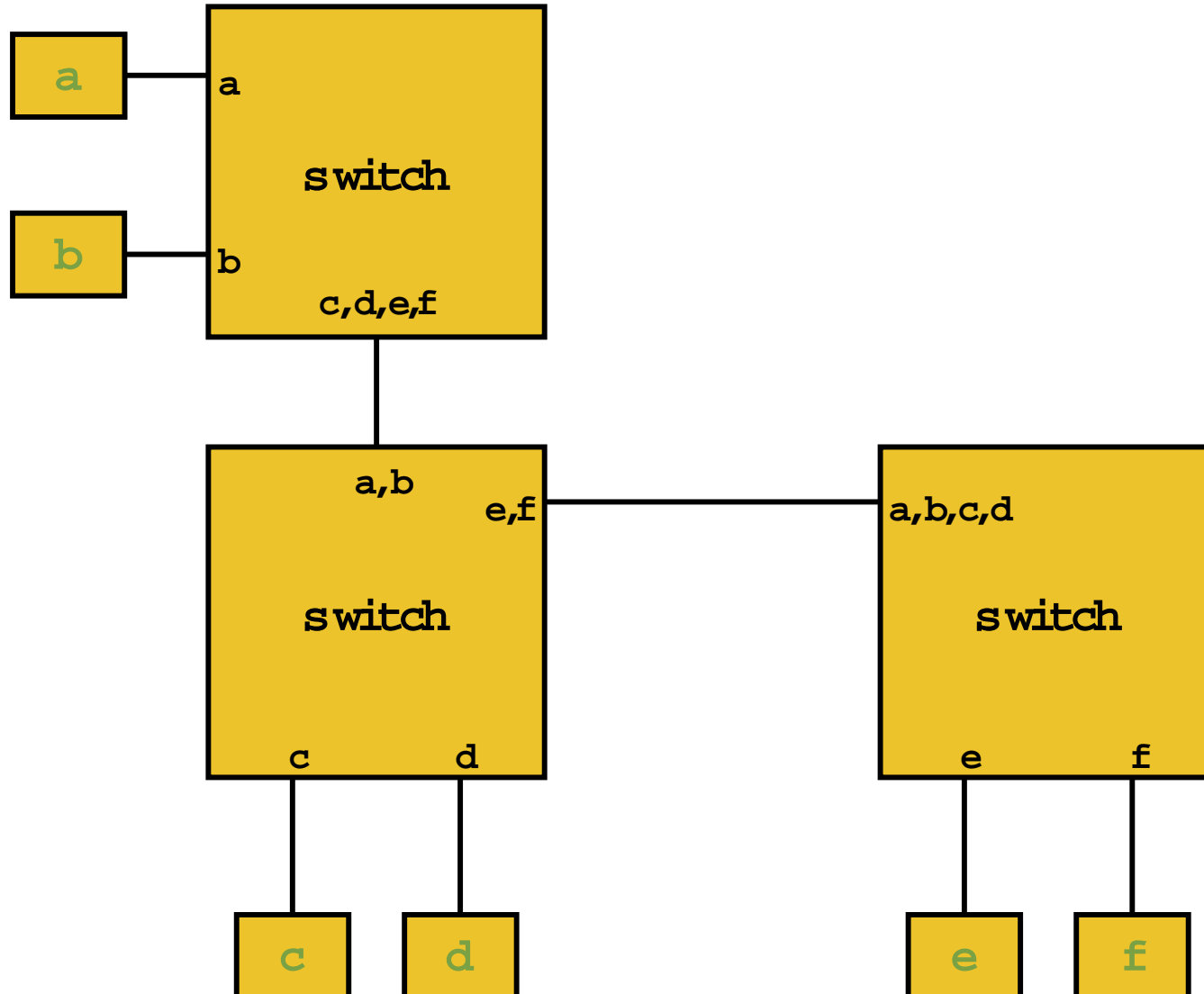
VLAN trunking, port trunking, and STP combined...



Switch technologies for controlling LAN traffic

- Security
 - Virtual Local Area Networks (VLANs)
- Redundancy
 - STP
 - Port Trunking
- Bandwidth
 - Controlling traffic
 - IGMP
 - QoS/CoS

Unknown Unicast , Multicast, and Broadcast control



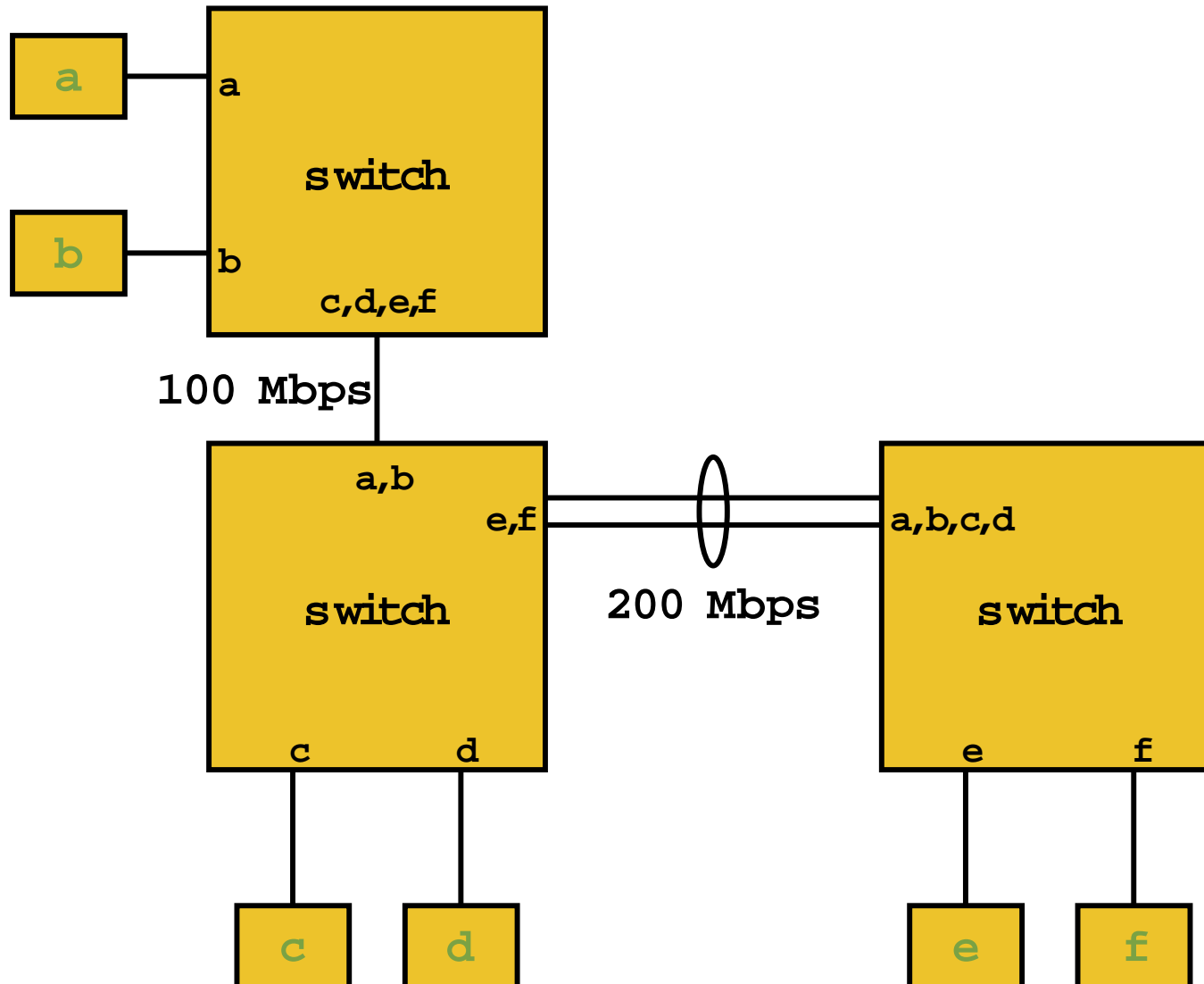
Switch technologies for controlling LAN traffic

- Security
 - Port security
 - Virtual Local Area Networks (VLANs)
- Redundancy
 - STP
 - Port Trunking
- Bandwidth
 - Controlling traffic
 - Unknown unicast / multicast / broadcast control
 - IGMP
 - QoS/CoS

Switch technologies for controlling LAN traffic

- Security
 - Port security
 - Virtual Local Area Networks (VLANs)
- Redundancy
 - STP
 - Port Trunking
- Bandwidth
 - Controlling traffic
 - Unknown unicast / multicast / broadcast control
 - IGMP
 - QoS/CoS
 - Upgrade options
 - Port Trunking

Port trunking for increased bandwidth



switch technologies for controlling LAN traffic

- Security
 - Port security
 - Virtual Local Area Networks (VLANs)
- Redundancy
 - STP
 - Port Trunking
- Bandwidth
 - Controlling traffic
 - Unknown unicast / multicast / broadcast control
 - IGMP
 - QoS/CoS
 - Upgrade options
 - Port Trunking
- Management
 - Port mirroring
 - Switch Management Interfaces (CLI, Menu, BBI/Web, SNMP)

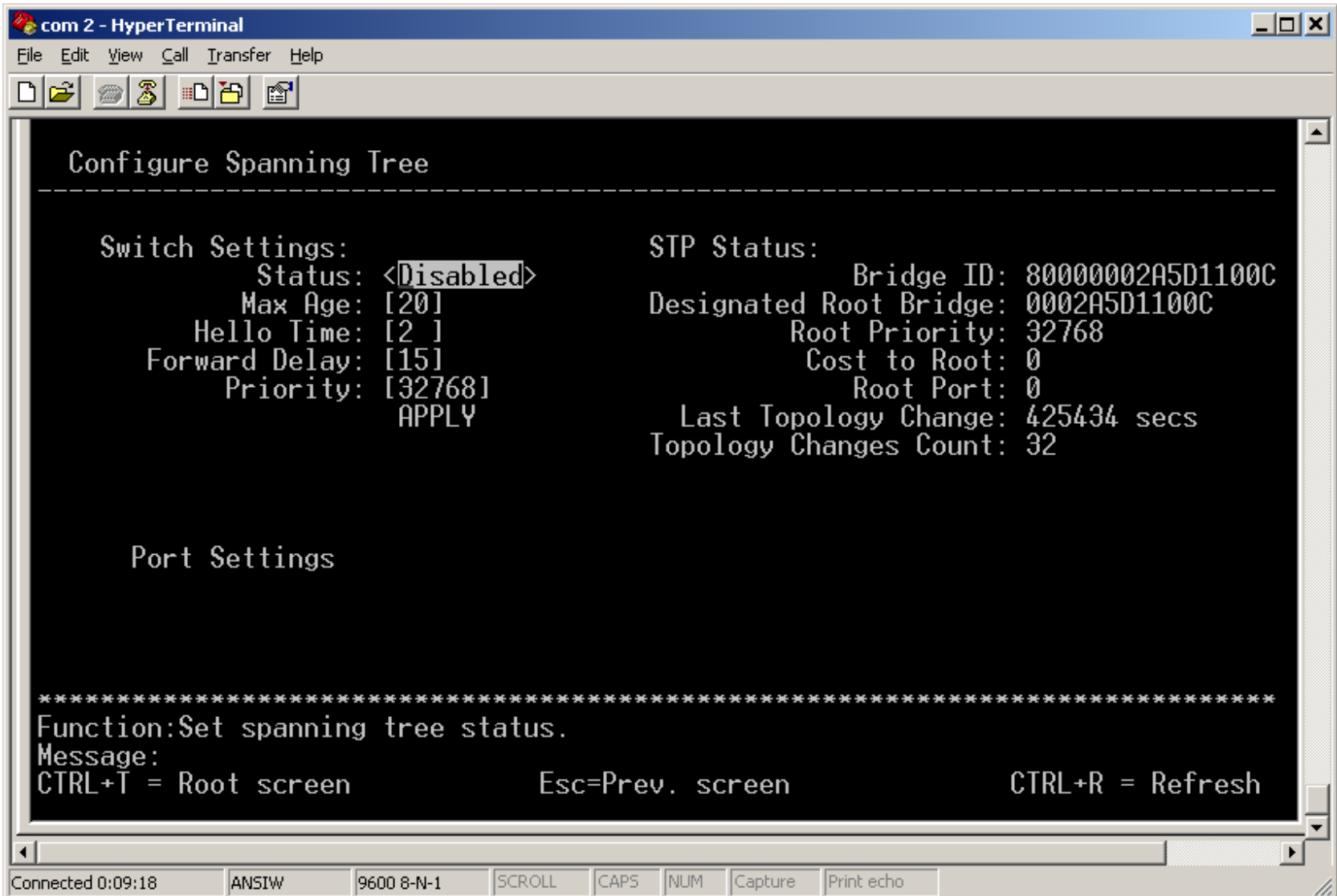
Switch management: CLI interface

```
com 1 - HyperTerminal
File Edit View Call Transfer Help

Cat4000> (enable) set spantree ?
backbonefast      Enable or disable fast convergence
bpdu-skewing       Set spantree BPDU skewing
defaultcostmode    Set spantree port cost mode
disable            Disable spanning tree
enable             Enable spanning tree
fwddelay           Set spantree forward delay
guard              Set spantree guard
hello              Set spantree hello interval
macreduction        Set spantree mac address reduction
maxage             Set spantree max aging time
mode               Set spantree mode
portcost           Set spantree port cost
portfast           Set spantree port fast start
portpri            Set spantree port priority
portvlancost       Set spantree port cost per vlan
portvlanpri        Set spantree port vlan priority
portinstancecost   Set spantree port cost per instance
portinstancepri    Set spantree port instance priority
priority           Set spantree priority
root               Set switch as primary or secondary root
uplinkfast         Enable or disable uplinkfast groups
Cat4000> (enable) set spantree _
```

Connected 0:08:51 ANSIW 9600 8-N-1 SCROLL CAPS NUM Capture Print echo

Switch management: menu interface



```
com 2 - HyperTerminal
File Edit View Call Transfer Help

Configure Spanning Tree
-----

Switch Settings:                                STP Status:
  Status: <Disabled>                             Bridge ID: 80000002A5D1100C
  Max Age: [20]                                Designated Root Bridge: 0002A5D1100C
  Hello Time: [2]                             Root Priority: 32768
  Forward Delay: [15]                         Cost to Root: 0
  Priority: [32768]                            Root Port: 0
  APPLY                                         Last Topology Change: 425434 secs
                                              Topology Changes Count: 32

Port Settings

*****
Function:Set spanning tree status.
Message:
CTRL+T = Root screen          Esc=Prev. screen          CTRL+R = Refresh

Connected 0:09:18  ANSIW  9600 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

Switch management: Web/BBI interface

Compaq ProLiant BL p-Class GbE Interconnect Switch - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media

Address http://1.1.1.1:100 Go

COMPAQ

ProLiant BL p-Class

- Configuration
 - IP Address
 - Switch Information
 - Advanced Settings
 - Port Configuration
 - Port Mirroring
 - Port Trunking
 - IGMP Snooping
 - Spanning Tree
 - STP Switch Settings
 - STP Port Settings
 - Static Filtering Table
 - VLANs
 - Port Bandwidth
 - Threshold of Broadcast
 - Port Priority
 - Class of Traffic
 - Class of Service
 - Port Security
 - Priority MAC Addresses
 - Serial Port Settings

Switch Spanning Tree Settings

Spanning Tree Protocol	Disabled
Time Since Topology Changes(Sec)	426027
Topology Change Count	32
Bridge ID	80000002a5d1100c
Designated Root	0002a5d1100c
Cost to Root	0
Root Port	0
Root Priority(Sec)	32768
Bridge Max Age (6-40 Sec)	20
Bridge Hello Time (1-10 Sec)	2
Bridge Forward Delay (4-30 Sec)	15
Bridge Priority (0-65535 Sec)	32768

Apply

Note: $2 * (\text{Forward Delay} - 1) \geq \text{Max Age}$
 $\text{Max Age} \geq 2 * (\text{Hello Time} + 1)$

COMPAQ
ProLiant BL /GbE Interconnect Switch A

N1 N2

S1 S2 S3 S4 S5 S6 S7 S8

XC U1 U2

Speed L/A Speed L/A

Pwr Mgmt

Speed L/A Speed L/A

Mgmt Console

Done Internet

Switch management: SNMP

The screenshot displays the Compaq Networking Management Software interface. The main window shows a network topology with various devices like Building, Campus, Closet, Floor, Site, Computer, and Generic Networking Device - Switch 1. A dialog box titled "Spanning Tree Configuration - Switch 1" is open, showing the following settings:

Spanning Tree Configuration - Switch 1	
Protocol Specification	IEEE Spanning Tree Protocol
Last Topology Change	4 Days 22 Hours 26 Minutes 39.0 Seconds
Topology Changes	32
Designated Root	80 00 00 02 a5 d1 10 0c
Path Cost to Root	0
Root Port	0
Hold Time (sec)	1
Priority	32768
Current Maximum Age	20
Max Aging Time (sec)	20
Current Hello Time (sec)	2
Hello Time (sec)	2
Current Forwarding Delay	15
Forwarding Delay (sec)	15

Buttons at the bottom of the dialog include Refresh, Apply, Port Configuration, Close, and Help. A "MIB Browser" button is also visible in the top right of the main window.

In the bottom right corner, there is a table titled "Interface List - Switch 1" showing the following data:

Identifier	Type
Interface 1	Fast
Interface 2	Fast
Interface 3	Fast
Interface 4	Fast

The status bar at the bottom indicates "Draw" and shows four zeros (0 0 0 0). A note states: "This window contains network entities you can drag and drop onto one of the network maps".

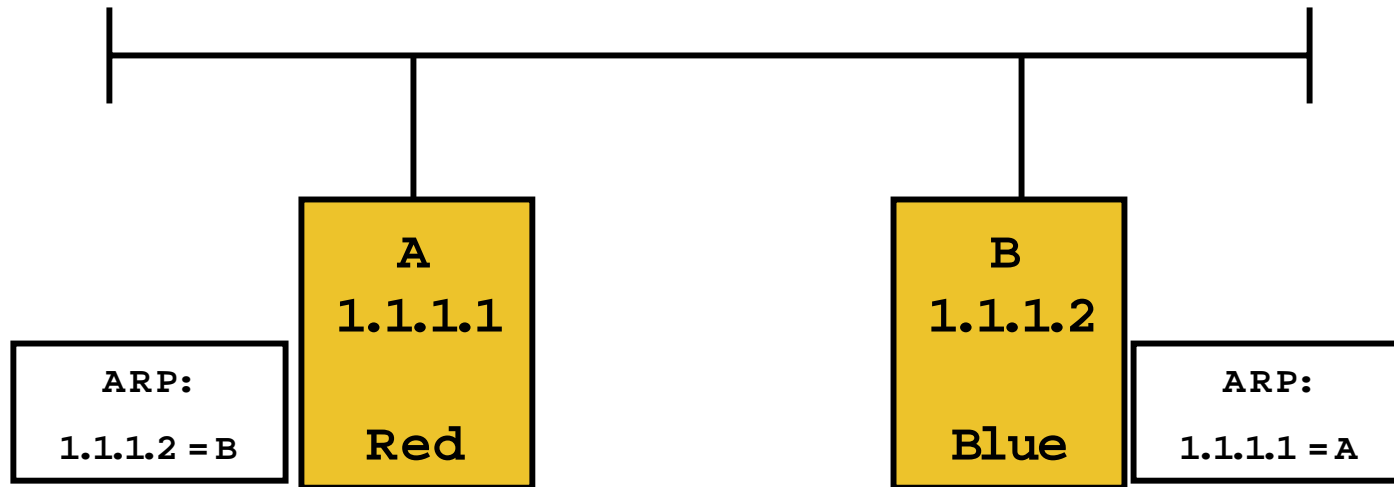


i n v e n t

Backup Slides

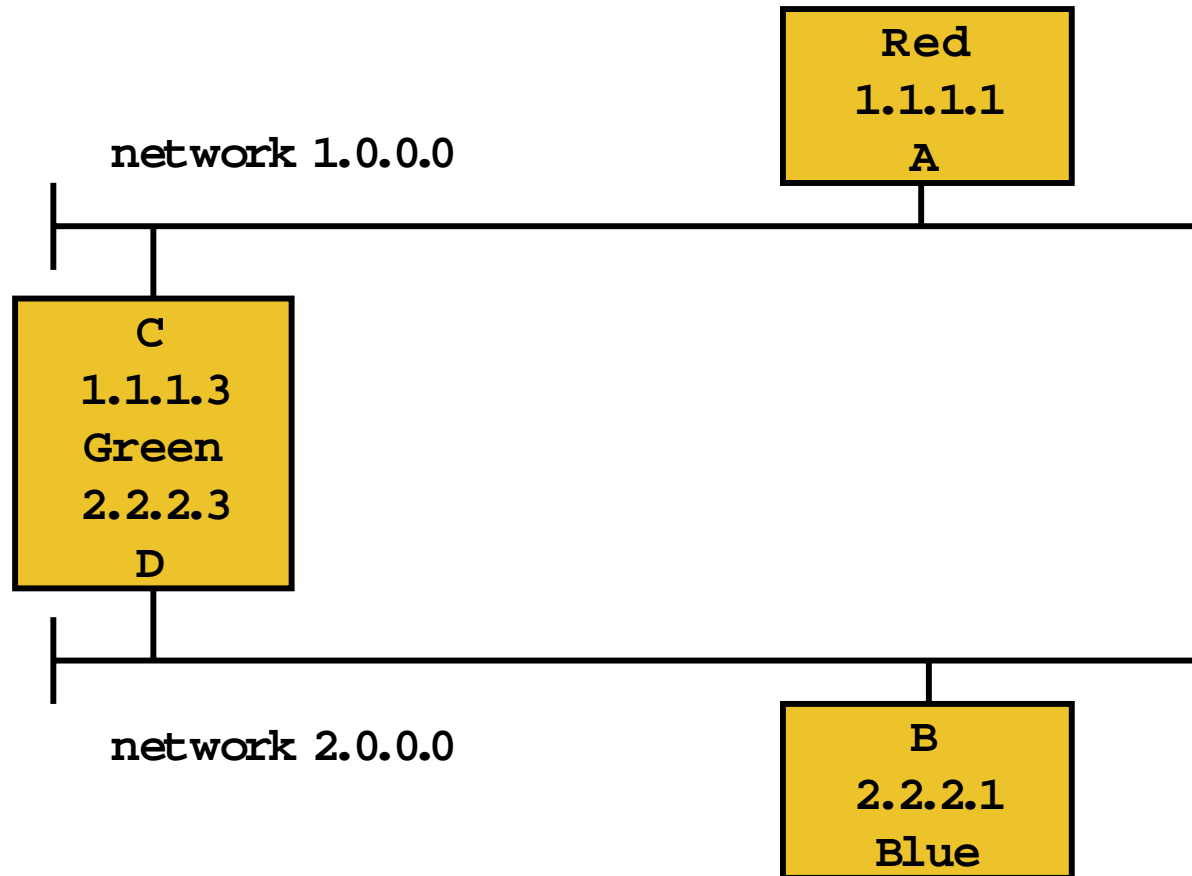
Communication process

Two devices on the same Layer 2 network



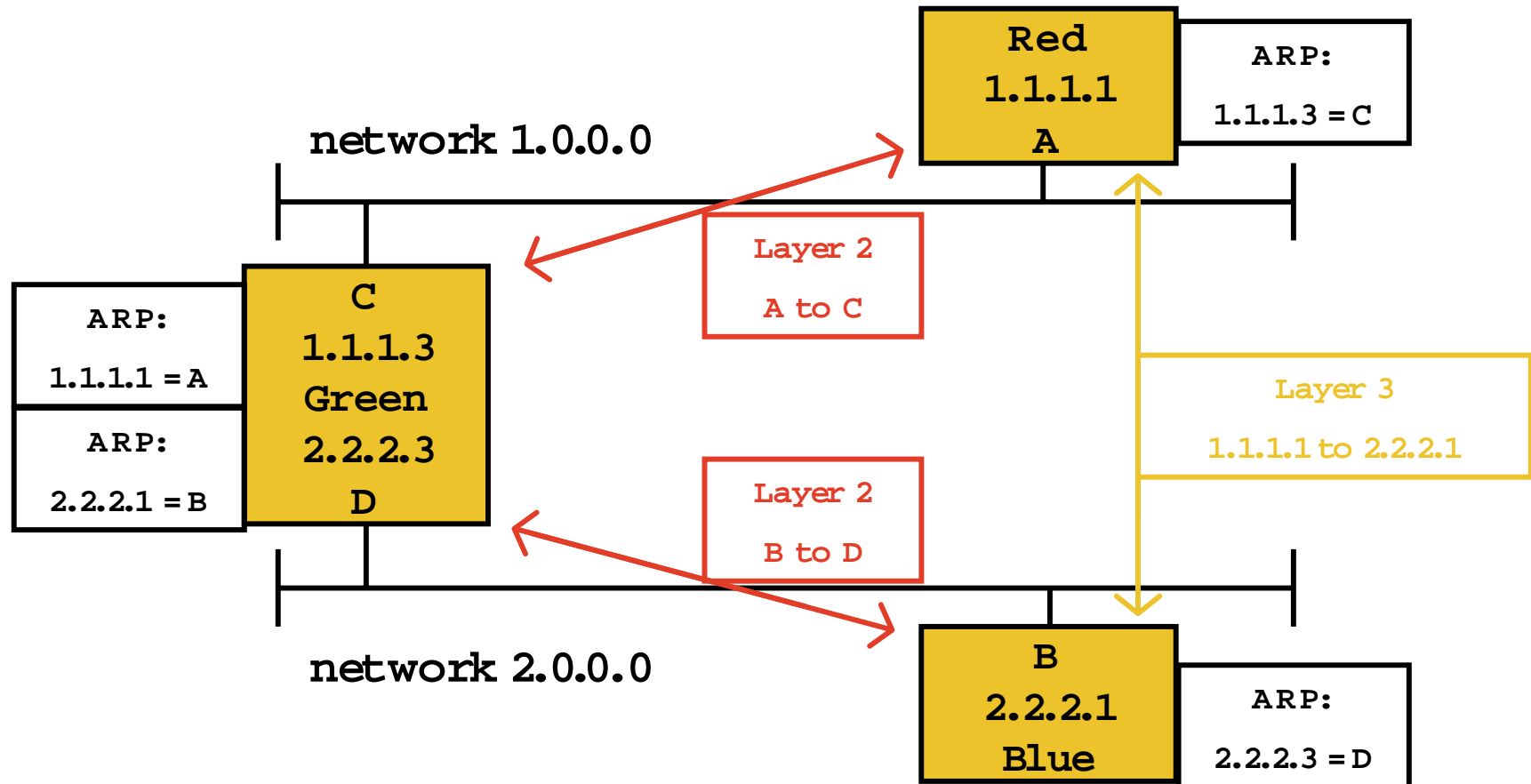
Communication process

Two devices on different Layer 2 networks



Communication process

Two devices on different Layer 2 networks





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