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Understanding VLAN Translation/Rewrites using Switches and Routers

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MTCINE #1409

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- 17 + years in IT, Network Architecture and Engineering
- **Areas of Design Focus:**
  - MikroTik integration with large multi-vendor networks
  - Design of BGP/MPLS/OSPF Service Provider Triple-Play networks
  - Design of large enterprise Data Center networks
- **Certifications**
  - MTCINE #1409
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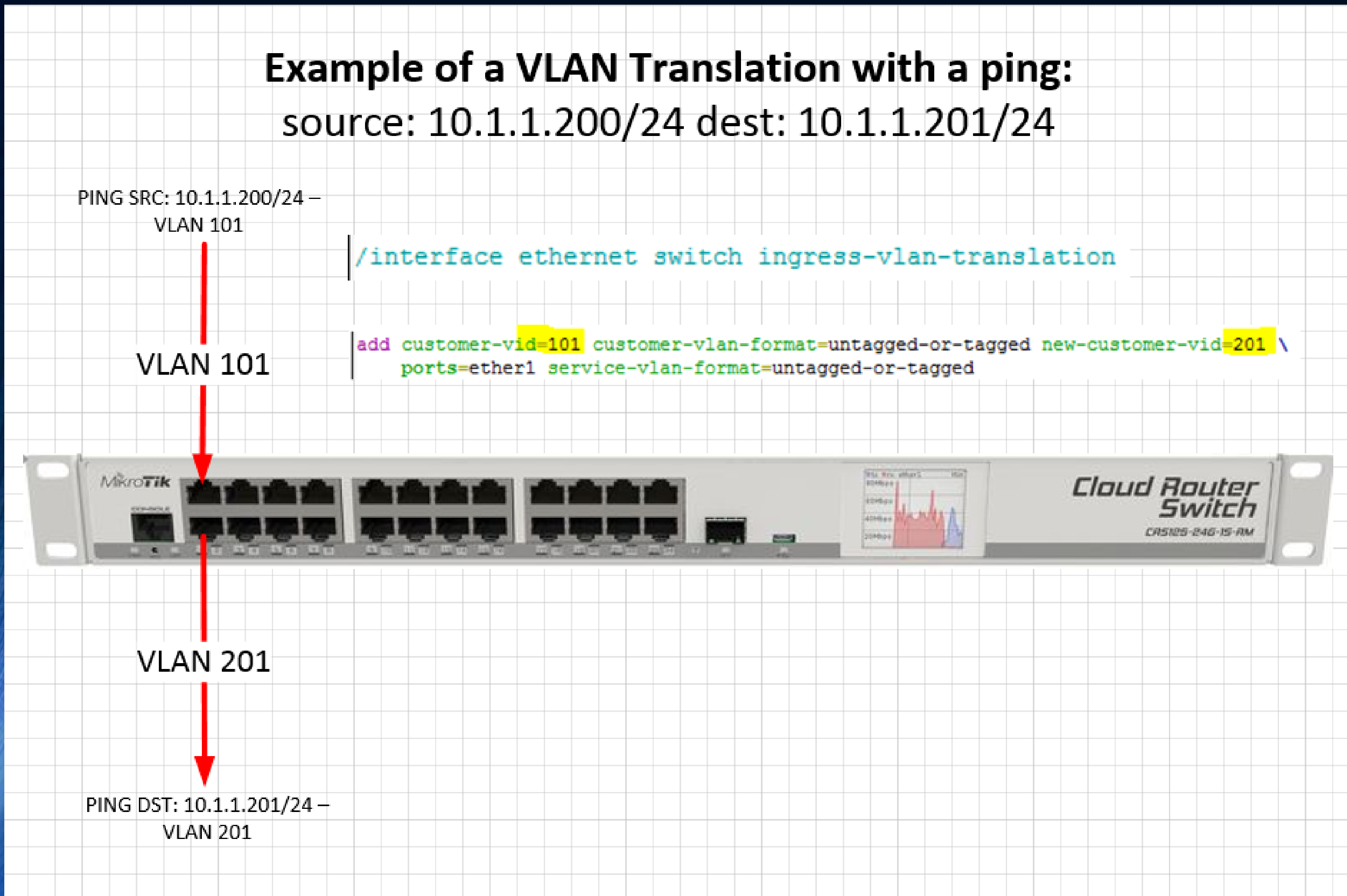
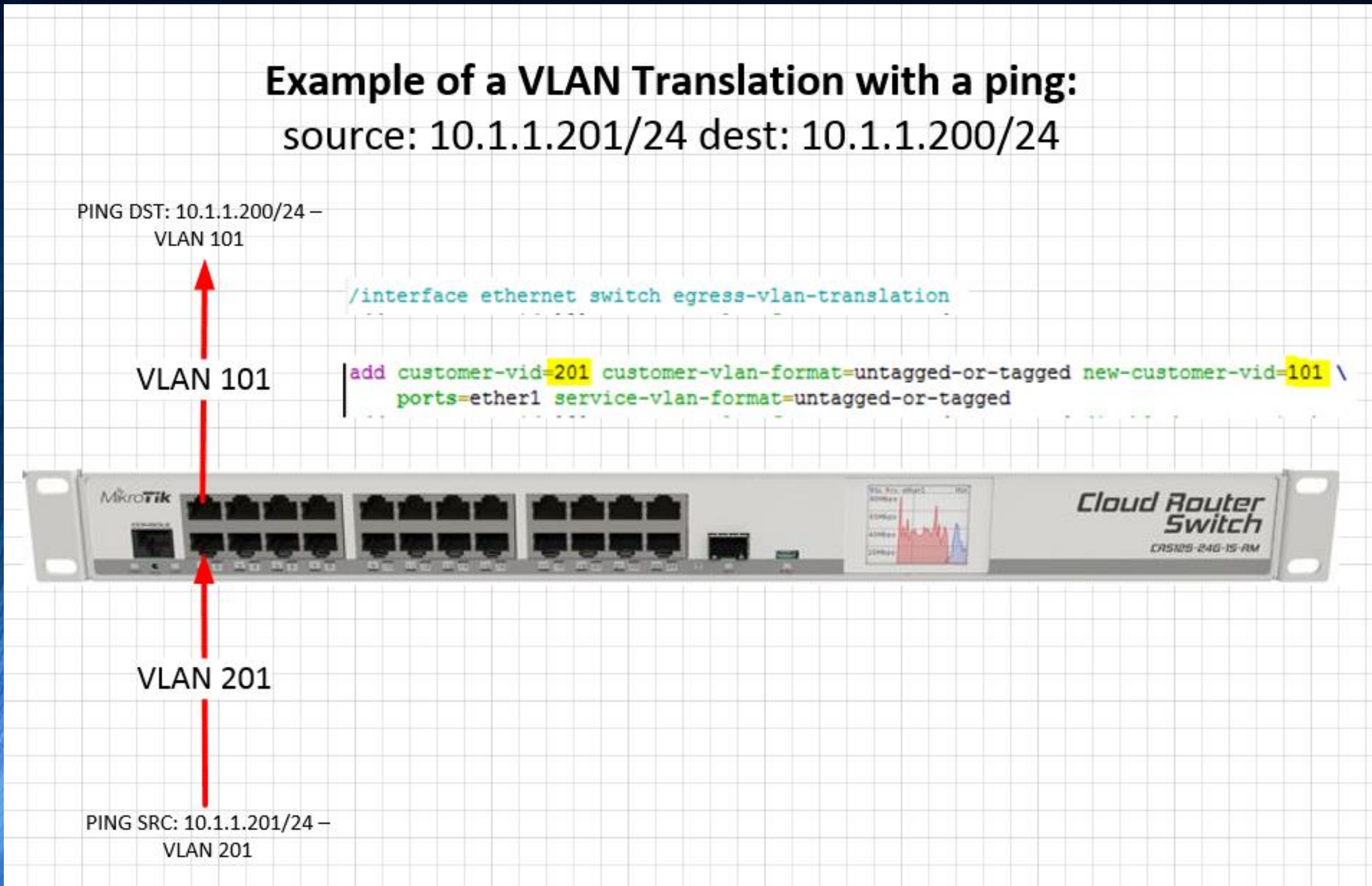
- **Objectives**
  - Learn what a VLAN Translation is and the different use cases
  - Understand the different implementation types for VLAN rewrites in RouterOS
  - Walk through implementation examples that uses VLAN translations in a Router and CRS switch.

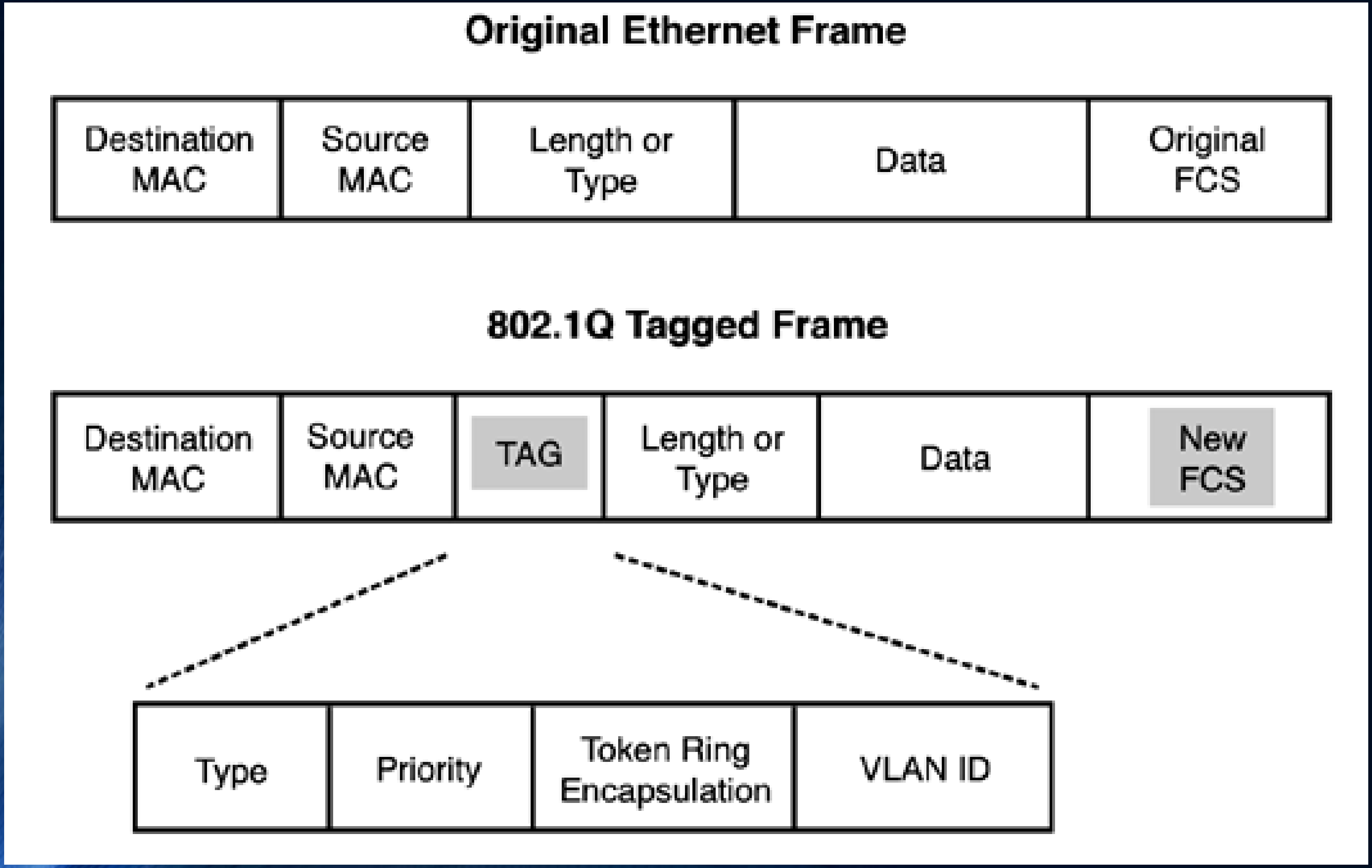
- **What is VLAN Translation?** VLAN Translation (or rewrite) involves replacing one ingress tag with another and vice-versa on egress.



- **What is VLAN Translation?** VLAN Translation (or rewrite) involves replacing one ingress tag with another and vice-versa on egress.



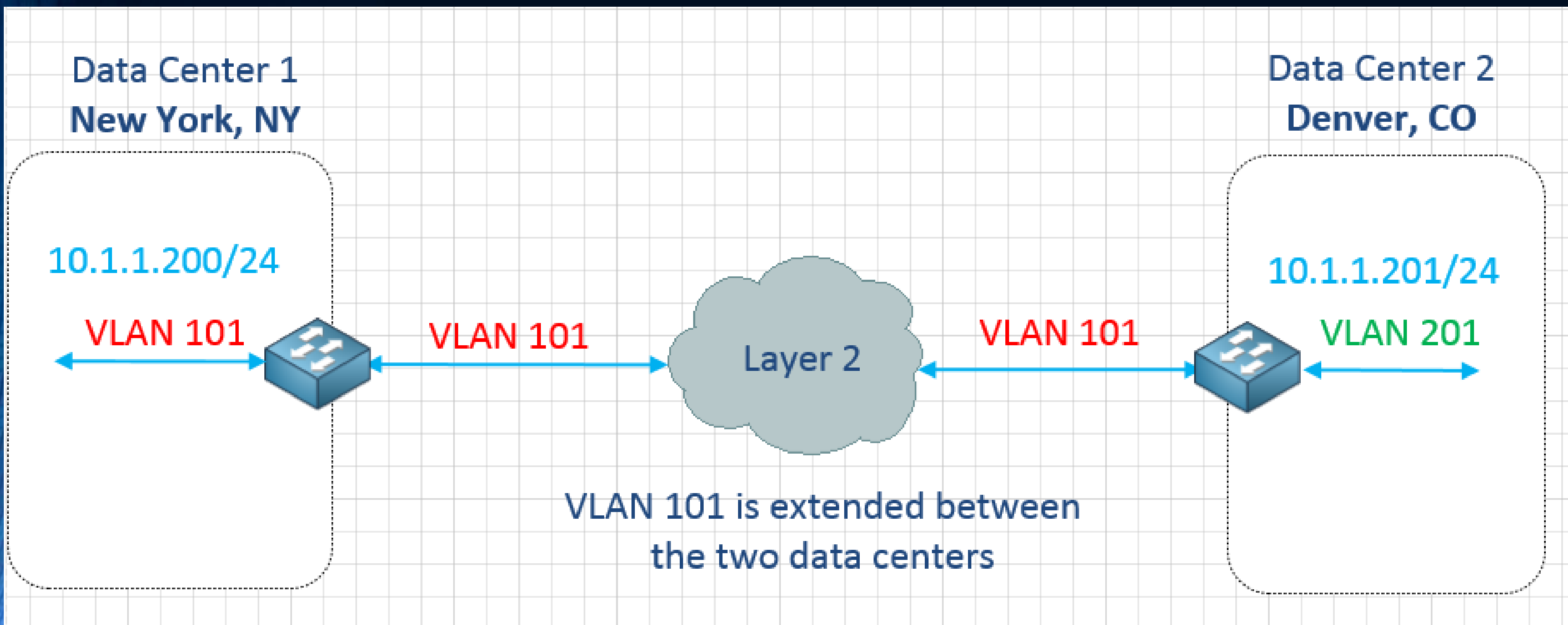
- **Is this QinQ? No.** VLAN Translation only involves one tag whereas QinQ adds an outer VLAN tag. In the frame below, the TAG field is rewritten from one VLAN to another while preserving all other information in the frame.



- **What problem are we trying to solve?**
- **Merging companies** – When large companies merge, there are often duplicate VLANS with different functions in campus and headquarters environments
- **Data Center Interconnect (DCI)** – When connecting large data centers at Layer 2, VLAN overlap is a major issue. A VLAN in one data center may used for web servers, while the same VLAN number in another data center could be for database servers.
- **Service Provider –** Large carrier networks often deal with overlapping VLANs from customers and other providers. VLAN translation can be used to join segments with different tags or prevent overlap.
- **What are some other use cases for VLAN Translations?**

- **Example:**
  - **Data Center 1 (NYC, NY, USA)** needs to extend Vlan 101 for web Servers on 10.1.1.0/24 to the Denver, CO DC
  - **Data Center 2 (Denver, CO, USA)** uses Vlan 101 for storage replication on 192.168.222.0/24
  - **VLAN 101 - 10.1.1.0/24** from NYC must be rewritten in Denver as **VLAN 201** to avoid conflict with the Storage Replication.
  - Routerboards can do this via bridging and CRS via switching.

Example: VLAN 101 in NYC becomes VLAN 201 once it reaches Denver, CO. The broadcast domain (light blue) is the same even though the VLAN tag changes



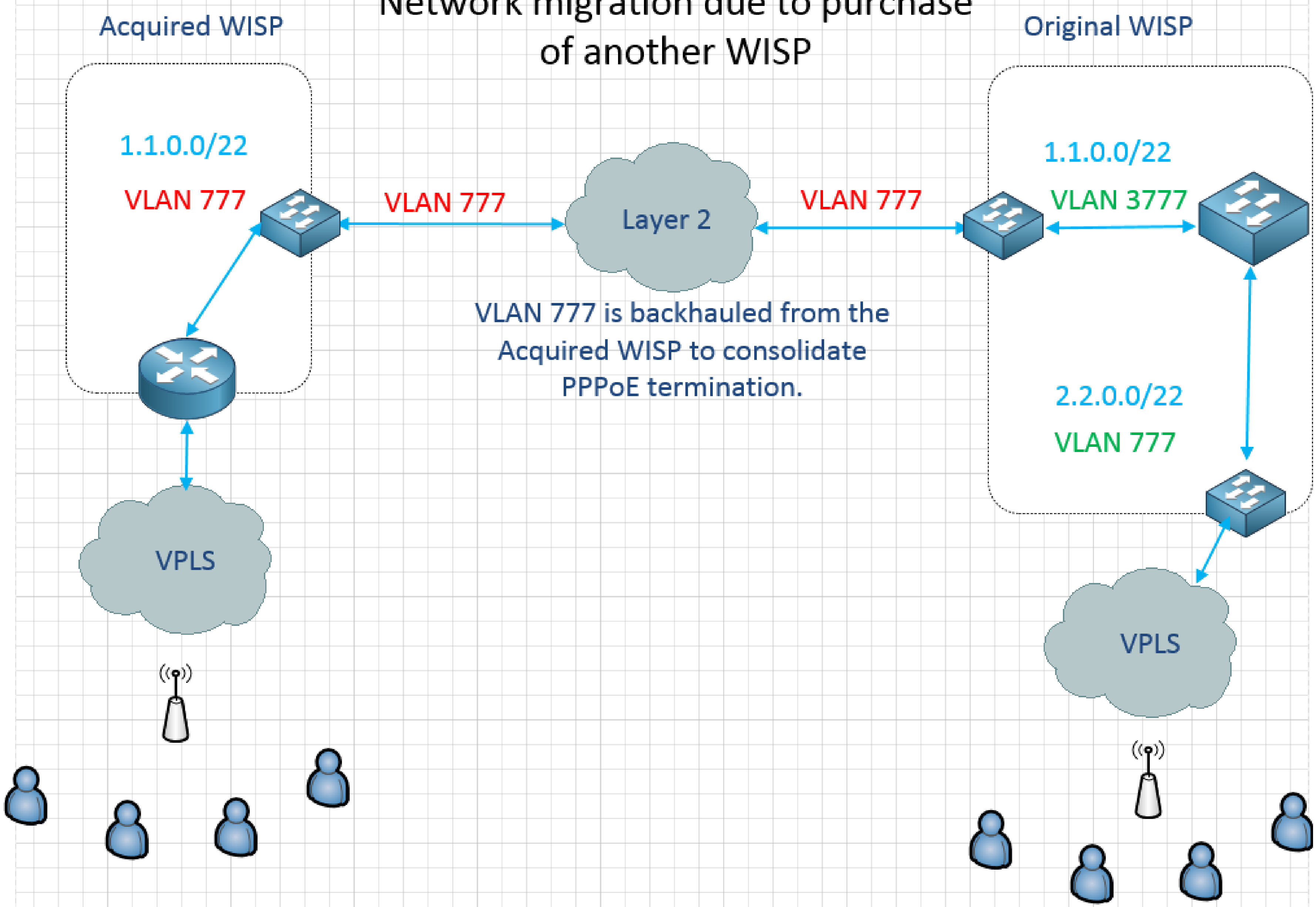
Example: VLAN 101 in NYC becomes VLAN 201 once it reaches Denver, CO. The broadcast domain (light blue) is the same even though the VLAN tag changes

Q. What is a broadcast domain?

Q. What Layer of the OSI Model does it exist at?

Q. Why would this be important when rewriting VLANs ?

Network migration due to purchase of another WISP



VLAN Translation LAB Scenario

Configuration Objective - Translate VLAN from R1 to R2 and ping successfully between laptops

Materials Needed

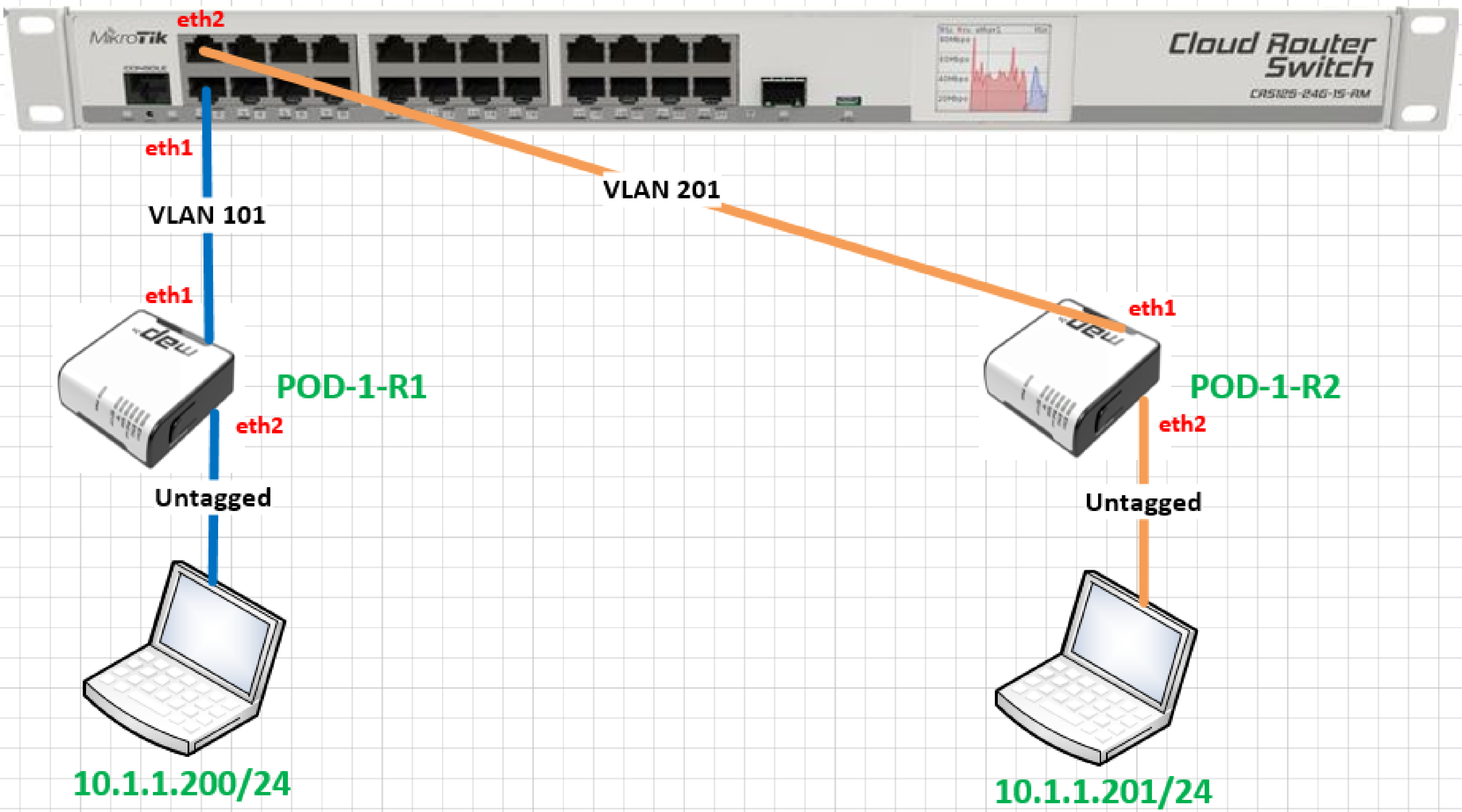
2 RouterBoards (each with at least 2 Ethernet ports)

2 Laptops with Ethernet port

4 Ethernet cables

CRS 125-24G-1S Switch

Lab Topology – Physical / Logical Connectivity for POD 1



Configuration Objective - Translate VLAN from R1 to R2 and ping successfully between laptops

VLAN Assignment

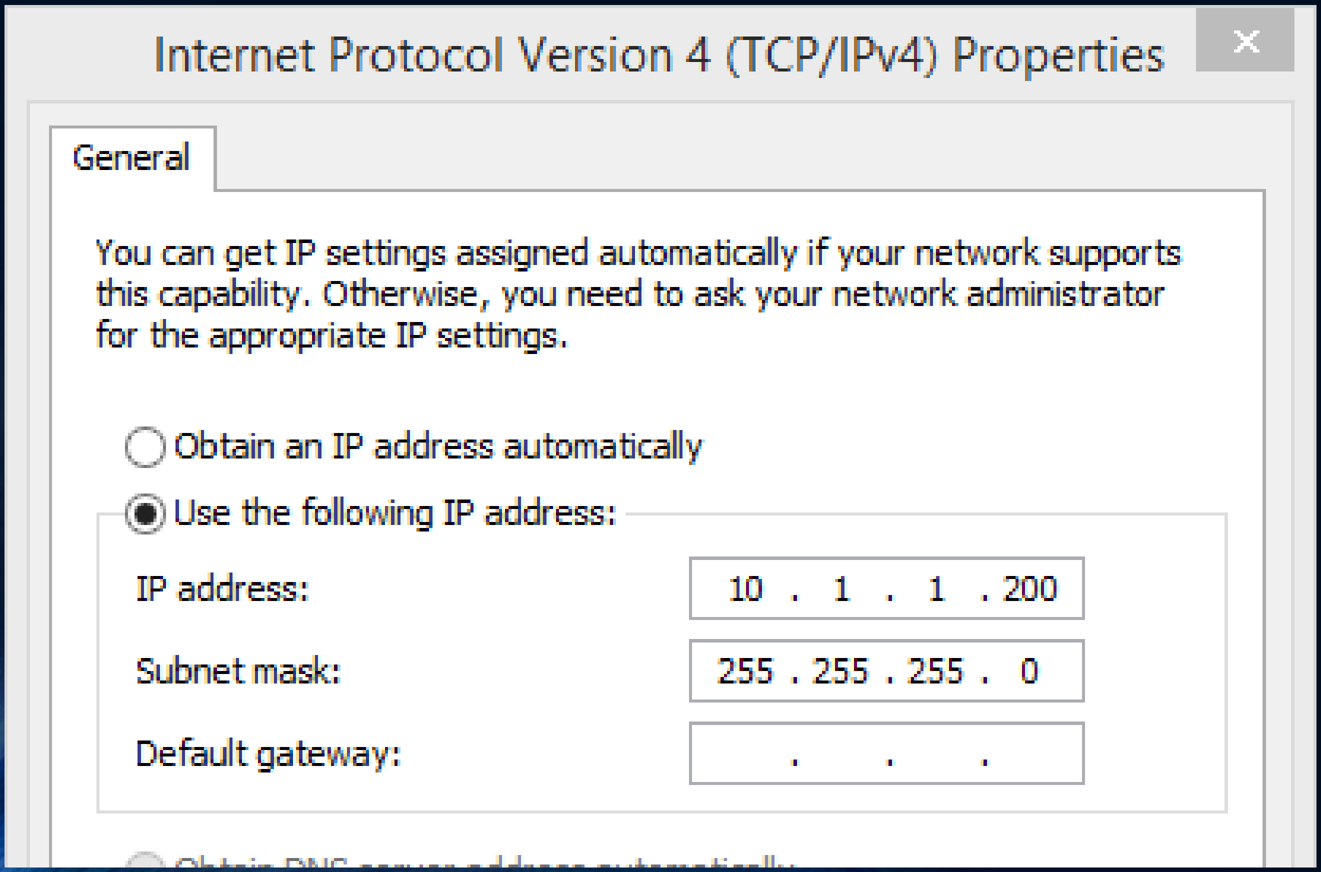
R1 VLAN – 101
R2 VLAN – 201

IP Address assignment for the Laptop

Laptop connected to R1 – 10.1.1.200/24
Laptop connected to R2 – 10.1.1.201/24

- Step 1
  - Reset system config with no default on both routerboards in the pod
- Step 2
  - Connect all devices according to the topology diagram.

- Step 3
  - Assign the IPs for both laptops – 10.1.1.200 and .201
  - Example (Windows) Using Laptop 1 (NOTE: No default gateway is needed for this lab)



Step 4

- Configure each lab Routerboard for the following

  - R1 - Interface Vlan 10x on eth1 (where x is your POD

```
/interface vlan
add interface=ether1 l2mtu=1594 name=Vlan101 vlan-id=101
```

  - R2 - Interface Vlan 20x on eth1 (where x is your POD

```
/interface vlan
add interface=ether1 l2mtu=1594 name=Vlan201 vlan-id=201
```

Step 5

Configure each lab Routerboard for the following

R1 – VLAN10x-Bridge (where x is your POD number) and add ports **eth2** and **Vlan10x**

```
/interface bridge
add name=VLAN101-Bridge
/interface bridge port
add bridge=VLAN101-Bridge interface=Vlan101
add bridge=VLAN101-Bridge interface=ether2
```

R2 – VLAN20x-Bridge (where x is your POD number) and add ports **eth2** and **Vlan20x**

```
/interface bridge
add name=VLAN201-Bridge
/interface bridge port
add bridge=VLAN201-Bridge interface=Vlan201
add bridge=VLAN201-Bridge interface=ether2
```

Step 6

Configure Ingress VLAN translation on the CRS

Ether1 – VLAN 101 to VLAN 201

Ether2 – VLAN 201 to VLAN 101

```
/interface ethernet switch ingress-vlan-translation
add customer-vid=201 customer-vlan-format=untagged-or-tagged new-customer-vid=\
    101 ports=ether2 service-vlan-format=untagged-or-tagged
add customer-vid=101 customer-vlan-format=untagged-or-tagged new-customer-vid=\
    201 ports=ether1 service-vlan-format=untagged-or-tagged
```

Step 8

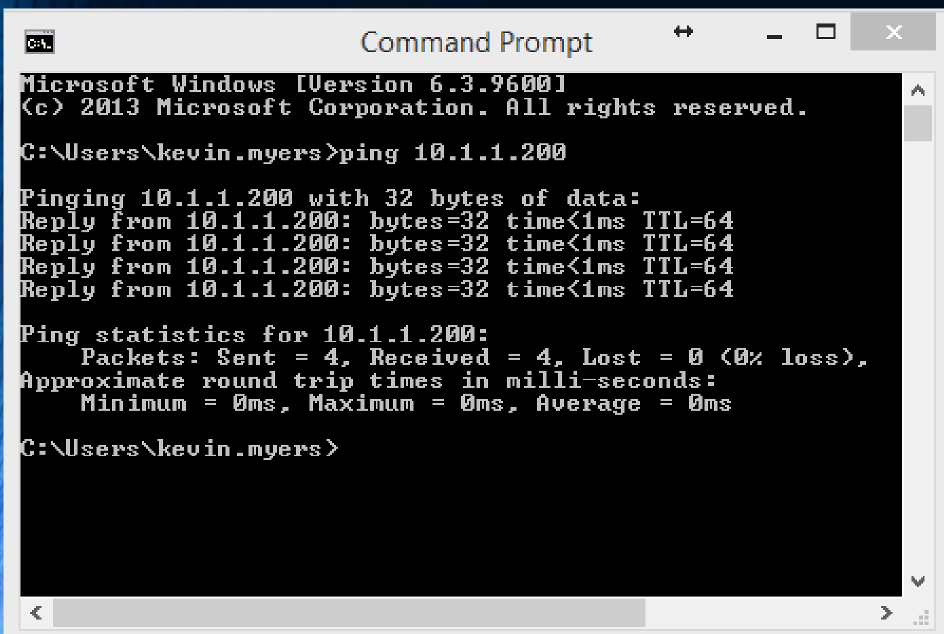
Configure Egress VLAN translation **(POD1 shown as an example)**

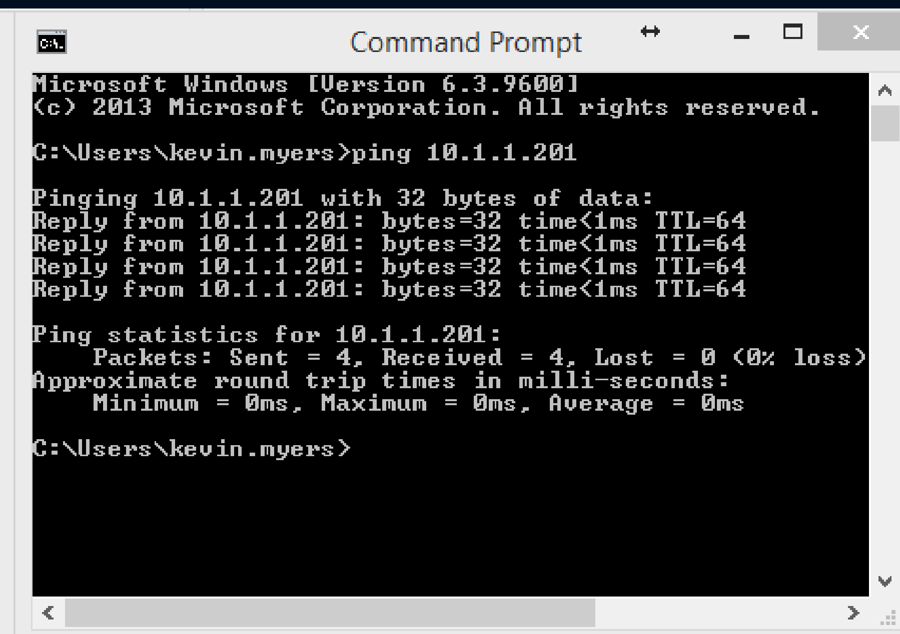
Ether1 – VLAN 201 to VLAN 101 (Use the correct port and VLAN for your POD)

Ether2 – VLAN 101 to VLAN 201 (Use the correct port and VLAN for your POD)

```
/interface ethernet switch egress-vlan-translation
add customer-vid=101 customer-vlan-format=untagged-or-tagged new-customer-vid=\
    201 ports=ether2 service-vlan-format=untagged-or-tagged
add customer-vid=201 customer-vlan-format=untagged-or-tagged new-customer-vid=\
    101 ports=ether1 service-vlan-format=untagged-or-tagged
```

- **Configuration Objective -** Translate VLAN from R1 to R2 in your POD and ping successfully between laptops
- Step 9
  - **Validation –** Ping from laptop to laptop (be sure to turn off software firewalls)



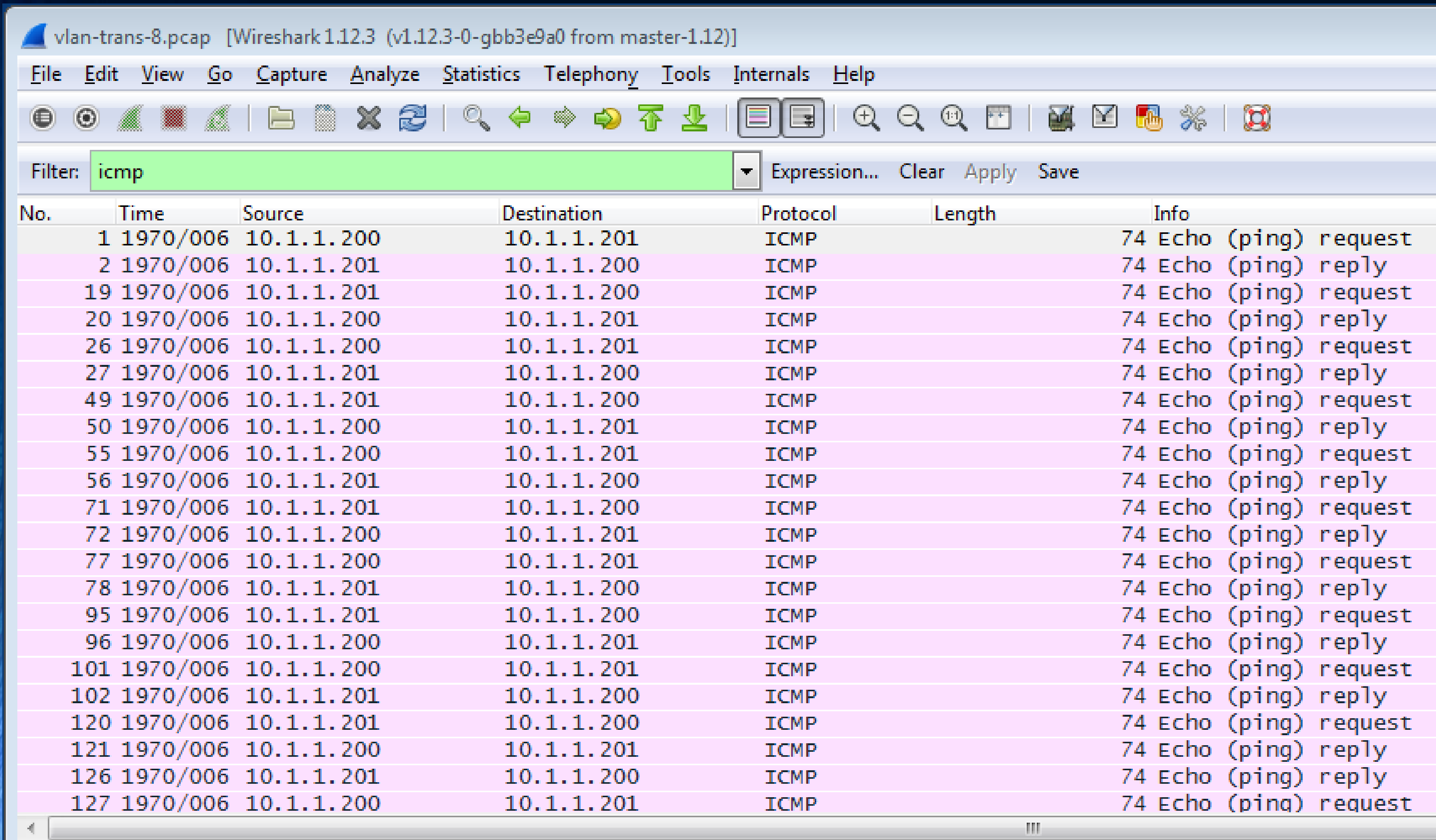


How do we know that config worked?

- Packet Sniffer using port mirroring on the CRS
- Switch ports on CRS do not show up in packet sniffer unless a mirror is set up and pointed to the CPU

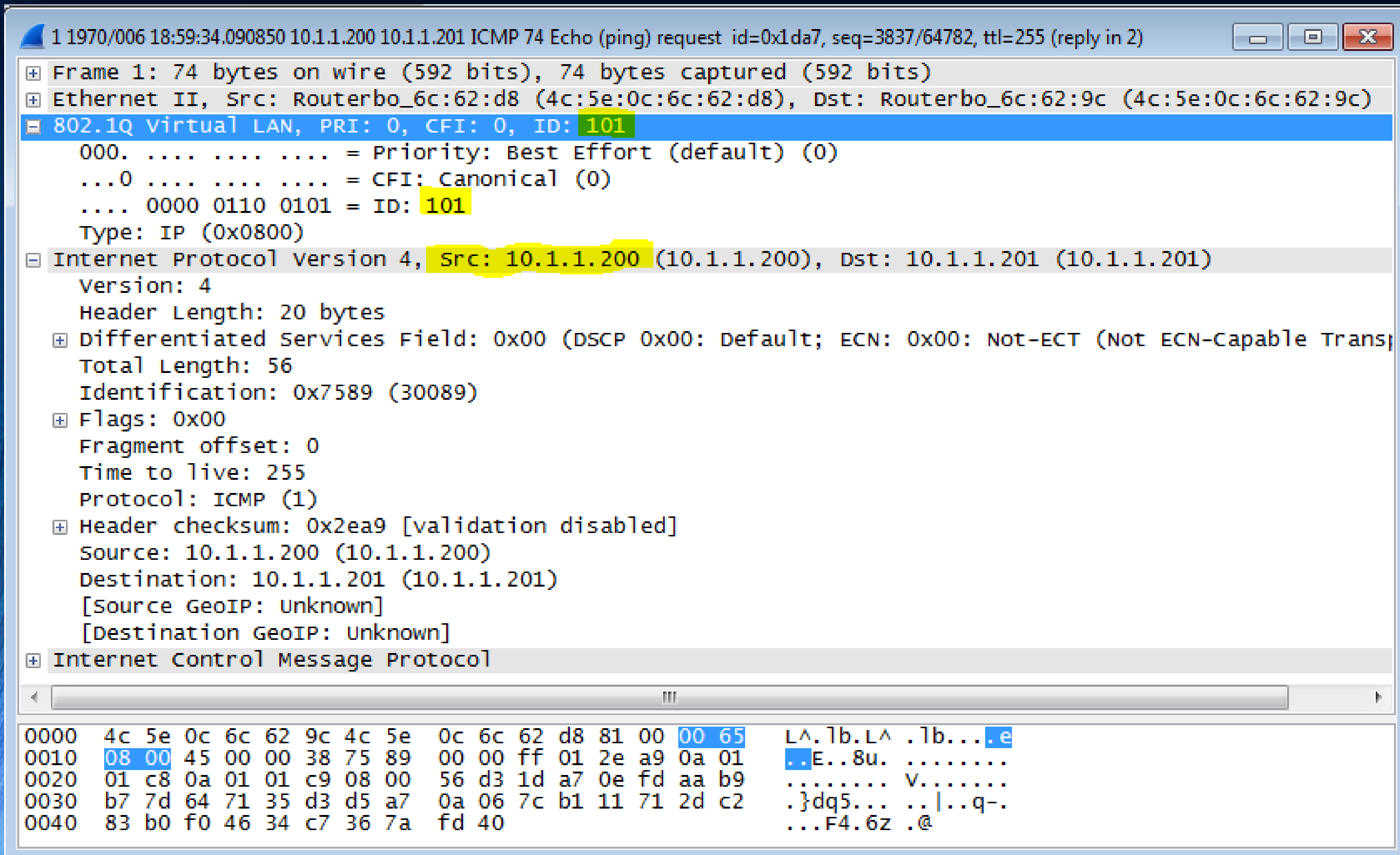
```
/interface ethernet switch
set bridge-type=customer-vid-used-as-lookup-vid \
    bypass-ingress-port-policing-for="" bypass-l2-security-check-filter-for="" \
    bypass-vlan-ingress-filter-for="" \
    drop-if-invalid-or-src-port-not-member-of-vlan-on-ports="" \
    drop-if-no-vlan-assignment-on-ports="" egress-mirror-ratio=1/1 \
    egress-mirror0=switch1-cpu,modified egress-mirror1=switch1-cpu,modified \
    fdb-uses=mirror0 forward-unknown-vlan=yes ingress-mirror-ratio=1/1 \
    ingress-mirror0=switch1-cpu,unmodified ingress-mirror1=\
    switch1-cpu,unmodified mac-level-isolation=yes \
    mirror-egress-if-ingress-mirrored=no mirror-tx-on-mirror-port=no \
    mirrored-packet-drop-precedence=green mirrored-packet-qos-priority=0 \
    multicast-lookup-mode=dst-ip-and-vid-for-ipv4 name=switch1 \
    override-existing-when-ufdb-full=no unicast-fdb-timeout=5m \
    unknown-vlan-lookup-mode=svl use-cvid-in-one2one-vlan-lookup=yes \
    use-svid-in-one2one-vlan-lookup=no vlan-uses=mirror0
```

Packet capture of ICMP between R1 and R2 in Wireshark

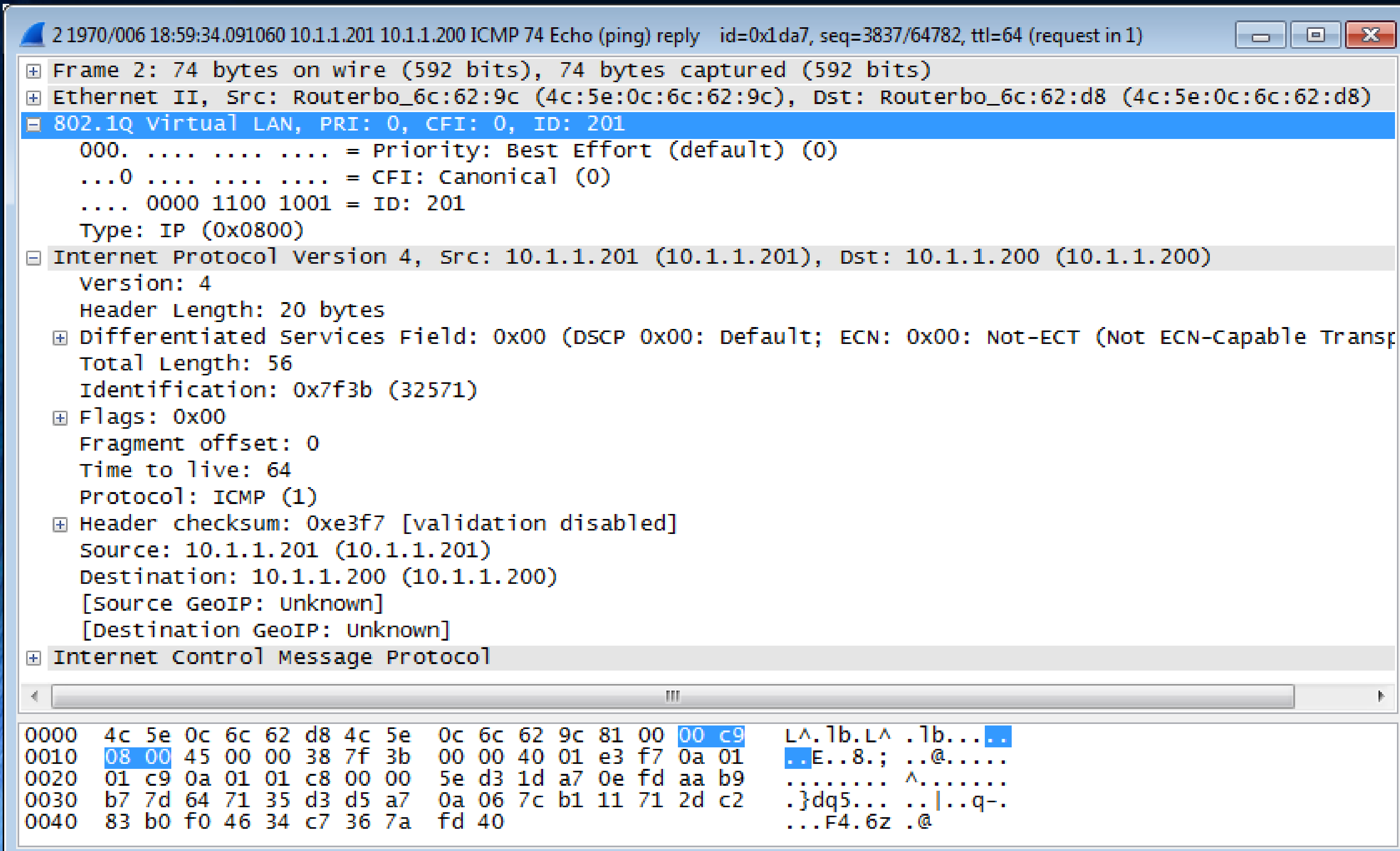


No.	Time	Source	Destination	Protocol	Length	Info
1	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request
2	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
19	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) request
20	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) reply
26	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request
27	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
49	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) request
50	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) reply
55	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request
56	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
71	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) request
72	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) reply
77	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request
78	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
95	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) request
96	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) reply
101	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request
102	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
120	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) request
121	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) reply
126	1970/006	10.1.1.201	10.1.1.200	ICMP	74	Echo (ping) reply
127	1970/006	10.1.1.200	10.1.1.201	ICMP	74	Echo (ping) request

Packet capture of ICMP from 10.1.1.200/24 (VLAN 101) to 10.1.1.201/24 (VLAN 201) in Wireshark



Packet capture of ICMP from 10.1.1.201/24 (VLAN 201) to 10.1.1.200/24 (VLAN 101) in Wireshark



Configuration example - Bridging

This configuration can be used in almost any RouterBoard to translate between VLANs using a bridge.

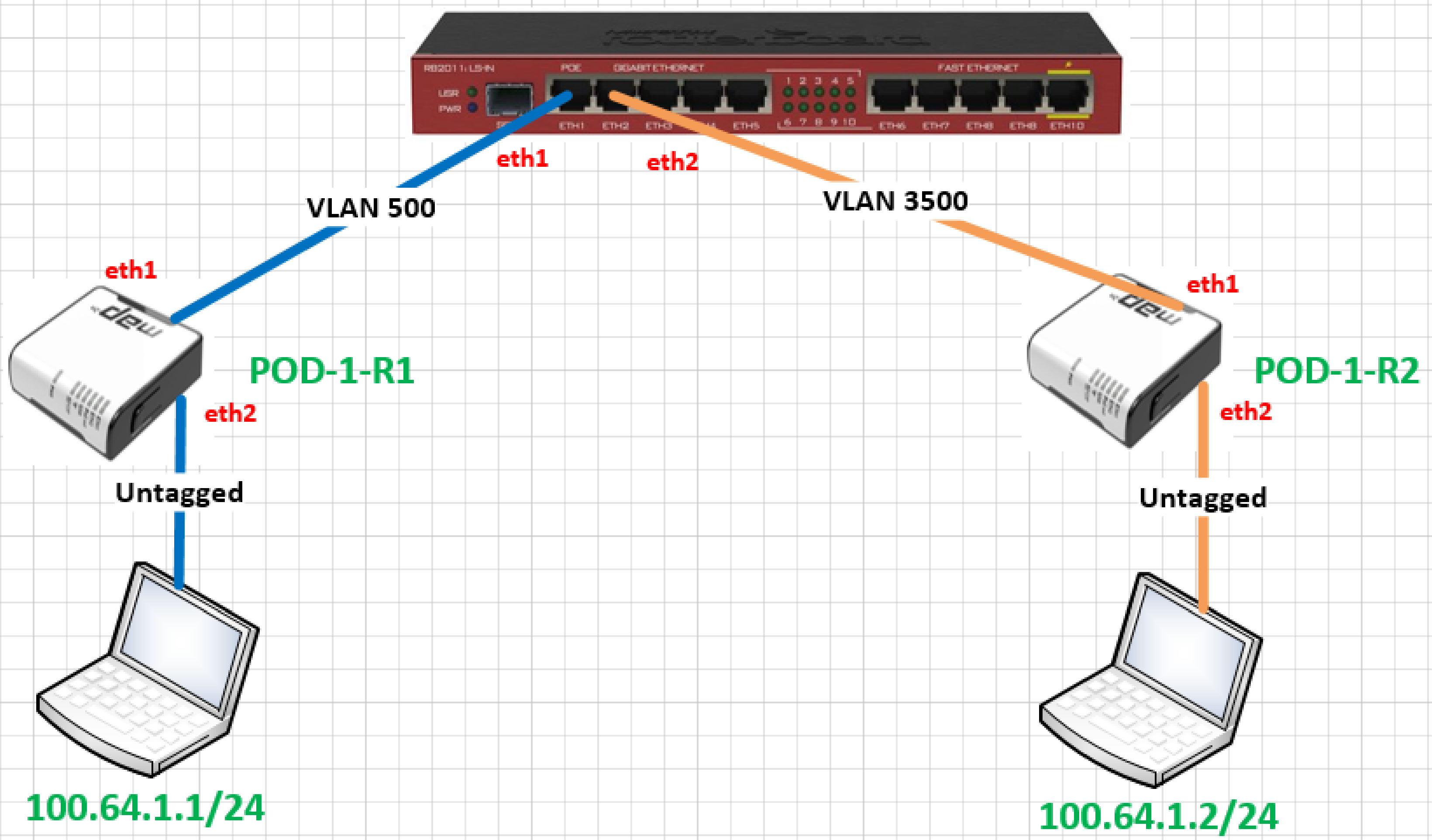
Create VLAN 500 and 3100 interface VLANs

```
/interface vlan
add interface=ether1 name=Vlan500 vlan-id=500
add interface=ether2 name=Vlan3500 vlan-id=3500
```

Create Bridge and add VLAN interface ports

```
/interface bridge
add name=Loopback0
add name=Vlan500-to-3500-Bridge
/interface bridge port
add bridge=Vlan500-to-3500-Bridge interface=Vlan3500
add bridge=Vlan500-to-3500-Bridge interface=Vlan500
```

Lab Topology – Physical / Logical Connectivity for VLAN rewrite using bridging



When to use switching vs. bridging – what is the difference?

- **Speed and packet latency is the answer** – switching is done in hardware and so the traffic going through the VLAN translation can happen at wire speed without CPU load or latency of processing. 1 Gigabit in the case of the CRS

When to use switching vs. bridging – what is the difference?

- Use CRS switches for applications that require higher throughput and port density.
  - Data Center Interconnect (DCI)
  - Service Provider core or aggregation layers
  - WISP Core layer to support acquisition and migration of a new WISP.

- Use routers for lower speed scenarios like at the edge.

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