Virtual LANs (VLANs)

What is a VLAN?

Why Use a VLAN?

How Does A VLAN Work?

Virtual LANs (VLANs)

What is a VLAN?

A "LAN" that has the appearance of being real but is not.

A network (subnet) definition where computers are logically assigned to LAN segments by soft-ware rather than by their physical connection to hubs, switches, bridges, or routers.
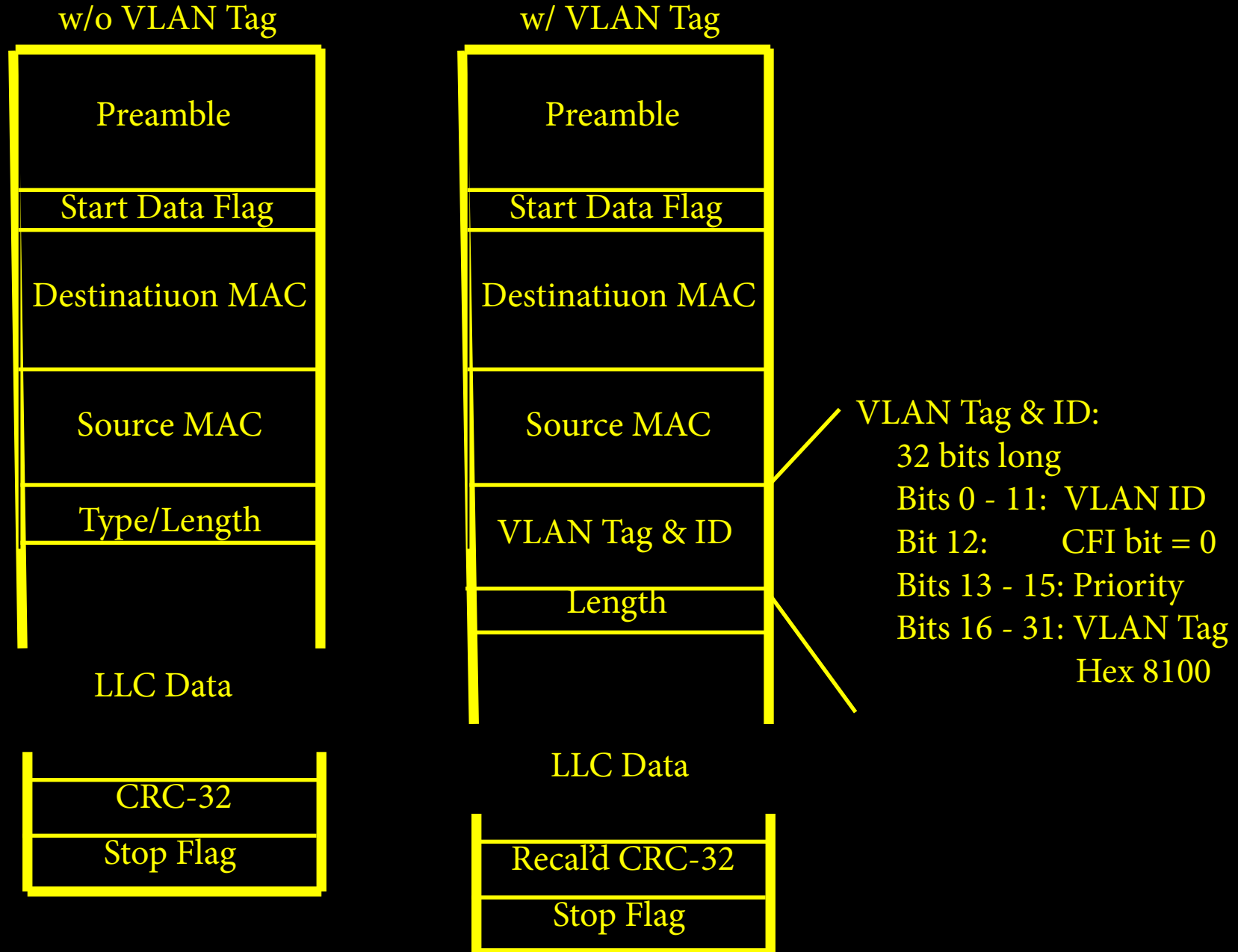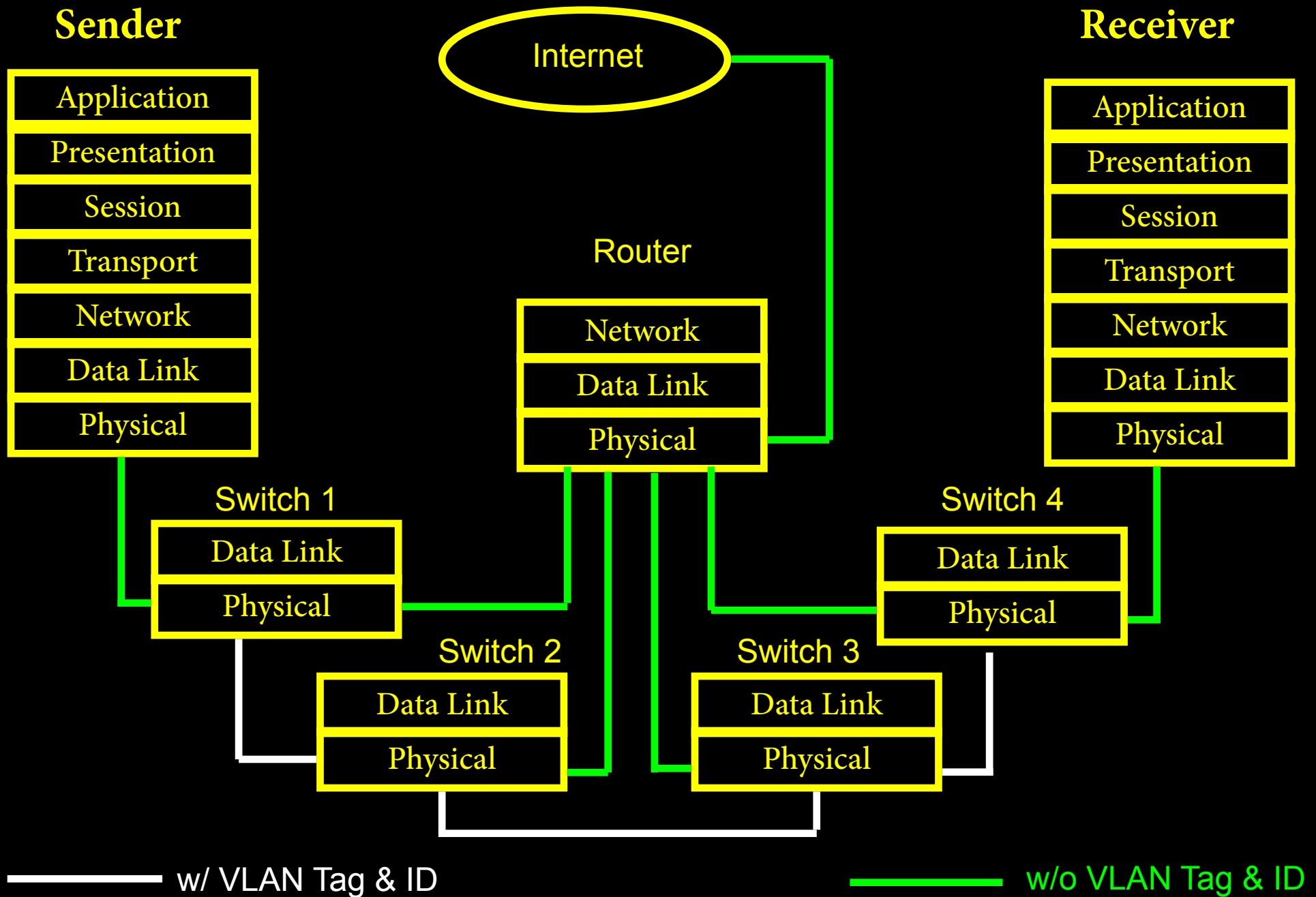
Virtual LANs (VLANs)

Why Use a VLAN?

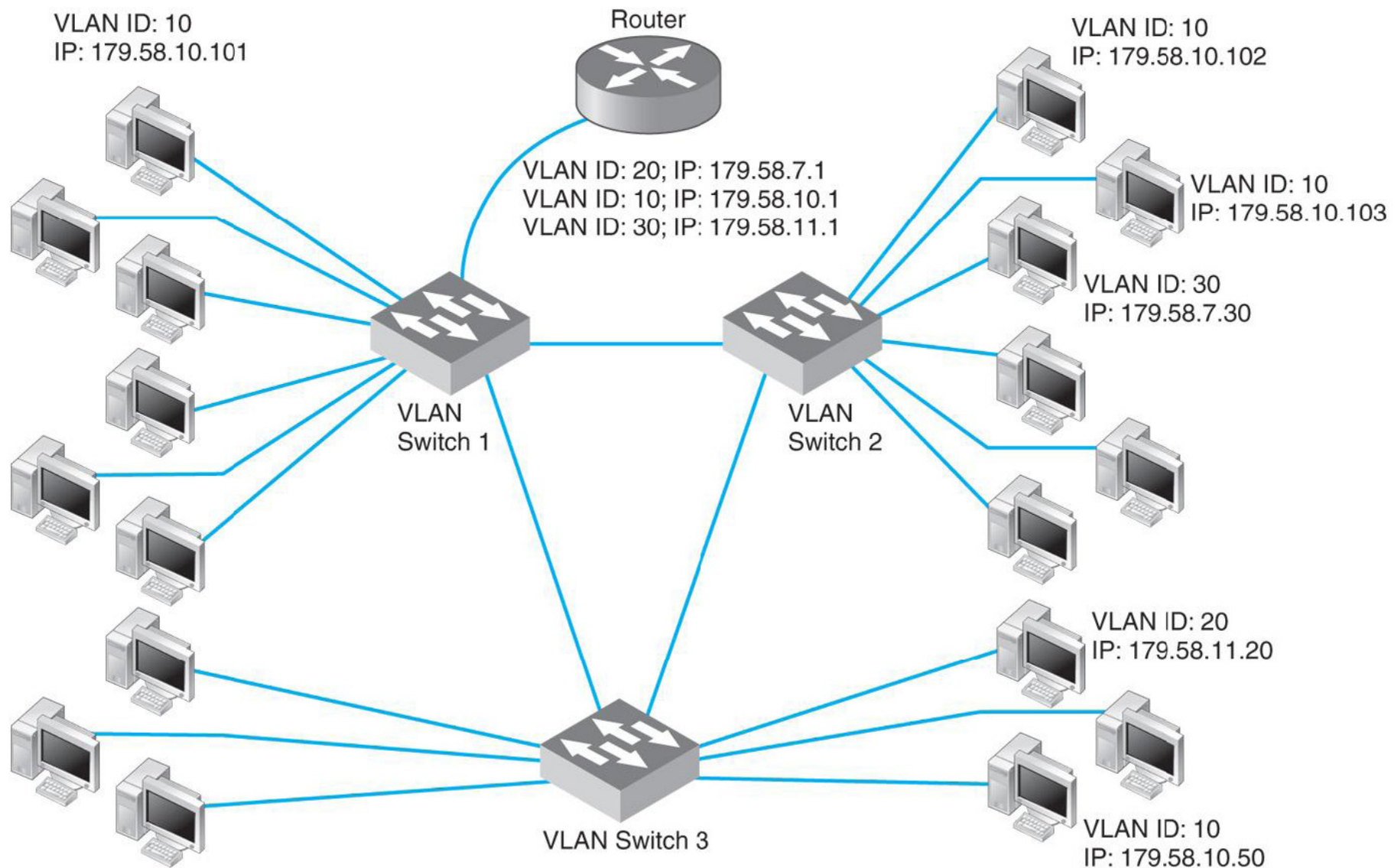Enables LAN definition of users with similar function, regardless of geographic location

Enables uniform management across all users of a similar function, regardless of geographic location

Ethernet Frame

w/o VLAN Tag

Preamble
Start Data Flag
Destinatiuon MAC
Source MAC
Type/Length

LLC Data

CRC-32
Stop Flag

w/ VLAN Tag

Preamble
Start Data Flag
Destinatiuon MAC
Source MAC
VLAN Tag & ID
Length

VLAN Tag & ID:
32 bits long
Bits 0 - 11: VLAN ID
Bit 12:   CFI bit = 0
Bits 13 - 15: Priority
Bits 16 - 31: VLAN Tag
              Hex 8100

LLC Data

Recal'd CRC-32
Stop Flag

VLAN Tags & ID Used Only Between VLAN Switches

Sender

Receiver

Internet

Application
Presentation
Session
Transport
Network
Data Link
Physical

Application
Presentation
Session
Transport
Network
Data Link
Physical

Router

Network
Data Link
Physical

Switch 1

Data Link
Physical

Switch 4

Data Link
Physical

Switch 2

Data Link
Physical

Switch 3

Data Link
Physical

——— w/ VLAN Tag & ID

——— w/o VLAN Tag & ID

VLAN ID: 10
IP: 179.58.10.101

Router

VLAN ID: 10
IP: 179.58.10.102

VLAN ID: 20; IP: 179.58.7.1
VLAN ID: 10; IP: 179.58.10.1
VLAN ID: 30; IP: 179.58.11.1

VLAN ID: 10
IP: 179.58.10.103

VLAN ID: 30
IP: 179.58.7.30

VLAN
Switch 1

VLAN
Switch 2

VLAN ID: 20
IP: 179.58.11.20

VLAN Switch 3

VLAN ID: 10
IP: 179.58.10.50

Sender/Receiver Scenarios

1. Same VLAN same switch   179.58.10.102 to 179.58.10.103
2. Same VLAN different switch   179.58.10.102 to 179.58.10.101
3. Different VLAN same switch   179.58.10.102 to 179.58.7.30
4. Different VLAN different switch 179.58.10.102 to 179.58.11.20

Scenario 1
Same VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

Scenario 1
Same VLAN Same Switch

1.   Switch 2 receives Ethernet frame from sender w/o VLAN tags

2.   Switch 2 determines from its forwarding table that receiver is connected to switch 2

Scenario 1
Same VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

2. Switch 2 determines from its forwarding table that receiver is connected to switch 2

3. Switch 2 forwards Ethernet frame to the switch port where receiver is connected, no VLAN tag and ID created.

Scenario 2
Same VLAN Different Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

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Same VLAN Different Switch

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Same VLAN Different Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

2. Switch 2 determines from its forwarding table that receiver is connected to switch 1

3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32

Scenario 2
Same VLAN Different Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

2. Switch 2 determines from its forwarding table that receiver is connected to switch 1

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4 Switch 2 forwards reconstructed Ethernet frame on to switch 1

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2. Switch 2 determines from its forwarding table that receiver is connected to switch 1

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4. Switch 2 forwards reconstructed Ethernet frame on to switch 1

5. Switch 1 determines from its forwarding table that receiver is connected to switch 1

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Same VLAN Different Switch

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5. Switch 1 determines from its forwarding table that receiver is connected to switch 1

6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32

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Same VLAN Different Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags

2. Switch 2 determines from its forwarding table that receiver is connected to switch 1

3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32

4. Switch 2 forwards reconstructed Ethernet frame on to switch 1

5. Switch 1 determines from its forwarding table that receiver is connected to switch 1

6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32

7. Switch 1 forwards Ethernet frame to switch port where receiver is connected

1.   Switch 2 receives Ethernet frame from sender w/o VLAN tags

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router

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Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1

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4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1

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5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected

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6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32

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Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
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6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID

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Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
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4. Switch 2 is configured to send frames for the router to switch 1
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6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32

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Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 2 is connected

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 2 is connected
14. Switch 2 receives Ethernet frame w/ VLAN Tag and ID

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
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10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 2 is connected
14. Switch 2 receives Ethernet frame w/ VLAN Tag and ID
15. Switch 2 determines from its forwarding table that destination MAC is reachable from one if its switch ports

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 2 is connected
14. Switch 2 receives Ethernet frame w/ VLAN Tag and ID
15. Switch 2 determines from its forwarding table that destination MAC is reachable from one if its switch ports
16. Switch 2 rebuilds Ethernet frame w/o VLAN Tag and ID, recalculates CRC-32

Scenario 3
Different VLAN Same Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 2
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 2 is connected
14. Switch 2 receives Ethernet frame w/ VLAN Tag and ID
15. Switch 2 determines from its forwarding table that destination MAC is reachable from one if its switch ports
16. Switch 2 rebuilds Ethernet frame w/o VLAN Tag and ID, recalculates CRC-32
17. Switch 2 forwards Ethernet frame to switch port where destination MAC is connected

Scenario 4
Different VLAN Different Switch

1. Switch 2 receives Ethernet frame from sender w/o VLAN tags
2. Switch 2 recognizes destination MAC as the router
3. Switch 2 rebuilds Ethernet frame, adding VLAN Tag and ID , recalculates CRC-32
4. Switch 2 is configured to send frames for the router to switch 1
5. Switch 1 determines frame is for the router, and the router is connected to switch 1
6. Switch 1 rebuilds Ethernet frame w/o VLAN tag and ID, recalculates CRC-32
7. Switch 1 forwards Ethernet frame to switch port where router is connected
8. Router, at level 3, reads IP packet, determines destination IP is reachable via router port where switch 1 is connected
9. Router creates new Ethernet frame with destination MAC address and recalculates CRC-32
10. Router forwards Ethernet frame to switch 1 w/o VLAN Tag & ID
11. Switch 1, from its forwarding table, determines destination MAC is reachable via switch 3
12. Switch 1 reconstructs Ethernet frame with VLAN Tag & ID, recalculates CRC-32
13. Switch 1 forwards Ethernet frame to port where switch 3 is connected
14. Switch 3 receives Ethernet frame w/ VLAN Tag and ID
15. Switch 3 determines from its forwarding table that destination MAC is reachable from one if its switch ports
16. Switch 3 rebuilds Ethernet frame w/o VLAN Tag and ID, recalculates CRC-32
17. Switch 3 forwards Ethernet frame to switch port where destination MAC is connected