Assignment 1 - Expand the VLAN based network

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5. Able to ping one another on the VLAN

```
PC3-Accounts> ip dhcp                                    PC1-Accounts> ip dhcp
DORA IP 192.168.150.3/24 GW 192.168.150.1                DORA IP 192.168.150.4/24 GW 192.168.150.1

PC3-Accounts> ping 192.168.150.2                         PC1-Accounts> ping 192.168.150.2

84 bytes from 192.168.150.2 icmp_seq=1 ttl=64 time=0.082 ms84 bytes from 192.168.150.2 icmp_seq=1 ttl=64 time=0.164 ms
84 bytes from 192.168.150.2 icmp_seq=2 ttl=64 time=0.165 ms84 bytes from 192.168.150.2 icmp_seq=2 ttl=64 time=0.151 ms
84 bytes from 192.168.150.2 icmp_seq=3 ttl=64 time=0.135 ms84 bytes from 192.168.150.2 icmp_seq=3 ttl=64 time=0.257 ms
84 bytes from 192.168.150.2 icmp_seq=4 ttl=64 time=0.263 ms84 bytes from 192.168.150.2 icmp_seq=4 ttl=64 time=0.274 ms
84 bytes from 192.168.150.2 icmp_seq=5 ttl=64 time=0.181 msc84 bytes from 192.168.150.2 icmp_seq=5 ttl=64 time=0.181 ms
^C                                                       ^C
```

Here we see two other VPC's with dhcp IPs of 192.168.150.3 & 192.168.150.4 pinging 192.168.150.2, all on the same VLAN. (It works)

6. Pinging to another VPC in the same VLAN (VLAN 150)

```
NAME    IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC3-Acc192.168.150.3/24      192.168.150.1     00:50:79:66:68:05  20014  127.0.0.1:20015
        fe80::250:79ff:fe66:6805/64

PC3-Accounts> trace 192.168.150.2 -P 1
trace to 192.168.150.2, 8 hops max (ICMP), press Ctrl+C to stop
 1   192.168.150.2   0.202 ms  0.206 ms  0.097 ms
```

This is 192.168.150.3 with running a trace to 192.168.150.2, another VPC on the same VLAN. The switch directs it immediately to the .2 VPC as it is on the same VLAN.

7. Pinging to another VPC in a different VLAN (VLAN 100 -> 150)

```
PC3-Sales> trace 192.168.150.2 -P 1
trace to 192.168.150.2, 8 hops max (ICMP), press Ctrl+C to stop
 1   192.168.100.1   0.417 ms  0.445 ms  0.399 ms
 2   192.168.150.2   1.928 ms  0.680 ms  0.600 ms

PC3-Sales>
```

This is 192.168.100.2 with running a trace to 192.168.150.2, a VPC on the 150 VLAN, not its own 100 VLAN. The switch directs it to the VLAN 100 gateway at 100.1, where it is routed from there to 150.2.

8. Packet capture Pinging different VLAN

```
 13 11.888528 Private_66:68… Broadcast      ARP     68 Who has 192.168.100.1? Tell 192.168.100.252
 14 11.888829 0c:03:12:c6:0… Private_66:68… ARP     46 192.168.100.1 is at 0c:03:12:c6:00:03
 15 11.889932 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (no response found!)
 16 11.890215 192.168.100.1  192.168.100.2… ICMP   138 Time-to-live exceeded (Time to live exceeded in transit)
 17 11.891370 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (no response found!)
 18 11.891545 192.168.100.1  192.168.100.2… ICMP   138 Time-to-live exceeded (Time to live exceeded in transit)
 19 11.892435 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (no response found!)
 20 11.892592 192.168.100.1  192.168.100.2… ICMP   138 Time-to-live exceeded (Time to live exceeded in transit)
 21 11.893983 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=2 (no response found!)
 22 11.894134 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (reply in 25)
 23 11.894193 Private_66:68… Broadcast      ARP     68 Who has 192.168.150.1? Tell 192.168.150.2
 24 11.894506 0c:03:12:c6:0… Private_66:68… ARP     46 192.168.150.1 is at 0c:03:12:c6:00:03
 25 11.895386 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=64 (request in 22)
 26 11.895656 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=63
 27 11.896534 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=2 (no response found!)
 28 11.896885 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (reply in 29)
 29 11.896962 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=64 (request in 28)
 30 11.897185 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=63
 31 11.897976 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=2 (no response found!)
 32 11.898213 192.168.100.2… 192.168.150.2  ICMP   110 Echo (ping) request  id=0xe759, seq=0/0, ttl=1 (reply in 33)
 33 11.898318 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=64 (request in 32)
 34 11.898572 192.168.150.2  192.168.100.2… ICMP   110 Echo (ping) reply    id=0xe759, seq=0/0, ttl=63
 35 16.884022 0c:03:12:c6:0… Private_66:68… ARP     46 Who has 192.168.100.252? Tell 192.168.100.1
 36 16.884137 Private_66:68… 0c:03:12:c6:0… ARP     46 192.168.100.252 is at 00:50:79:66:68:06
 37 16.893906 0c:03:12:c6:0… Private_66:68… ARP     46 Who has 192.168.150.2? Tell 192.168.150.1
 38 16.894386 Private_66:68… 0c:03:12:c6:0… ARP     46 192.168.150.2 is at 00:50:79:66:68:07
```

The 802.1q protocol here, also referred to as Dot1q, is the networking standard that supports VLANs (virtual local area networking) on Ethernet. It adds a VLAN tag to the ethernet frame carrying the ARP request. This helps routers and switches identify the VLAN to which the frame belongs. It is crucial to ensure correct routing between VLANs, for isolating and distinguishing traffic between VLANs.

The first of the 2 ARP packets are the VPC's looking for the router gateway of its VLAN. The second is the response, letting the VPC know the MAC address for the gateway. (ARP packets being used for VLAN Gateway discovery, where 802.1q tagging is added)

Following that, (with some failed pings due to timeout), the VPC on VLAN-100 pings the second VPC on VLAN-150, requesting that it to reply to it.

The 2 ARP following the ping request packets are the VLAN-150 VPC looking for its own VLAN's gateway. The VPC is then sent the MAC address.

Following that, we are capturing the ping replies by 192.168.100.2 VPC, and the requests being sent by the 192.168.150.2 VPC again. These are all tagged with 802.1q tags to keep packets separate by VLAN, ensuring correct destination.

Bonus part – Discussed in lab with Des

The router sends out ARP requests to the two VPCs, from their respecting VLAN gateways. This is most likely the router being **'aggressive when it comes to populating its tables and, upon hearing ARP traffic or being involved in ARP messages, will subsequently generate their own ARP requests to populate their tables.**'

My theory is based off this here, it is not connected to the pinging between the two VPC's as it is 5 seconds later, which would indicate it is independent to our objective focus.