Lecture 3

VLANs

Objectives

VLANs

Broadcast Domains

Routing device do not forward broadcasts
They define the edge of the domain.

L2 Switches forward broadcasts out all
ports (except ingress)

Host C

Host B

Host A
Broadcast

Broadcast Domain 1

Host D
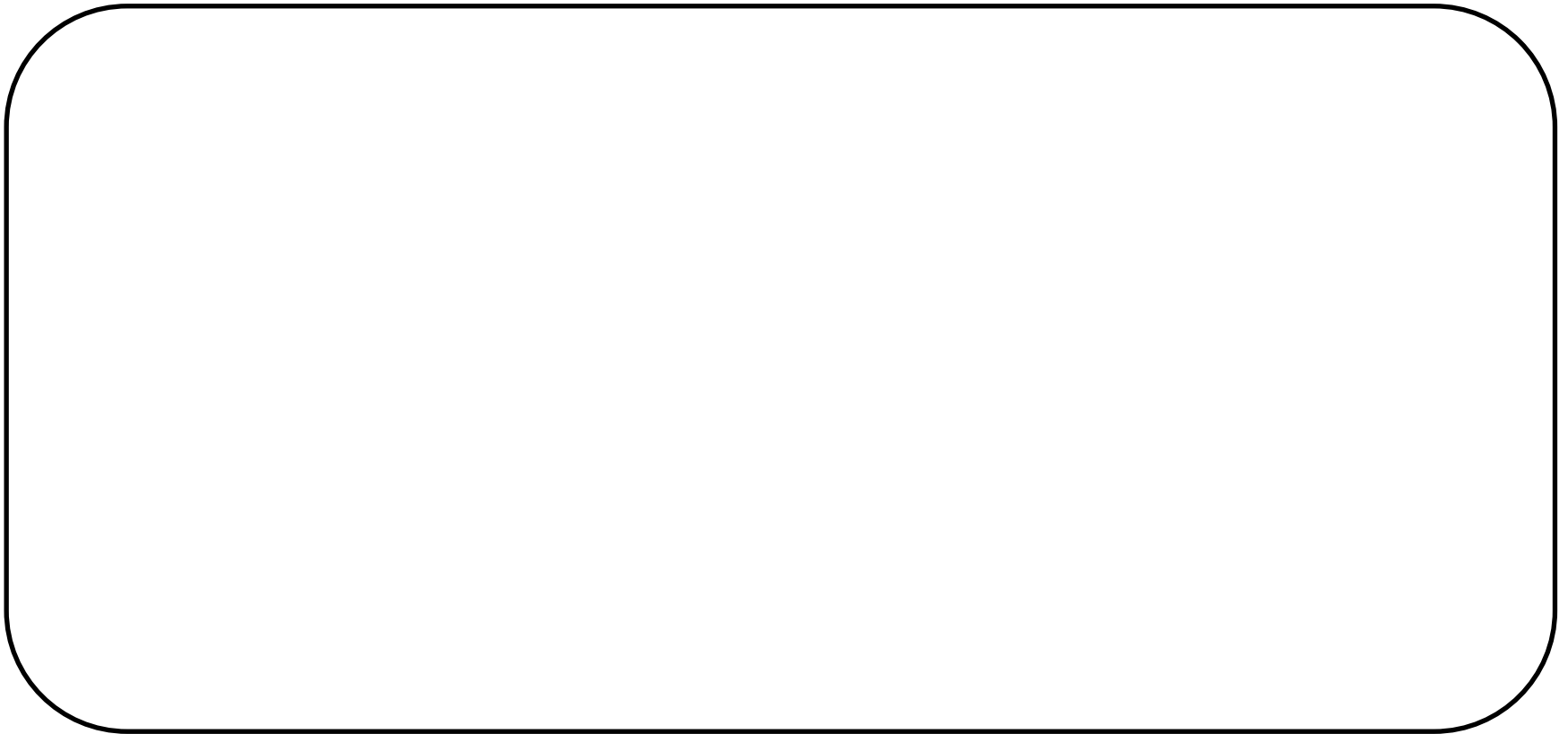Broadcast

Host E
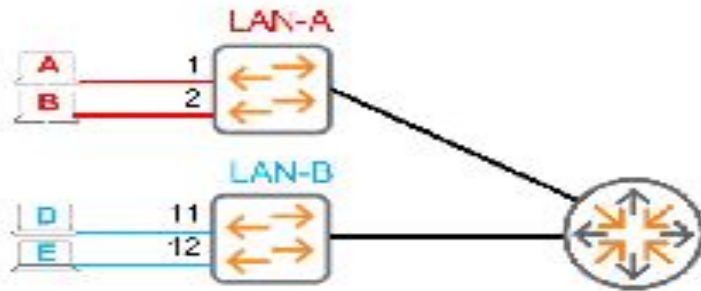
Host F
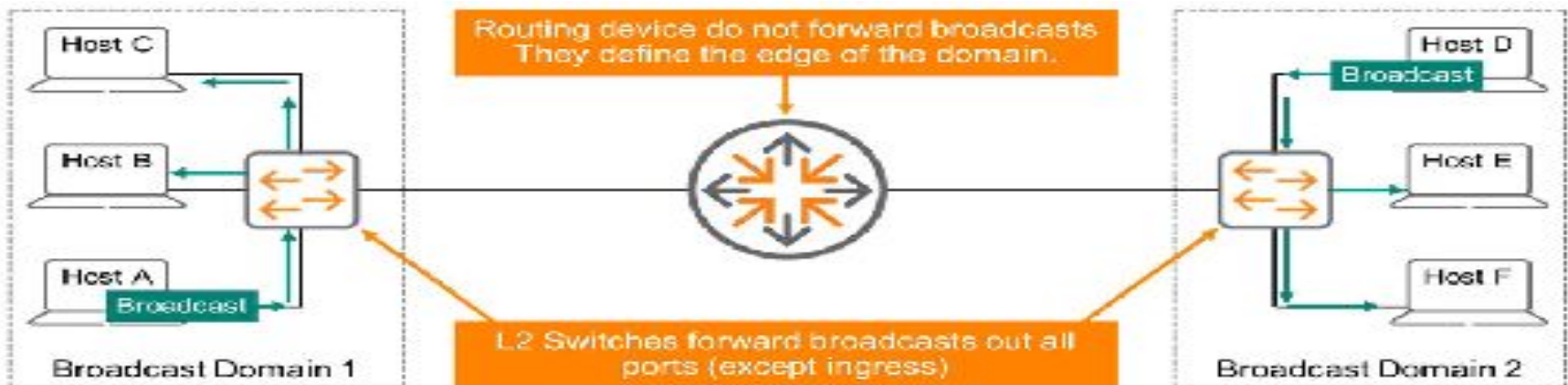
Broadcast Domain 2

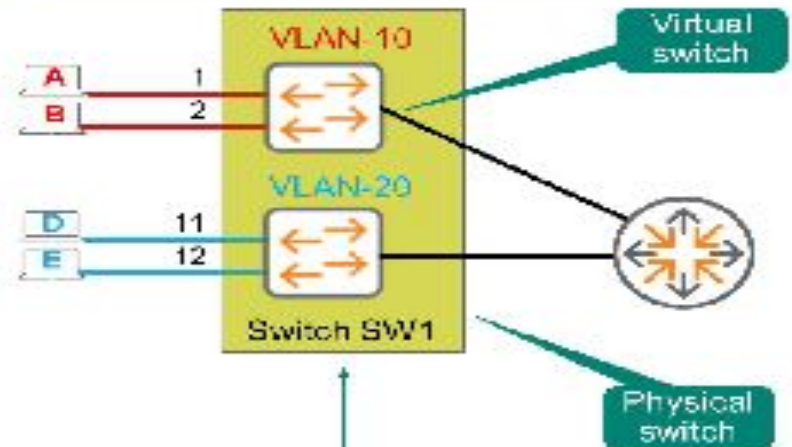# Broadcast Domains

Broadcast Domains

Smaller broadcast domains mean better performance.

Virtual LAN

LAN: Devices in the same broadcast domain

VLAN: Devices in the same broadcast domain

LAN-A

A — 1
B — 2

LAN-B

D — 11
E — 12

VLAN-10

A — 1
B — 2

VLAN-20

D — 11
E — 12

Switch SW1

Virtual switch

Physical switch

Both scenarios operate in the same way

Virtual LAN

Simply add a router, which can route unicast and multicast traffic between the LANs.

Virtual LAN

Virtual LAN

Virtual LANs

partitioned
|pɑːˈtɪʃənd| and isolated

Vlan 10 Vlan 20

Vlan Trunk
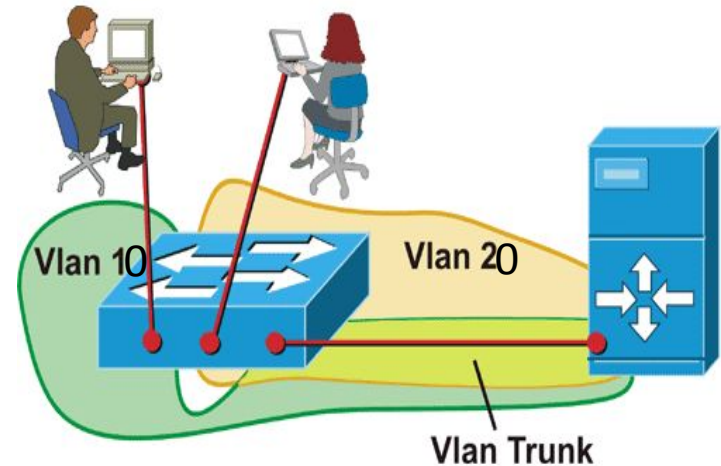
a subnet is based on location (physical connection)
is based on port configuration (logical connection)

VLAN 20 Router VLAN 2

VLAN 10 VLAN 10

Switch Switch

Subnet A Subnet B

VLAN 20 VLAN 2 0

11
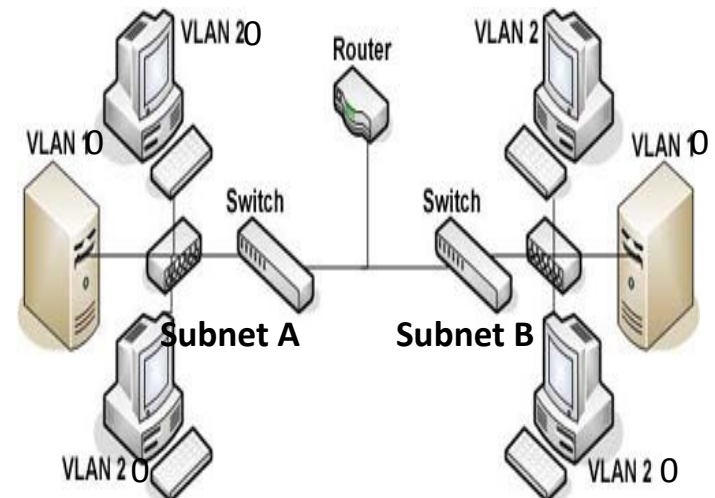
Virtual LANs

on the port to which a device is attached

VLAN - Virtual Local Area Network
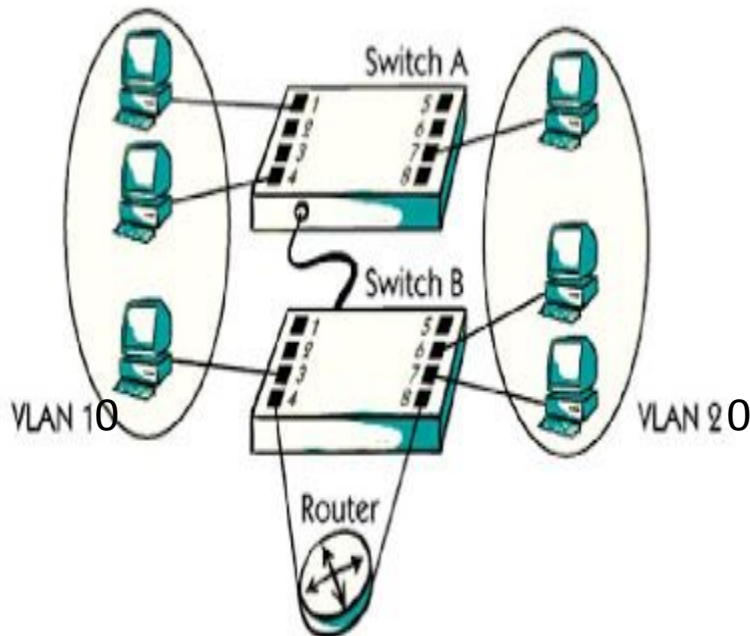
ports located on different physical switches

Traffic between ports in the same VLAN

are propagated through the VLAN

Traffic between VLANs

does not cross VLANs

VLAN Creation

In ArubaOS-CX VLAN 1 is created by default and cannot be removed. By default, all ports are members of this VLAN. This is a common default for many switches.

By default all ports are mapped to VLAN 1

VLAN-10

1
.
.
.
24

VLAN-1
Default

Switch SW1

VLAN 10 exists, but nothing is connected
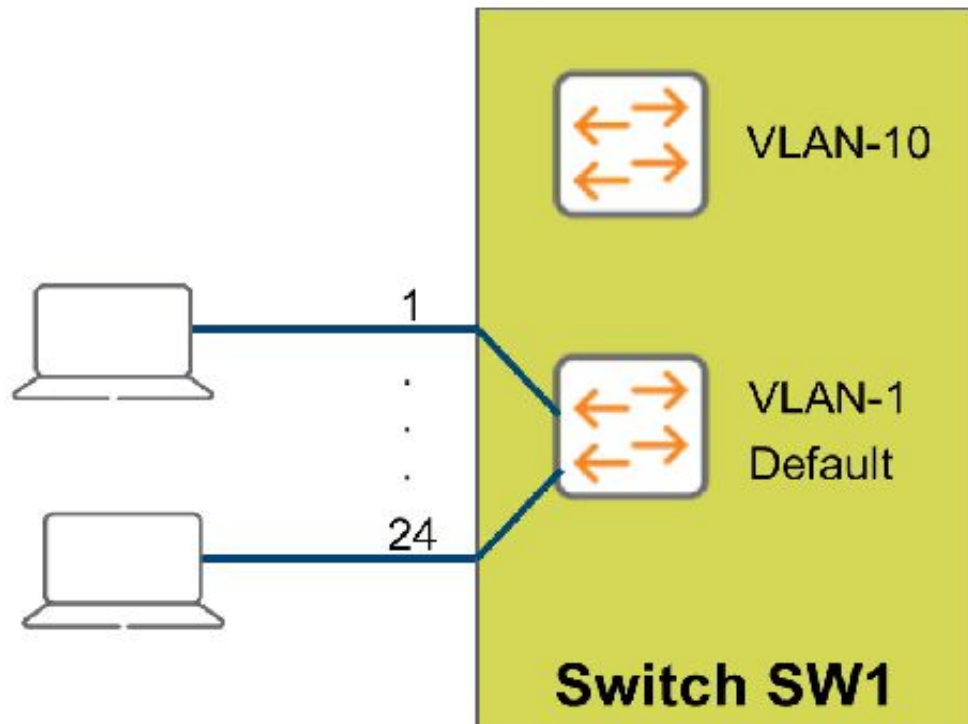
Virtual LANs (VLANs) Types

Default VLAN	• Includes **all switch ports** when a switch is in its default configuration. In the default configuration, the default VLAN carries **both management traffic and standard network traffic**.
Primary VLAN	• **Initially the default VLAN**. For HP switches, the primary VLAN is the only VLAN **on the switch that can receive a switch‑generated address via DHCP**. • You can designate a custom VLAN as the primary VLAN and make it responsible for some management functions.

Virtual LANs (VLANs) Types

Mana-ge ment VLAN

- **Management VLAN is used for managing the switch from a remote location by using protocols such as telnet, SSH, SNMP, syslog etc.**
- **Normally the Management VLAN is VLAN 1, but you can use any VLAN as a management VLAN.**
- **To identify a specific VLAN as the only VLAN from which users can connect to the switch management interface.**

Virtual LANs (VLANs) Types

Secure Mana-ge ment VLAN

- **When created as a custom VLAN, the secure management VLAN is an isolated network specifically used for switch management. Access to management functions is then limited to only those ports configured as secure management VLAN members. Traffic cannot be routed to or from this VLAN.**

Voice VLAN

- **Custom VLAN that can be created to isolate VoIP traffic from other network traffic.**

VLAN Creation

```
SW1(config)# VLAN 10
SW1(config-VLAN-10)#
```

```
SW1(config)# VLAN 2-5,10
```

```
SW1(config)# no VLAN 10
```

```
SW1(config)# VLAN 10
SW1(config-VLAN-10)# shutdown
```

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VLAN Creation

```
SW1(config)# VLAN 10
SW1(config-VLAN-10)# name Sales
```

No devices are yet attached to this virtual switch, as shown in the figure.

VLAN Creation

- **Define the VLAN name and ID;**
- **Transfer ports from the default VLAN to the new VLAN;**
- **Assign an IP address to the VLAN (optional).**

VLAN links

Access link; Trunk link

Access link	• Port linked to a network device other than another switch.
Trunk link	• Port linked to another switch.

Tagging is based on the 802.1Q standard.

Access Ports

```
SW1(config)# vlan 10
SW1(config-vlan-10)# name Sales
SW1(config-vlan-10)# exit
SW1(config)# vlan 20
SW1(config-vlan-20)# name Service
SW1(config-vlan-20)# exit
```

Define VLANs

```
SW1(config)# interface 1/1/1-1/1/2
SW1(config-if-<1/1/1-1/1/2># vlan access 10
SW1(config-if-<1/1/1-1/1/2># exit
SW1(config)# interface 1/1/11-1/1/12
SW1(config-if-<1/1/11-1/1/5># vlan access 20
SW1(config-if-<1/1/11-1/1/12># exit
```

Map ports to VLANs
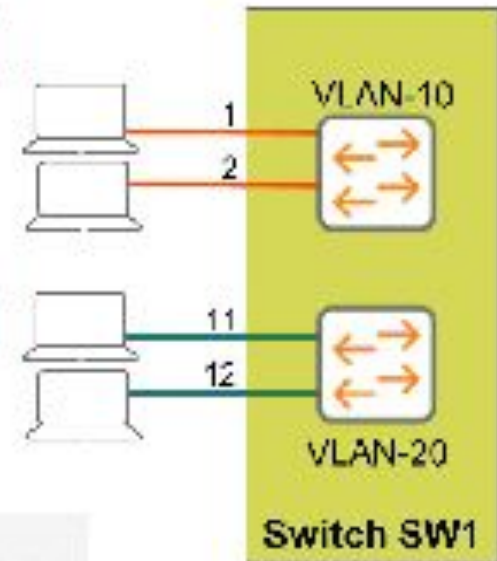
```
SW1# show vlan
--------------------------------------------------------------------
VLAN   Name              Status   Reason   Type        Interfaces

1      DEFAULT_VLAN_1    up       ok       default     various interfaces
10     Sales             up       ok       static      1/1/1 - 1/1/2
20     Service           up       ok       static      1/1/11 1/1/12
```

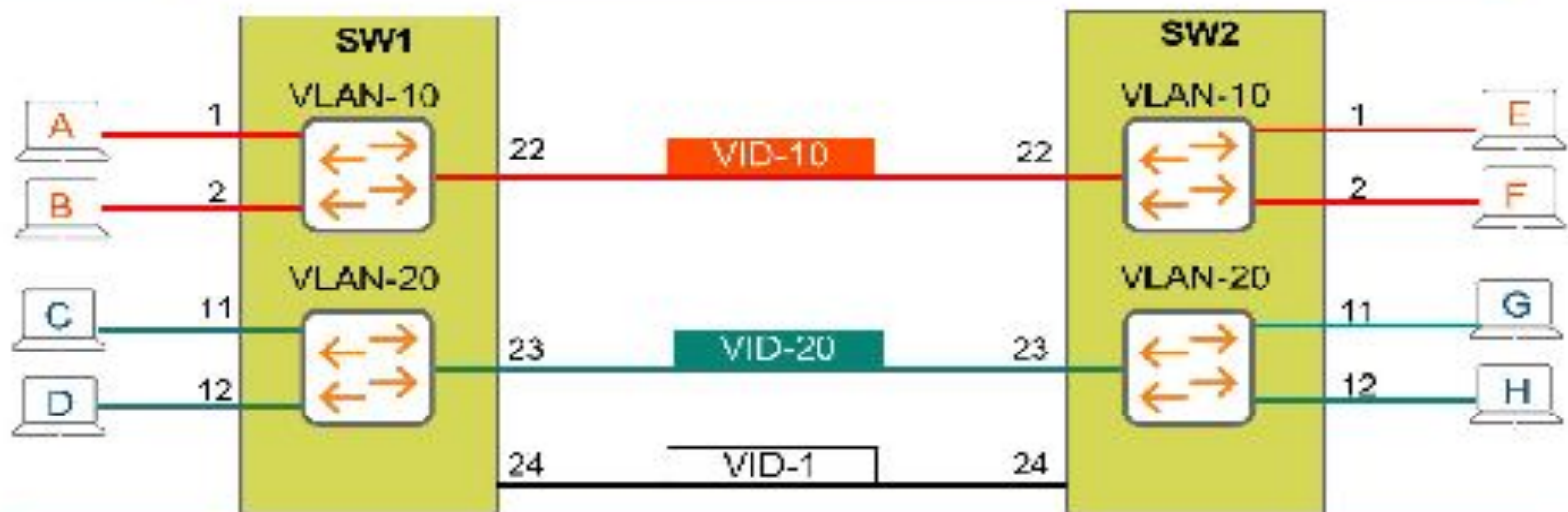VLAN-10

VLAN-20

Switch SW1

The rest of the ports are still mapped to VLAN1

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Access Ports

those other AOS-CX switches areLayer-3. To convert these interfaces to Layer-2 mode, use the command "no routing."

Extending VLAN Across Multiple Switches

Problem You must extend VLANs over multiple switches using one port.

SW1

VLAN-10
A — 1
B — 2
22 — VID-10

VLAN-20
C — 11
D — 12
23 — VID-20

24 — VID-1

SW2

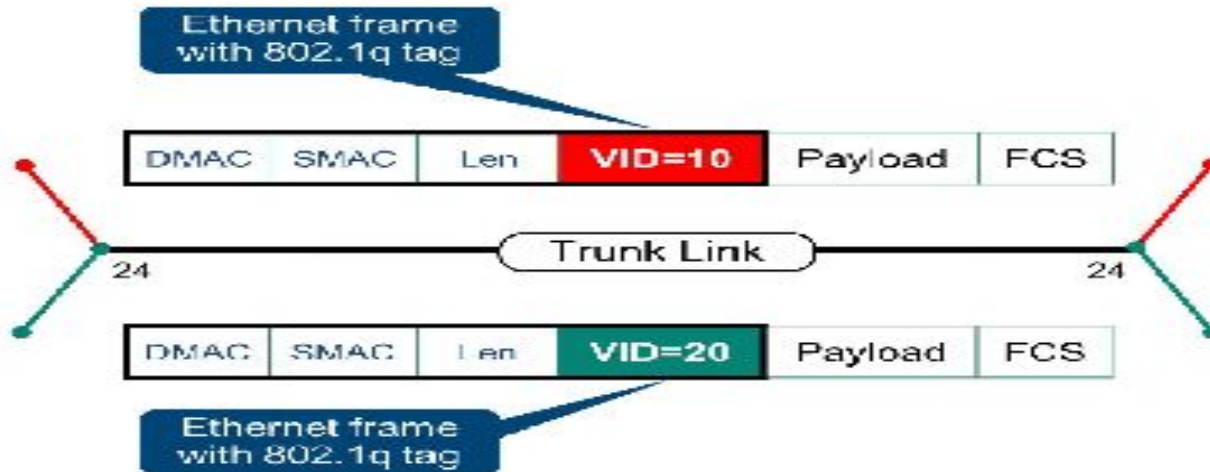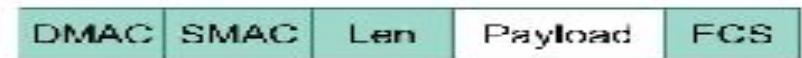VLAN-10
22 — 1 — E
2 — F

VLAN-20
23 — 11 — G
12 — H

24

You used TWO ports for inter-switch VLAN connections – not scalable!

Extending VLAN Across Multiple Switches

We need a way to use one single physical port to connect multiple VLANs.
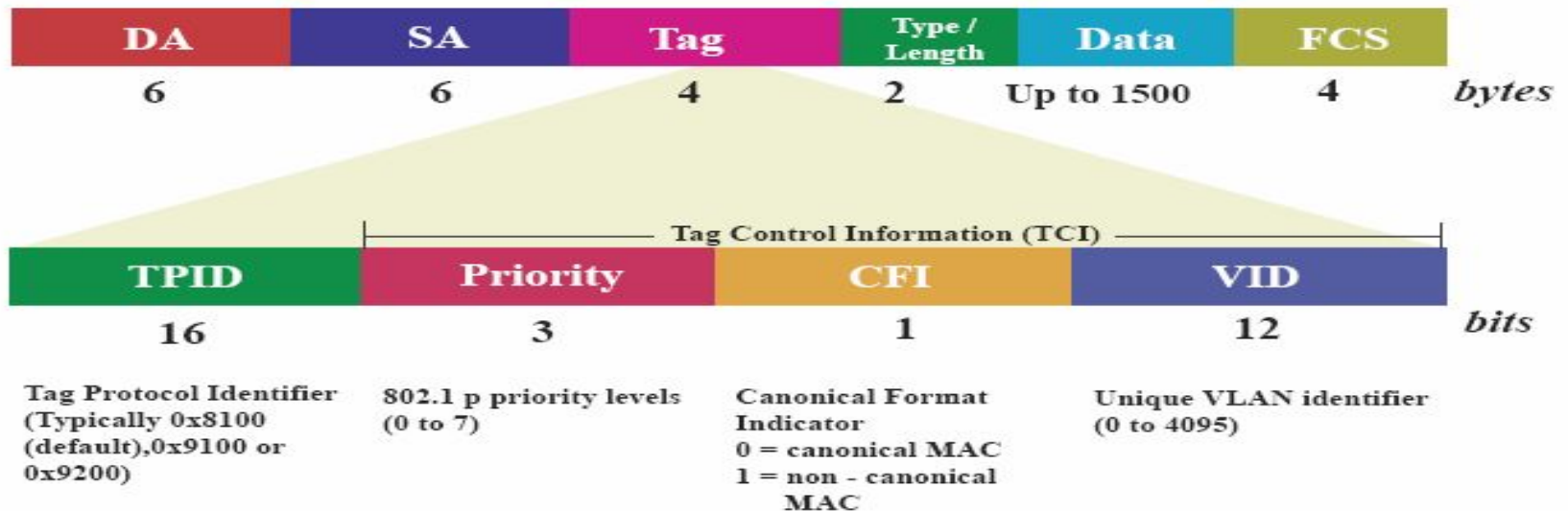
802.1Q Tagging

DMAC	SMAC	Len	Payload	FCS

Ethernet frame
with 802.1q tag

DMAC	SMAC	Len	**VID=10**	Payload	FCS

Trunk Link

24   24

DMAC	SMAC	Len	**VID=20**	Payload	FCS

Ethernet frame
with 802.1q tag

One trunk link carry traffic of multiple VLANs

802.1Q Tagging

This standard adds an additional 4 bytes field, the 802.1Q Tag field.
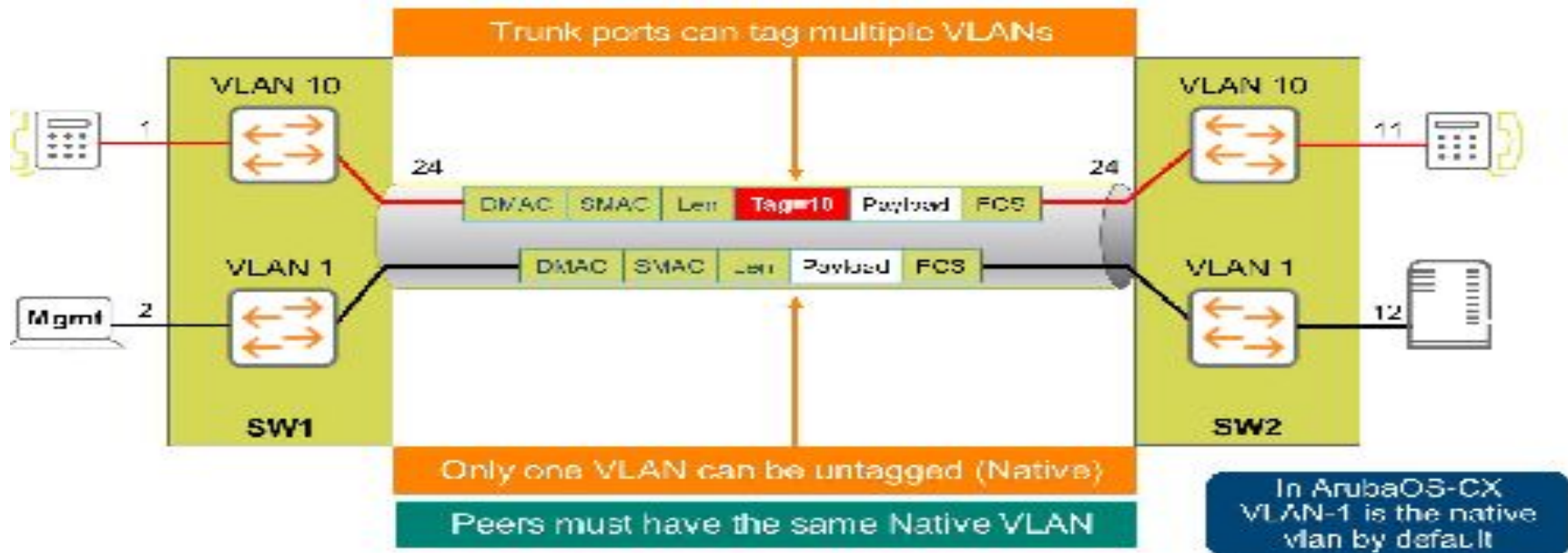
802.1Q Tagging

This frame is for VLAN 10

This frame is for VLAN 20

Thus, you can now extend the VLAN concept across multiple switches, using a single physical port.

802.1Q Tagging

This VLAN is known as the Native VLAN or Untagged VLAN. By default, in ArubaOS-CX VLAN 1 is considered the native VLAN.

Configure VLAN Trunks: Allowed VLANs

```
SW1(config)# interface 1/1/24
SW1(config-if)#VLAN trunk allow 1,10,20
```
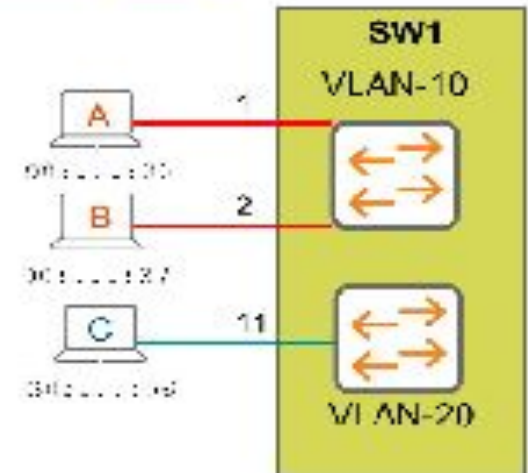

Forward frames based on Destination MAC   Build MAC table based on Source MAC

| Destination MAC | Source MAC | Len | Payload | FCS |

```
Sw1# show mac-address
MAC age-time              : 300 seconds
Number of MAC addresses   : 3

MAC address          VLAN    Type      Port
00:20:02:bc:ee:00     10    dynamic    1/1/1
00:0b:b6:b1:ee:b7     10    dynamic    1/1/2
00:80:59:a4:84:00     20    dynamic    1/1/1
```

Entry timeout = 300s

SW1
VLAN-10
A   1
B   2
C   11
VLAN-20

Configure VLAN Trunks: Allowed VLANs

```
SW1# Show VLAN Port 1/1/24

------------------------------------------------------------------------

VLAN          Name                    Mode              Mapping

------------------------------------------------------------------------

1             DEFAULT_VLAN_1          native-untagged   port

10            Sales                   trunk             port

20            Service                 trunk             port
```

Configure VLAN Trunks-Native VLAN

```
SW1(config)# interface 1/1/24
SW1(config-if)# VLAN Trunk native 10
```

1	DEFAULT VLAN 1	trunk	port
10	Sales	native-untagged	port
20	service	trunk	port

Address Resolution Protocol (ARP)

At this point, Address Resolution Protocol (ARP) becomes involved in the process.

ARP is used to convert an IP address to a physical address

ARP Request

says "Who has 192.168.1.2 and what is your MAC address?"

broadcast MAC address for the destination (FF:FF:FF:FF:FF:FF).

ARP Request
Destination MAC: FF:FF:FF:FF:FF:FF

Computer A
192.168.1.1
MAC: AAA

Computer B
192.168.1.2
MAC: BBB

33
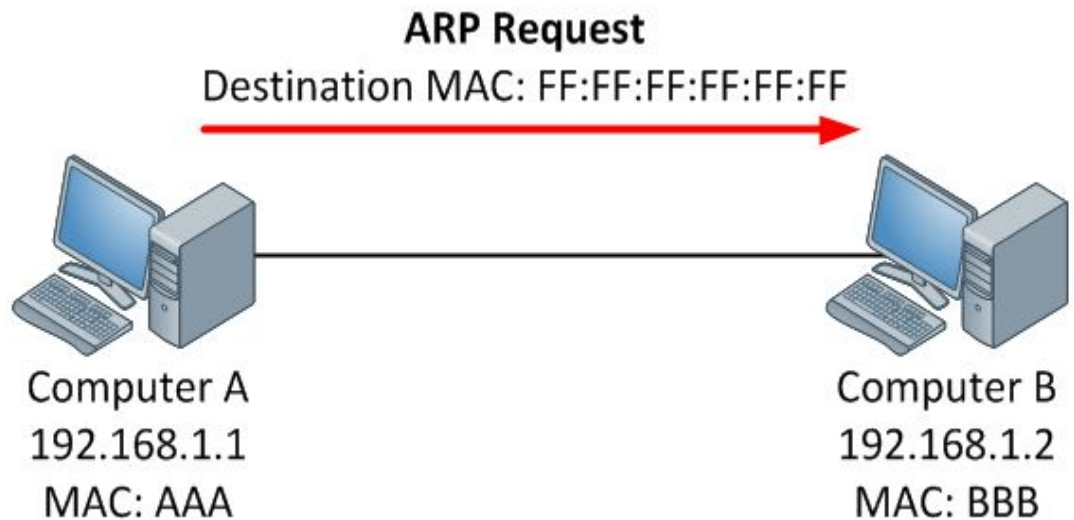
ARP Reply

"That's me! And this is my MAC address".

ARP Reply
Source MAC: BBB
Destination MAC: AAA

Computer A
192.168.1.1
MAC: AAA

Computer B
192.168.1.2
MAC: BBB
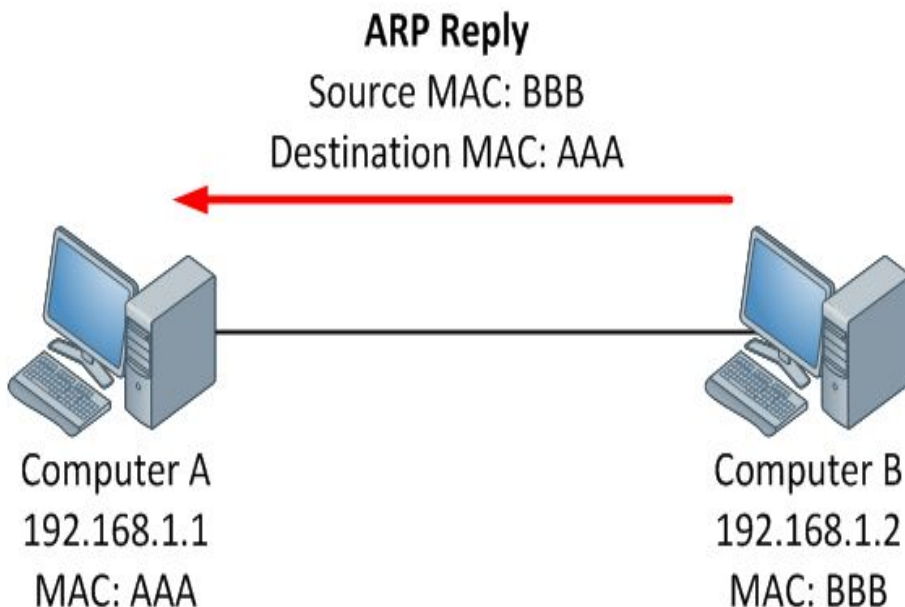
keeps a table of recently used hardware and IP addresses in memory, called the ARP cache

after

20 minutes

Address Resolution Protocol (ARP)
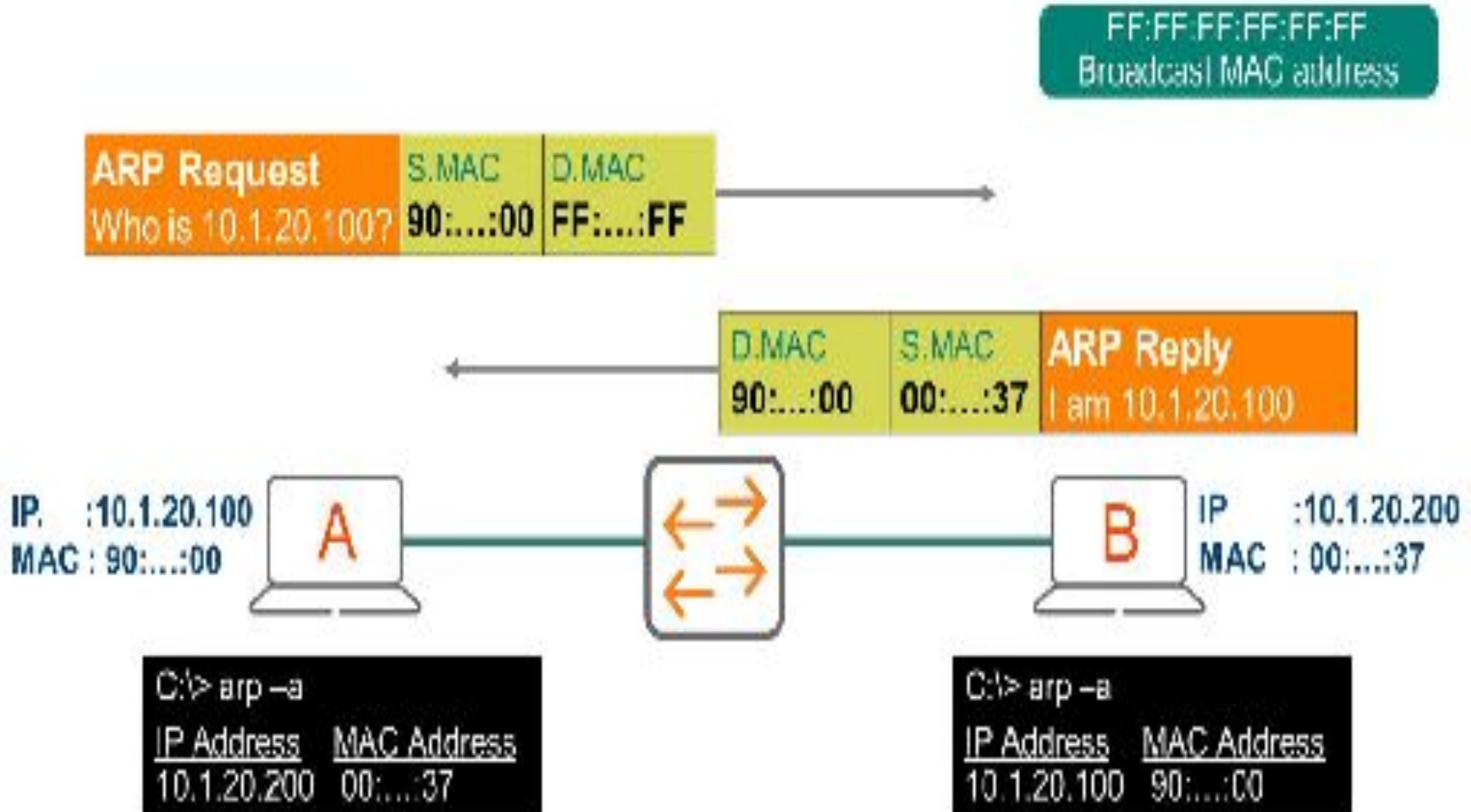
ARP Packet Format
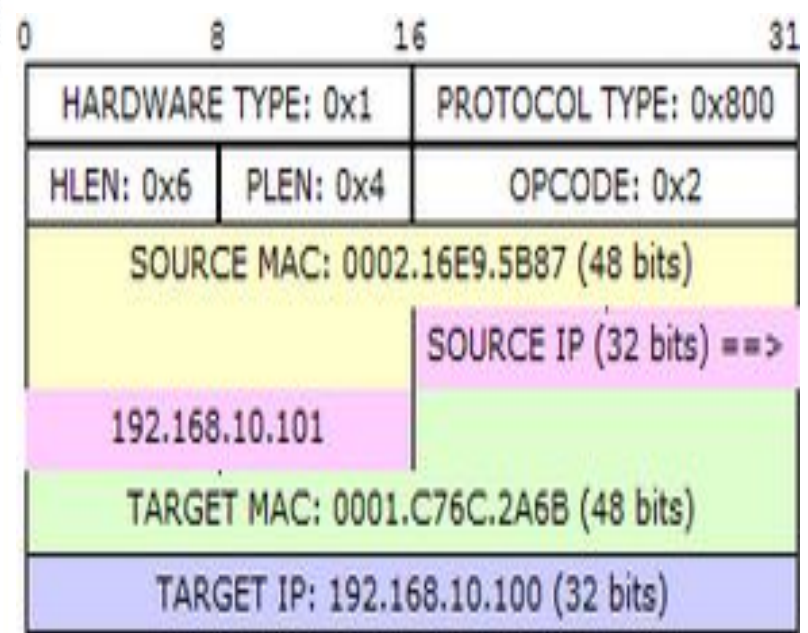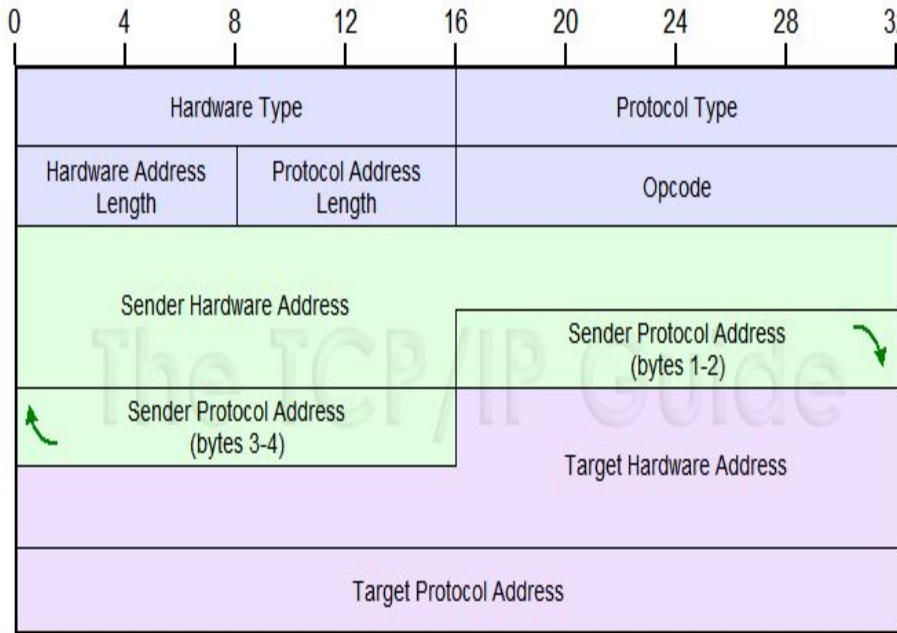
Hardware Type		Protocol Type	
Hardware Address Length	Protocol Address Length	Opcode	
Sender Hardware Address			
		Sender Protocol Address (bytes 1-2)	
Sender Protocol Address (bytes 3-4)			
		Target Hardware Address	
Target Protocol Address			

HARDWARE TYPE: 0x1		PROTOCOL TYPE: 0x800
HLEN: 0x6	PLEN: 0x4	OPCODE: 0x2
SOURCE MAC: 0002.16E9.5B87 (48 bits)		
		SOURCE IP (32 bits) ==>
192.168.10.101		
TARGET MAC: 0001.C76C.2A6B (48 bits)		
TARGET IP: 192.168.10.100 (32 bits)		

hw type	sender hw addr
protocol type	sender ip
hwlen plen,	target hw address
operation	target ip

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VLANs

Configure a VLAN

Access-1
6300-A

1/1/1   1/1/3

PC-1   PC-3
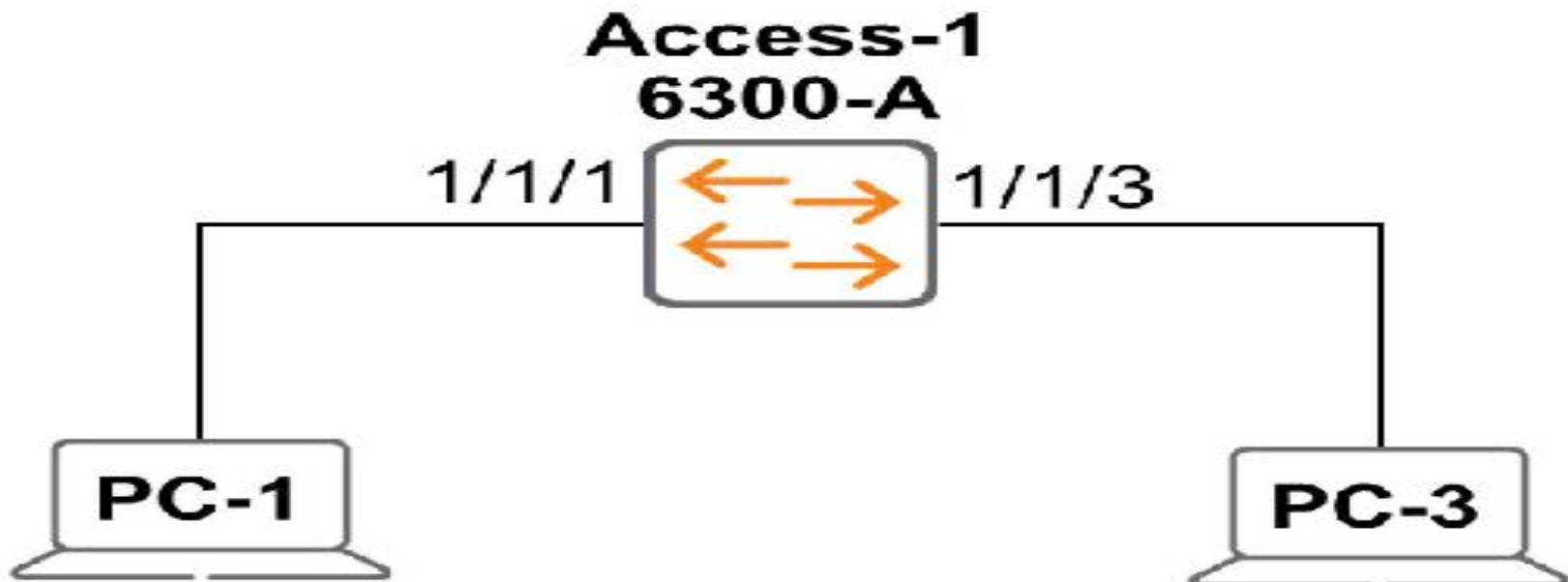
Configure a VLAN

```
T11 Access 1# show VLAN

---------------------------------------------------------------
---------------
VLAN   Name                            Status   Reason              Type
Interfaces

---------------------------------------------------------------
1      DEFAULT_VLAN_1                  up       ok                  default
1/1/1-1/1/28

T11-Access-1#
```

Configure a VLAN

```
T11-Access-1# configure terminal
T11-Access-1(config)# VLAN1111
T11-Access-1(config-VLAN-1111)# name EMPLOYEES
T11-Access-1(config-VLAN-1111)# exit
```

```
T11 Access 1(config)# Show VLAN
--------------------------------------------------------------------------------
--------------
VLAN   Name                              Status   Reason                Type
Interfaces
--------------------------------------------------------------------------------


1      DEFAULT_VLAN_1                    up       ok                    default
1/1/1-1/1/28
1111   EMPLOYEES                        down     no_member_port  static
T11-Access-1(config)#
```

Configure a VLAN

```
T11-Access-1(config)# interface 1/1/1
T11-Access-1(config-if)# VLAN access 1111
T11-Access-1(config-if)# interface 1/1/3
T11-Access-1(config-if)# VLAN access 1111
T11-Access-1(config-if)# exit
```

```
T11 Access 1(config)# Show VLAN

-----------------------------------------------------------------
-------------
VLAN   Name                          Status   Reason                 Type
Interfaces
-----------------------------------------------------------------

1      DEFAULT_VLAN_1                down     no_member_forwarding   default
1/1/2,1/1/4-1/1/28

1111   EMPLOYEES                     up       ok                     static
1/1/1,1/1/3

T11-Access-1(config)#
```

Configure a VLAN

```
T11-Access-1(config)# Show VLAN Port 1/1/1

-------------------------------------------------------------------

VLAN    Name                              Mode            Mapping

-------------------------------------------------------------------

1111    EMPLOYEES                         access          port

T11-Access-1(config)#
```

```
T11-Access-1(config)# Show VLAN Summary
Number of existing VLANs: 2
Number of static VLANs: 2
Number of dynamic VLANs: 0
```
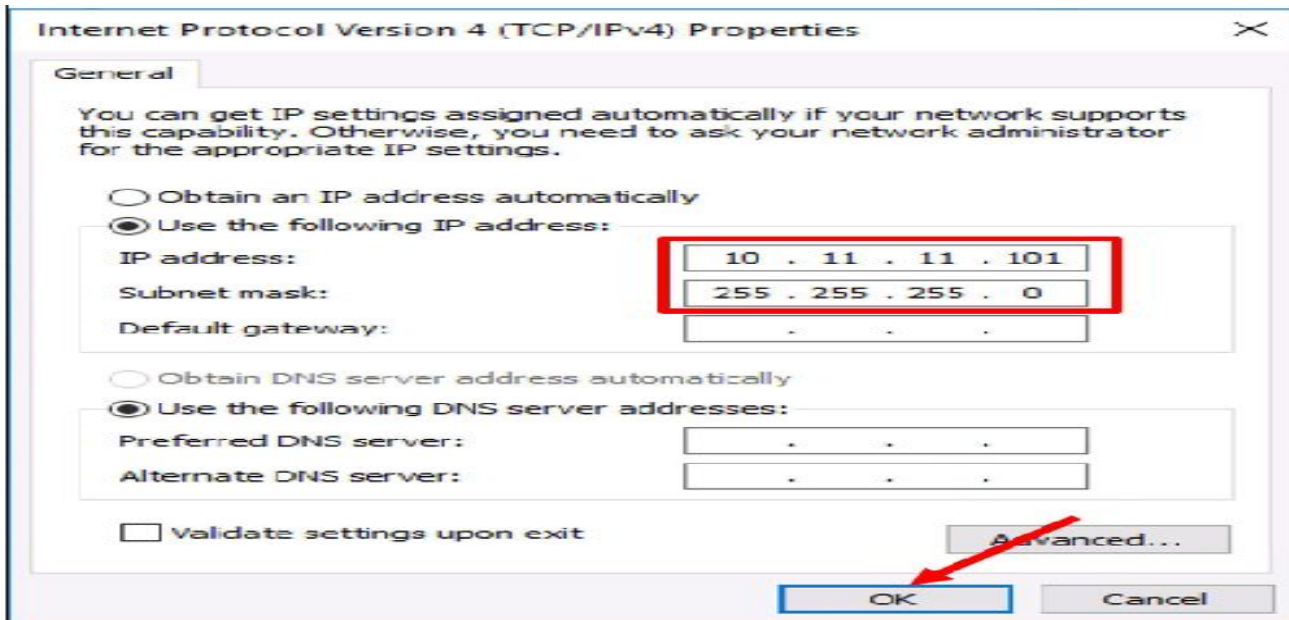
Configure a VLAN

```
T11-Access-1(config)# show interface 1/1/1
Interface 1/1/1 is up
      Admin state is up
      Link transitions: 1t
      Description: TO_PC-1
      Hardware: Ethernet, MAC Address: 88:3a:30:98:30:27
      MTU 1500
      Type 1GbT
Full-duplex
      qos trust none
      Speed 1000 Mb/s
      Auto-negotiation is on
      Flow-control: off
      Error-control: off
      MDI mode: MDIX
VLAN Mode: access
      Access VLAN: 1111
```

Configure a VLAN

Add a Second Switch to the Topology
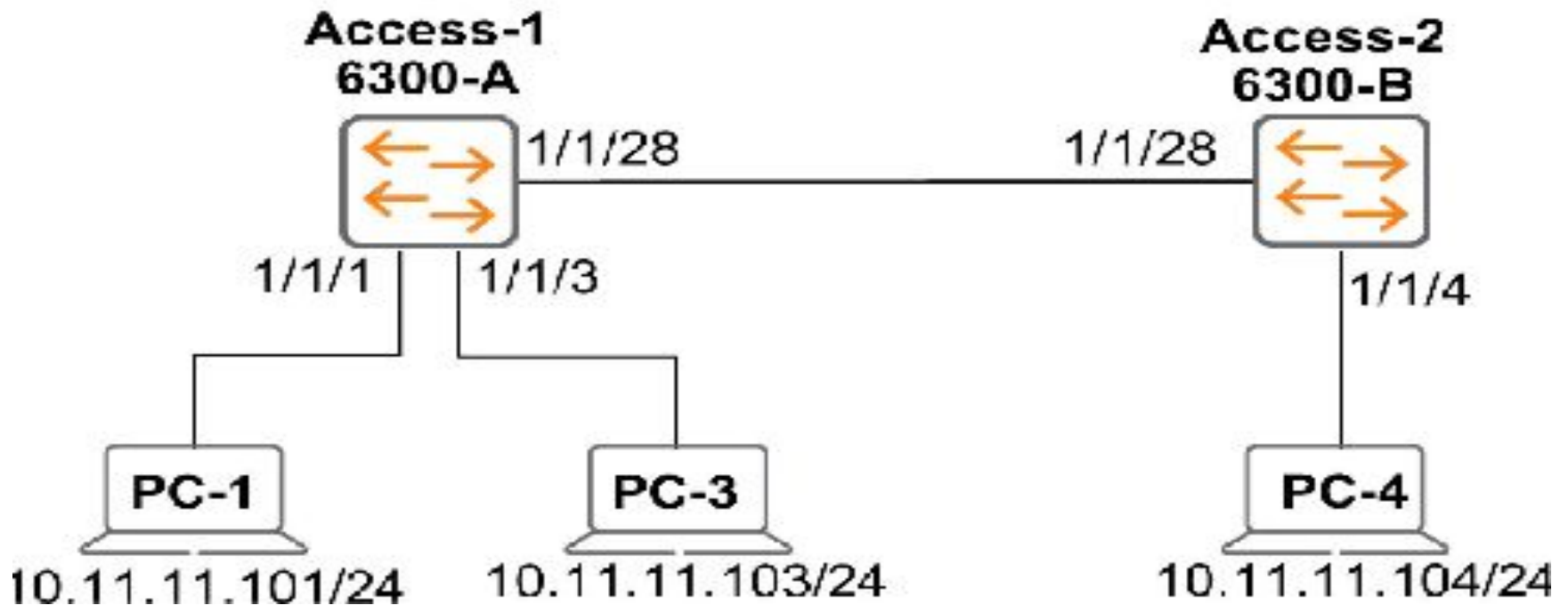
Add a Second Switch to the Topology

1. Configure the initial settings on T11-Access-2

admin   no password

```
6300# configure terminal
6300(config)# hostname T11-Access-2
T11-Access-2(config)# session-timeout 1440
T11-Access-2(config)#
```

```
T11-Access-2(config-if-<1/1/2-1/1/28>)# shutdown
T11-Access-2(config-if-<1/1/2-1/1/28>)# exit
```

Add a Second Switch to the Topology

```
T11-Access-2(config)# interface 1/1/4
T11-Access-2(config-if)# description TO_PC-4
```

```
T11-Access-2(config-if)# no shutdown
T11-Access-2(config-if)# exit
```

Add a Second Switch to the Topology

7. Enable Link Between Access Switches.

```
T11-Access-1# configure terminal
T11-Access-1(config)# interface 1/1/28
T11-Access-1(config-if)#no shutdown
T11-Access-1(config-if)#end
```

```
T11-Access-2# configure terminal
T11-Access-2(config)# interface 1/1/28
T11-Access-2(config-if)#no shutdown
T11-Access-2(config-if)#end
```

Add a Second Switch to the Topology

```
T11-Access-1# configure terminal
T11-Access-1(config)# interface 1/1/28
T11-Access-1(config-if)# description TO_T8-ACCESS-2_PORT-28
T11-Access-1(config-if)# end
T11-Access-2# configure terminal
T11-Access-2(config)# interface 1/1/28
T11-Access-2(config-if)# description TO_T11-ACCESS-1_PORT-28
T11-Access-2(config-if)# end
```

```
Microsoft Windows [Version 10.0.17134.441]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\student>ping 10.11.11.101

Pinging 10.11.11.101 with 32 bytes of data:
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.

Ping statistics for 10.11.11.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

C:\Users\student>
```

Add a Second Switch to the Topology

12. Extend Connectivity for VLAN 1111

```
T11-Access-1# configure terminal
T11-Access-1(config)#interface1/1/28
T11-Access-1(config-if)# VLAN Trunk allowed 1,1111
T11-Access-1(config-if)# end
```

```
T11 Access 1# show interface trunk

----------------------------------------------------------

Port     Native VLAN Trunk VLANs

----------------------------------------------------------

1/1/28   1              1,1111
```

Add a Second Switch to the Topology

```
T11-Access-2# configure terminal
T11-Access-2(config)# VLAN 1111
T11-Access-2(config-VLAN-1111)# name EMPLOYEES
T11-Access-2(config-VLAN-1111)# exit
```

```
T11-Access-2(config)# interface 1/1/28
T11-Access-2(config-if)# VLAN trunk allowed 1,1111
T11-Access-2(config-if)# exit
```

```
T11-Access-2(config)# interface 1/1/4
T11-Access-2(config-if)# VLAN access 1111
T11-Access-2(config-if)# end
```

Add a Second Switch to the Topology

```
T11 Access 2# show interface trunk

--------------------------------------------------------------------

Port      Native VLAN Trunk VLANs

--------------------------------------------------------------------

1/1/28    1               1,1111
```

```
Microsoft Windows [Version 10.0.17134.441]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\student>ping 10.11.11.103

Pinging 10.11.11.103 with 32 bytes of data:
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.
Reply from 10.11.11.104: Destination host unreachable.

Ping statistics for 10.11.11.103:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

C:\Users\student>ping 10.11.11.103

Pinging 10.11.11.103 with 32 bytes of data:
Reply from 10.11.11.103: bytes=32 time=1ms TTL=128
Reply from 10.11.11.103: bytes=32 time<1ms TTL=128
Reply from 10.11.11.103: bytes=32 time<1ms TTL=128
Reply from 10.11.11.103: bytes=32 time<1ms TTL=128

Ping statistics for 10.11.11.103:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\Users\student>
```

Add a Second Switch to the Topology

```
T11-Access-1# write memory
Configuration changes will take time to process, please be patient.
T11-Access-2# write memory
Configuration changes will take time to process, please be patient.
```

```
T11-Access-1# copy running-config checkpoint Lab4-2_final
Configuration changes will take time to process, please be patient.
T11-Access-1#
T11-Access-2# copy running-config checkpoint Lab4-2_final
Configuration changes will take time to process, please be patient.
T11-Access-2#
```

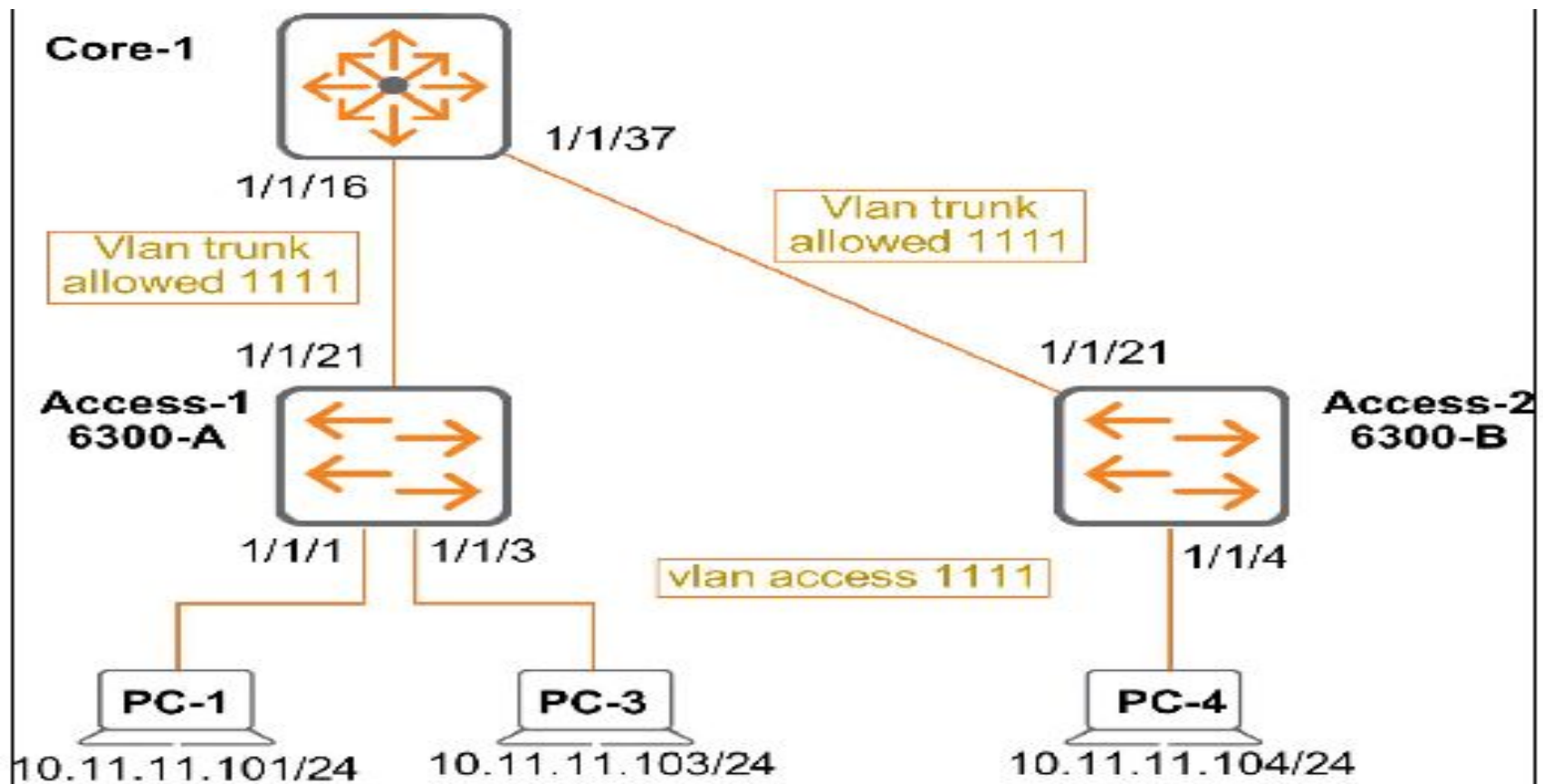# Add a Core Switch to the Topology
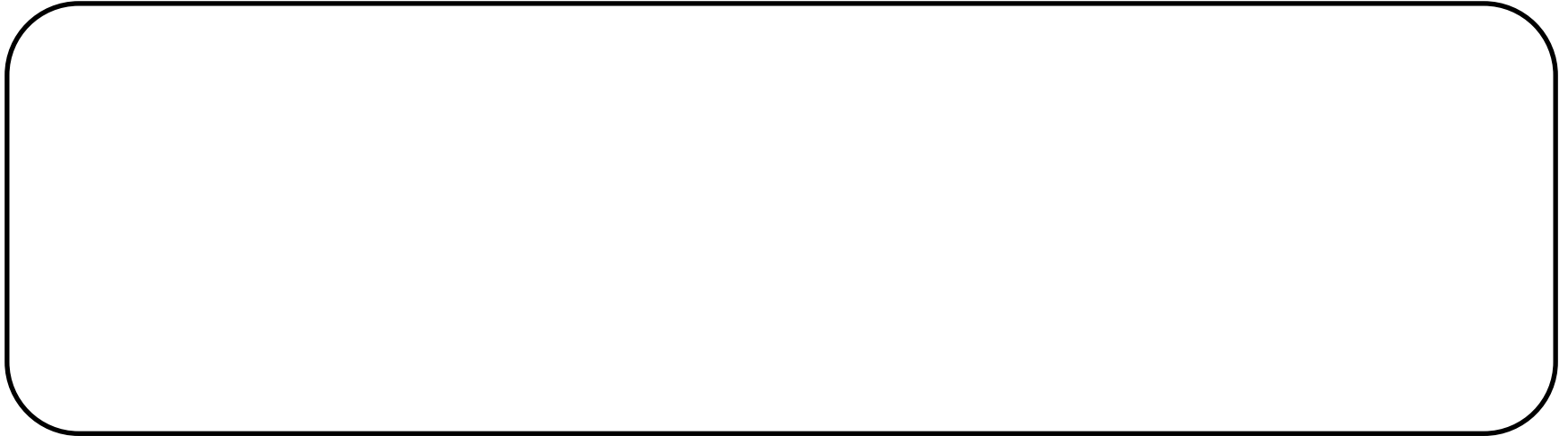
Add a Core Switch to the Topology

- **Deploy a Core Switch to the topology**
- **Configure uplinks as trunk ports by enabling 802.1Q**
- **Add anew VLAN for another users' type**
- **Enable DHCP server on Access-1**

Add a Core Switch to the Topology

Add a Core-1 to the Topology

Add a Core Switch to the Topology

Add a Core Switch to the Topology

Access-1   **Access-2**

```
T11-Access-1# configure terminal
T11-Access-1(config)# interface 1/1/28
T11-Access-1(config-if)# shutdown
T11-Access-2# configure terminal
T11-Access-2(config)# interface 1/1/28
T11-Access-2(config-if)# shutdown
```

Access-1

```
T11-Access-1(config)# interface 1/1/21
T11-Access-1(config-if)# VLAN trunk allowed 1,1111
T11-Access-1(config-if)# no shutdown
```

Add a Core Switch to the Topology

Access-1

```
T11 Access 1(config if)# show LLDP neighbor-info

LLDP Neighbor Information
============================

Total Neighbor Entries          : 2

Total Neighbor Entries Deleted  : 1

Total Neighbor Entries Dropped  : 0

Total Neighbor Entries Aged-Out : 1

LOCAL-PORT    CHASSIS-ID            PORT-ID        PORT-DESC        TTL
SYS-NAME

-----------------------------------------------------------------------

1/1/21        90:20:c2:bc:ed:00    1/1/16         1/1/16           120
Core-1
```

Access-1

```
T11-Access-1(config-if)# description TO_CORE-1_PORT-16
```

Add a Core Switch to the Topology

Access-2

```
T11-Access-2(config)# interface 1/1/21
T11-Access-2(config-if)# VLAN trunk allowed 1111
T11-Access-2(config-if)# no shutdown
```

```
T11 Access 2(config if)# show LLDP neighbor-info

LLDP Neighbor information

===========================

Total Neighbor Entries            : 2

Total Neighbor Entries Deleted    : 1

Total Neighbor Entries Dropped    : 0

Total Neighbor Entries Aged-Out   : 1

LOCAL PORT    CHASSIS ID            PORT ID          PORT DESC       TTL
SYS-NAME
----------------------------------------------------------------------------
1/1/21        90:20:n2:bn:ed:00     1/1/37           1/1/37          120
Core-1
```

Access-2

```
T11-Access-2(config-if)# description TO_CORE-1_PORT-37
```

Add a Core Switch to the Topology

Core-1

```
Core 1# show LLDP neighbor-info | include T11

1/1/16        88:3a:30:98:30:00   1/1/21        1/1/21        120
T11-Access-1

1/1/37        88:3a:30:97:a4:40   1/1/22        1/1/22        120
T11 Access 2
```

```
Core-1# configure terminal
Core-1(config)# VLAN 1111
Core-1(config-VLAN-1111)# name T11_EMPLOYEES
Core-1(config-VLAN-1111)# exit
```

Add a Core Switch to the Topology

Core-1(config)# **interface 1/1/16**

Core-1(config-if)# **description TO_T11-ACCESS-1_PORT-21**

Core-1(config-if)#**VLAN trunk allowed 1111**

Core-1(config)# **interface 1/1/37**

Core-1(config-if)# **description TO_T11-ACCESS-2_PORT-21**

Core-1(config-if)#**VLAN trunk allowed 1111**

Add a Core Switch to the Topology


```
Microsoft Windows [Version 16.0.17134.441]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\student>ping 10.11.11.104

Pinging 10.11.11.104 with 32 bytes of data:
Reply from 10.11.11.104: bytes=32 time=1ms TTL=128
Reply from 10.11.11.104: bytes=32 time=1ms TTL=128
Reply from 10.11.11.104: bytes=32 time=1ms TTL=128
Reply from 10.11.11.104: bytes=32 time=1ms TTL=128

Ping statistics for 10.11.11.104:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\Users\student>
```

Add a Core Switch to the Topology

Adding a Second VLAN

Add a Core Switch to the Topology
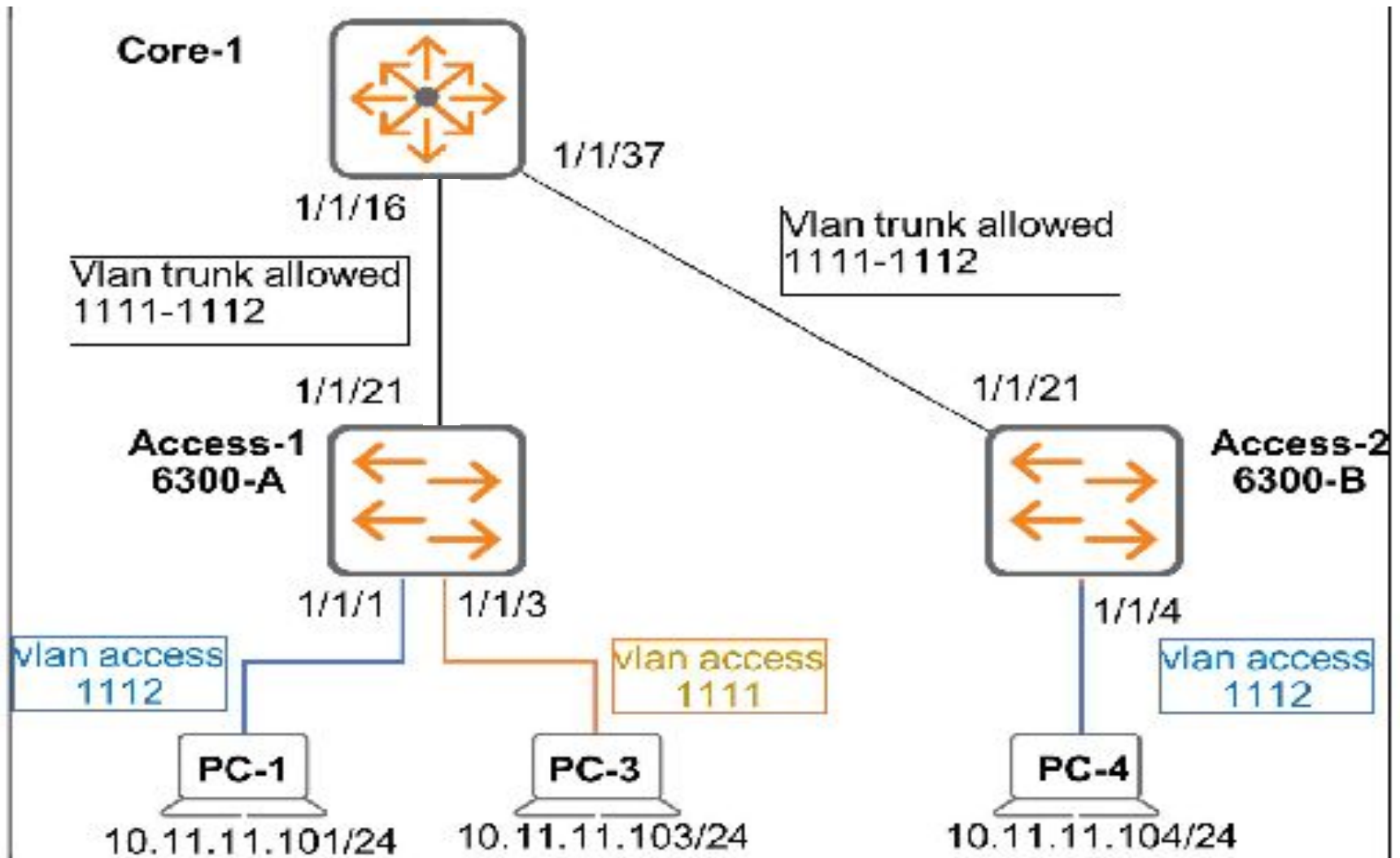
Add a Core Switch to the Topology

Access-1

```
T11-Access-1# configure terminal
T11-Access-1(config)# VLAN 1112
T11-Access-1(config-VLAN-1112)# name MANAGERS
T11-Access-1(config-VLAN-1112)# exit
T11-Access-1(config)# interface 1/1/21
T11-Access-1(config-if)# VLAN trunk allowed 1112
T11-Access-1(config-if)# exit
```

```
T11 Access 1(config)# show VLAN
-----------------------------------------------------------------------
VLAN    Name                        Status    Reason                      Type
Interfaces
-----------------------------------------------------------------------
1       DEFAULT_VLAN_1.             down      no_member_forwarding        default
1/1/2,1/1/4-1/1/20,1/1/22-1/1/28

1111    EMPLOYEES                   up        ok                          static
1/1/1,1/1/3,1/1/21,1/1/28

1112    MANAGERS                    up        ok                          static
1/1/21
```

Add a Core Switch to the Topology

Access-2

```
T11-Access-2# configure terminal
T11-Access-2(config)# VLAN1112
T11-Access-2(config-VLAN-1112)# name MANAGERS
T11-Access-2(config-VLAN-1112)# exit
T11-Access-2(config)#
T11-Access-2(config)# interface 1/1/21
T11-Access-2(config-if)# VLAN trunk allowed 1112
T11-Access-2(config-if)# exit
T11-Access-2(config)#
```

Add a Core Switch to the Topology

Core-1

```
Core-1# configure terminal
Core-1(config)# VLAN 1112
Core-1(config-VLAN-1112)# name T11_MANAGERS
Core-1(config-VLAN-1112)# exit
```

```
Core-1(config)# interface 1/1/16
Core-1(config-if)# VLAN trunk allowed 1112
```

```
Core-1(config)# interface 1/1/37
Core-1(config-if)# VLAN trunk allowed 1112
```

Add a Core Switch to the Topology

Access-1

```
T11-Access-1(config)# interface 1/1/1
T11-Access-1(config-if)# VLAN access 1112
```

Access-2

```
T11-Access-2(config)# interface 1/1/4
T11-Access-2(config-if)# VLAN access 1112
T11-Access-2(config-if)#
```

PC-1

PC-4

Add a Core Switch to the Topology

PC-4   **PC-1**

Add a Core Switch to the Topology

PC-4   PC-3

Add a Core Switch to the Topology

```
T11-Access-1# write memory
Configuration changes will take time to process, please be patient.
T11-Access-2# write memory
Configuration changes will take time to process, please be patient.
Core-1# write memory
Configuration changes will take time to process, please be patient.
```

```
T11-Access-1# copy running-config checkpoint Lab4-3_final
Configuration changes will take time to process, please be patient.
T11-Access-2# copy running-config checkpoint Lab4-3_final
Configuration changes will take time to process, please be patient.
```