DCI (EoIP)

Data Center Interconnect
(Ethernet over IP)

About Presenter

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Work history

Moeez Aftab

Allied Bank Limited
Network Projects 2017 – Present

CYBERNET Service Provider
Sr. TAC Engineer 2015 - 2017

Superior Connection
NOC Engineer 2014 - 2015

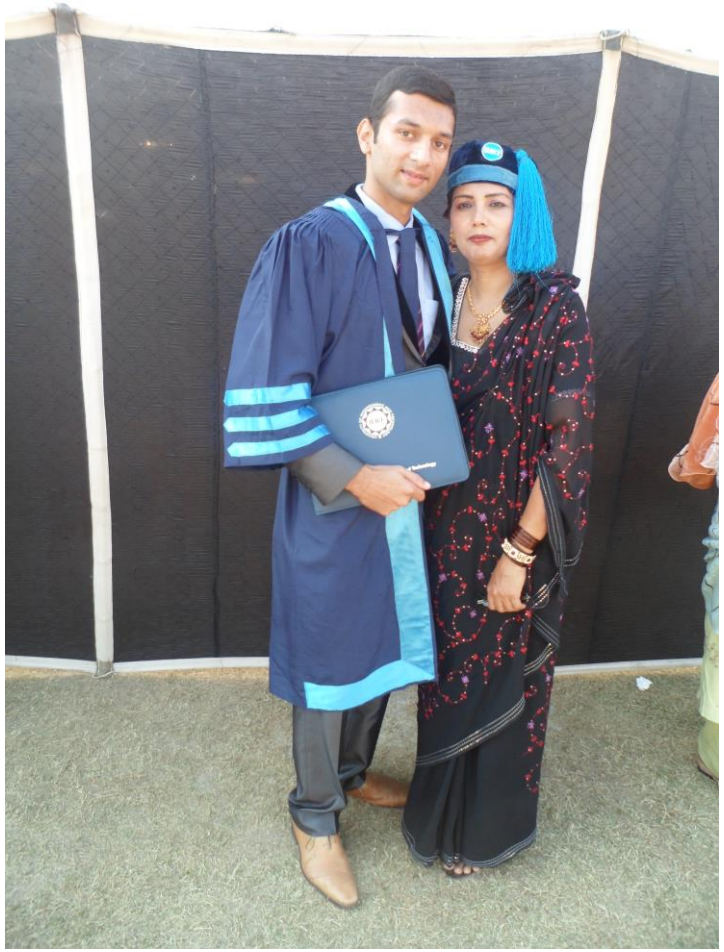
Starlite Telecommunication
Support Engineer 2013 - 2014

Work history

Moeez Aftab

CORVIT Systems
Workshops on Mikrotik

Mother

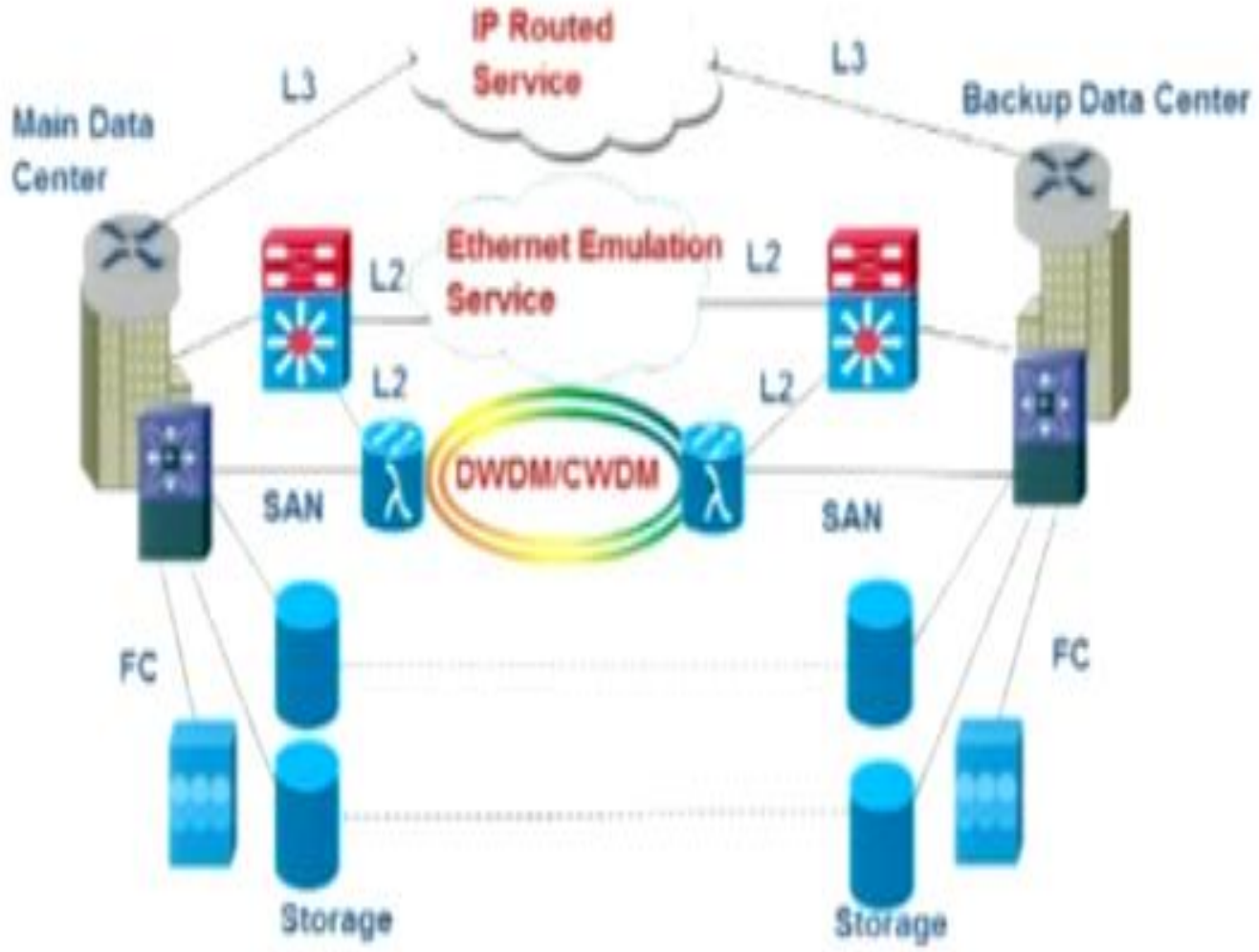


Agenda

- DCI technology
- DCI protocols Using IP/MPLS Domains
- Technical overview of EoIP
- Proposed design for DCI using EoIP
- Configuration steps

DCI Technology

- Data Center are expending beyond traditional boundaries due to:
  - Extending operating system, file system cluster, data base cluster
  - Virtual/physical machine mobility due to load sharing, disaster prevention
  - Legacy devices/application with embedded IP addressing.
  - Time to deployment and operational reasons.
  - Extend DC to solve power/heat/space limitations.



Business Drivers for L2 connectivity

Business Drivers	IT Solutions
Disaster Prevention	Active / Standby migration
Business Continuance	Server HA clusters, “Geo-clustering”
Workload Mobility	Move, consolidate servers “Vmotion”

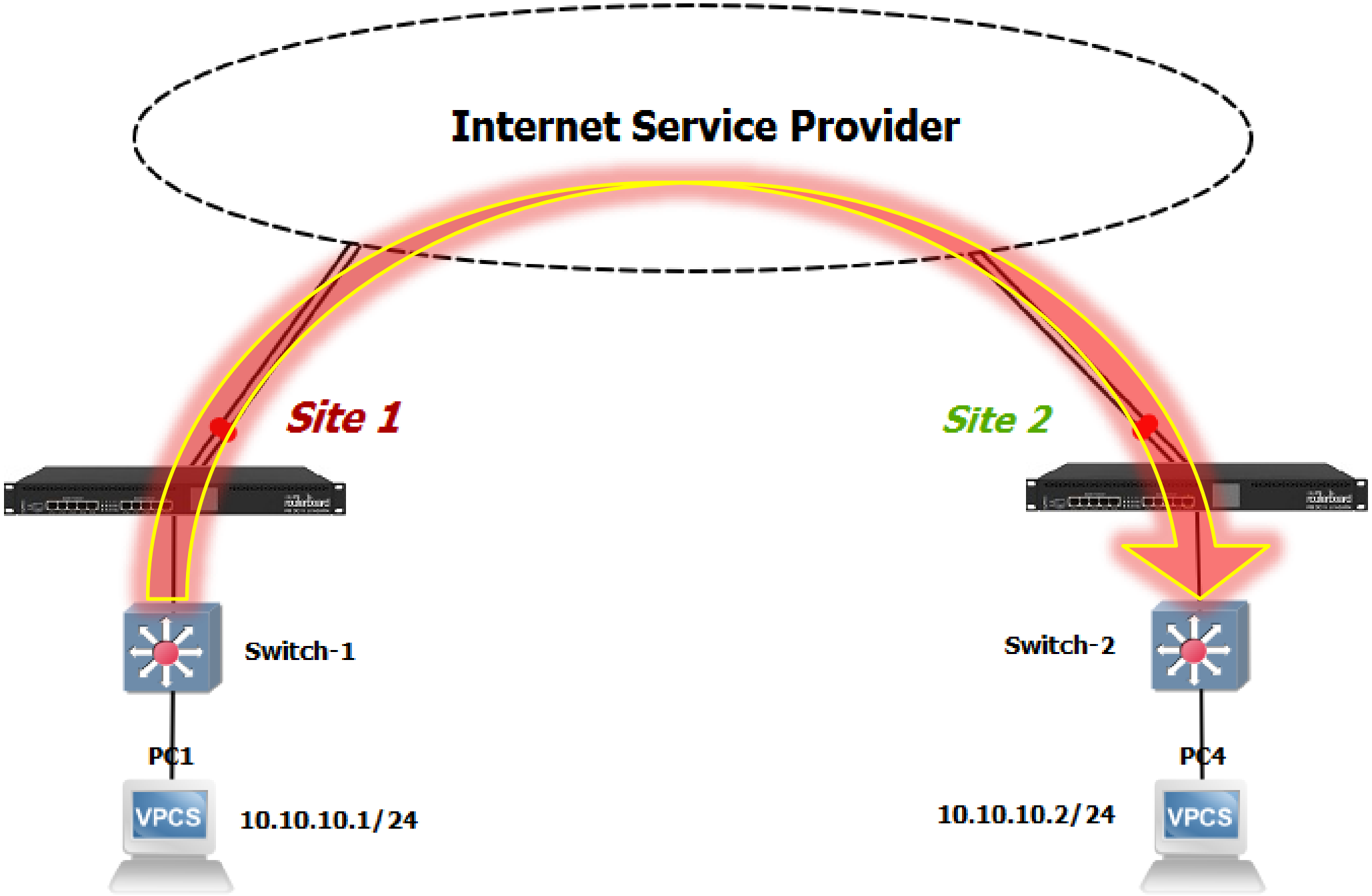
Layer 2 Extension (DCI) Protocols over IP/MPLS Based Network

IP	MPLS
L2TP	VPLS
EoIP	EVPN
EVPN	EVC
	NvGRE

Technical Overview of EoIP

EoIP

Ethernet over IP (EoIP) Tunneling is a MikroTik RouterOS protocol that creates an Ethernet tunnel between two routers on top of an IP connection.


Internet Service Provider
Site 1
Site 2
Switch-1
Switch-2
PC1
PC4
VPCS
VPCS
10.10.10.1/24
10.10.10.2/24

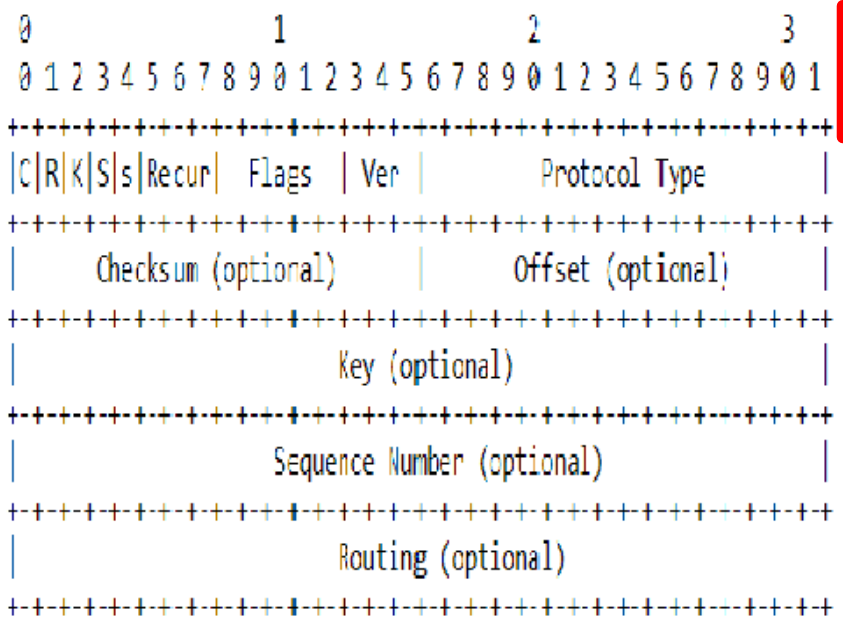
EoIP Header

- The EoIP protocol encapsulates Ethernet frames in GRE (IP protocol number 47) packets and sends them to the remote side of the EoIP tunnel.

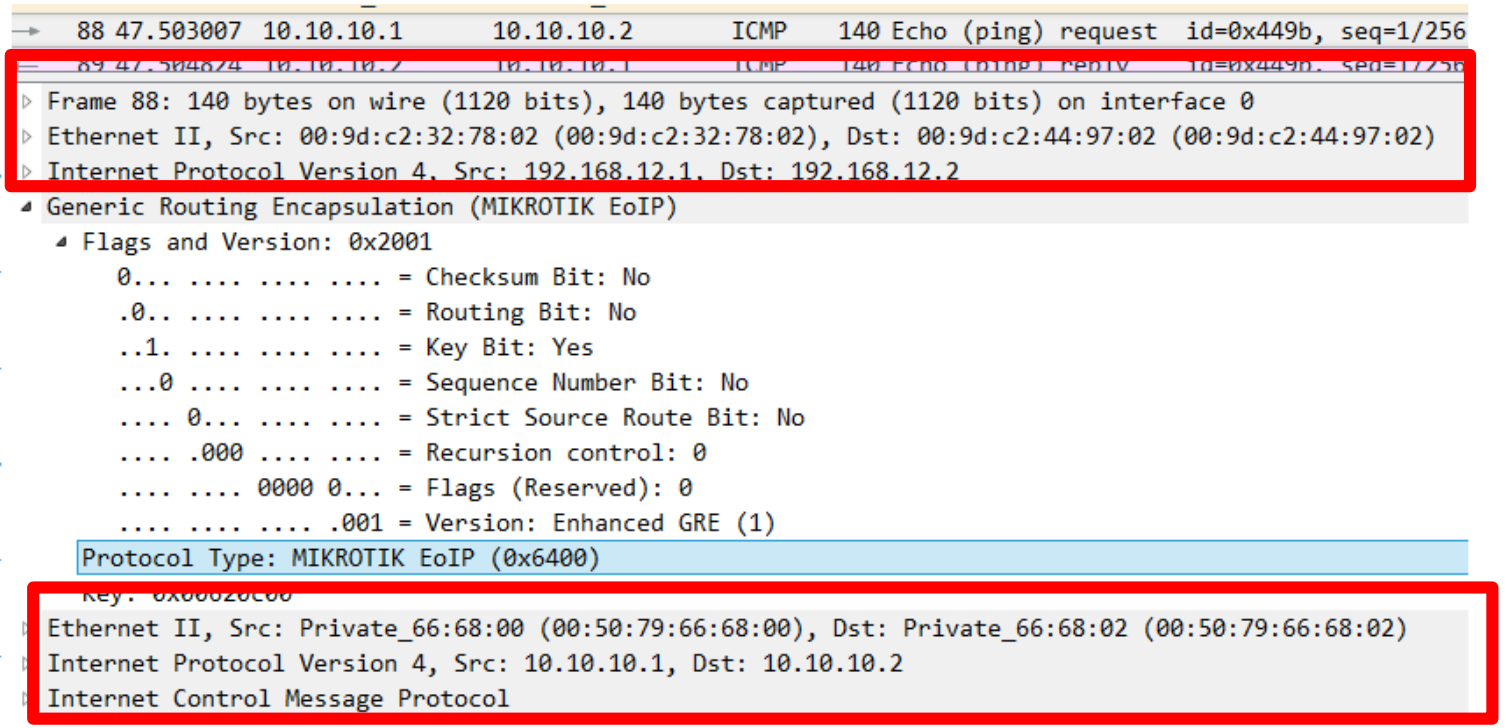
- EoIP tunnel adds at least 42 byte overhead (8byte GRE + 14 byte Ethernet + 20 byte IP)

GRE vs EoIP Header

GRE Header

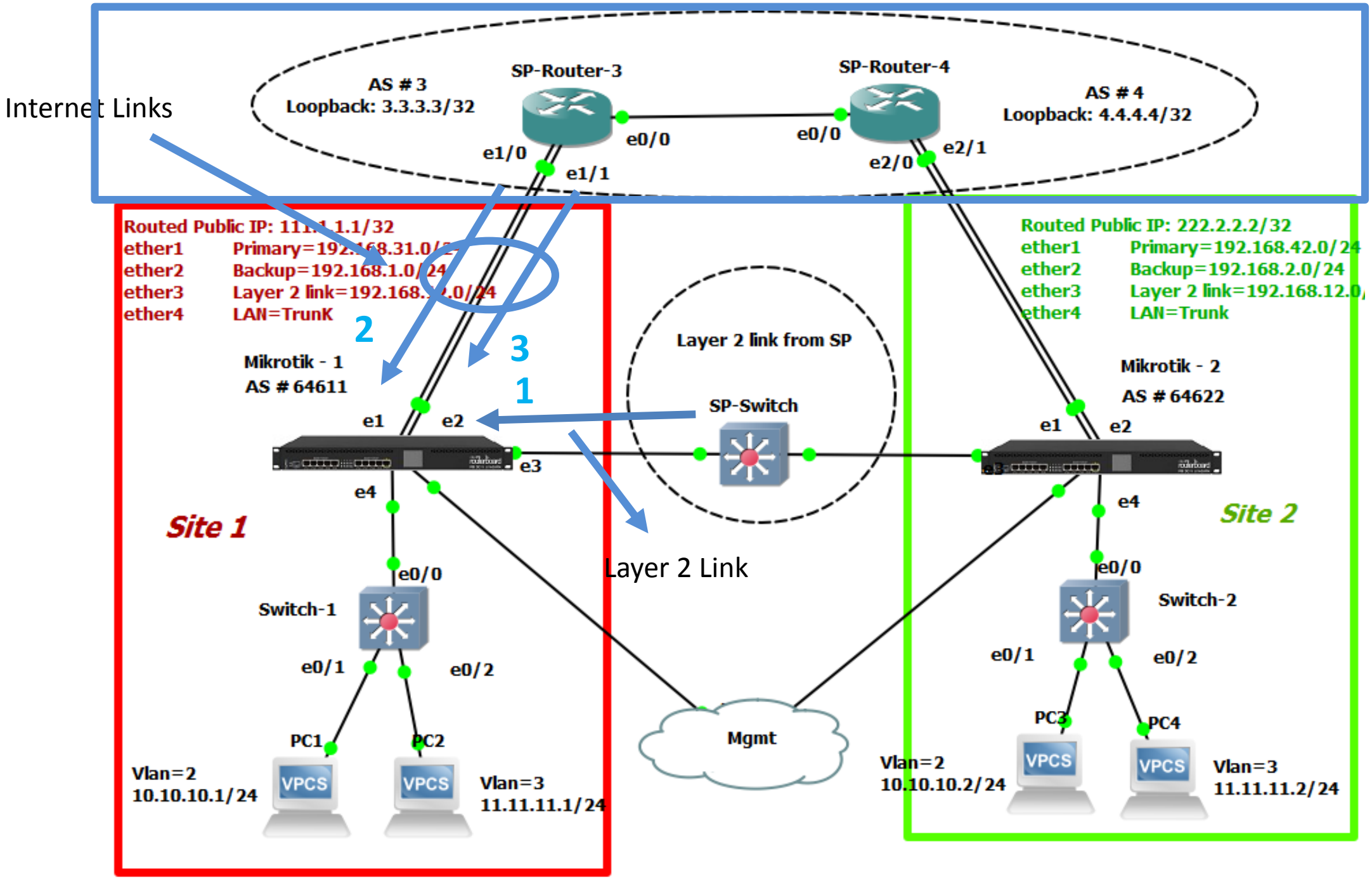


EoIP Header



EoIP Proposed Design

From Client End Perspective


Internet Links
AS # 3
Loopback: 3.3.3.3/32
SP-Router-3
SP-Router-4
AS # 4
Loopback: 4.4.4.4/32
e0/0
e0/0
e1/0
e1/1
e2/0
e2/1
Routed Public IP: 111.1.1.1/32
ether1 Primary=192.168.31.0/24
ether2 Backup=192.168.1.0/24
ether3 Layer 2 link=192.168.12.0/24
ether4 LAN=TrunK
Routed Public IP: 222.2.2.2/32
ether1 Primary=192.168.42.0/24
ether2 Backup=192.168.2.0/24
ether3 Layer 2 link=192.168.12.0/
ether4 LAN=Trunk
2
3
1
Layer 2 link from SP
Mikrotik - 1
AS # 64611
SP-Switch
Mikrotik - 2
AS # 64622
e1
e2
e3
e4
e1
e2
e4
Site 1
Site 2
Layer 2 Link
e0/0
Switch-1
e0/0
Switch-2
e0/1
e0/2
e0/1
e0/2
PC1
PC2
PC3
PC4
Mgmt
VPCS
VPCS
VPCS
VPCS
Vlan=2
10.10.10.1/24
Vlan=3
11.11.11.1/24
Vlan=2
10.10.10.2/24
Vlan=3
11.11.11.2/24

Configuring EOIP tunnel

- Internet Link
  - Fiber (Primary Link)
  - RF (Backup Link)
- Layer 2 link

Configuration Steps

1. Configure routed pool given by your SP. In our case it's 111.1.1.1/32 for your site 1 and 222.2.2.2/32 for your site 2.
   a) Primary Link = BGP & Static Route
   b) Secondary Link = Static Route
2. Create the EoIP tunnel over this IP Prefix.
3. Create another EoIP tunnel over Layer 2 circuit.
4. Call both these EoIP tunnel's in Bridge/Bonding.

Basic Configuration

Name Interface
Assign IP address

Site 1

R	ether1 - Primary	Ethernet	1500
R	ether2 - Backup	Ethernet	1500
R	ether3 - DarkCore	Ethernet	1500
RS	ether4 - LAN	Ethernet	1500

Address List

Address	Network	Interface
111.1.1.1	111.1.1.1	Loopback
192.168.1.1/24	192.168.1.0	ether2 - Backup
192.168.12.1/24	192.168.12.0	ether3 - DarkCore
192.168.31.1/24	192.168.31.0	ether1 - Primary
192.168.48.11/24	192.168.48.0	ether10 - Mgmt

Site 2

R	ether1 - Primary	Ethernet	1500
R	ether2 - Backup	Ethernet	1500
R	ether3 - DarkCore	Ethernet	1500
RS	ether4 - LAN	Ethernet	1500

Address List

Address	Network	Interface
192.168.2.2/24	192.168.2.0	ether2 - Backup
192.168.12.2/24	192.168.12.0	ether3 - DarkCore
192.168.42.2/24	192.168.42.0	ether1 - Primary
192.168.48.22/24	192.168.48.0	ether10 - Mgmt
222.2.2.2	222.2.2.2	Loopback

BGP Pairing

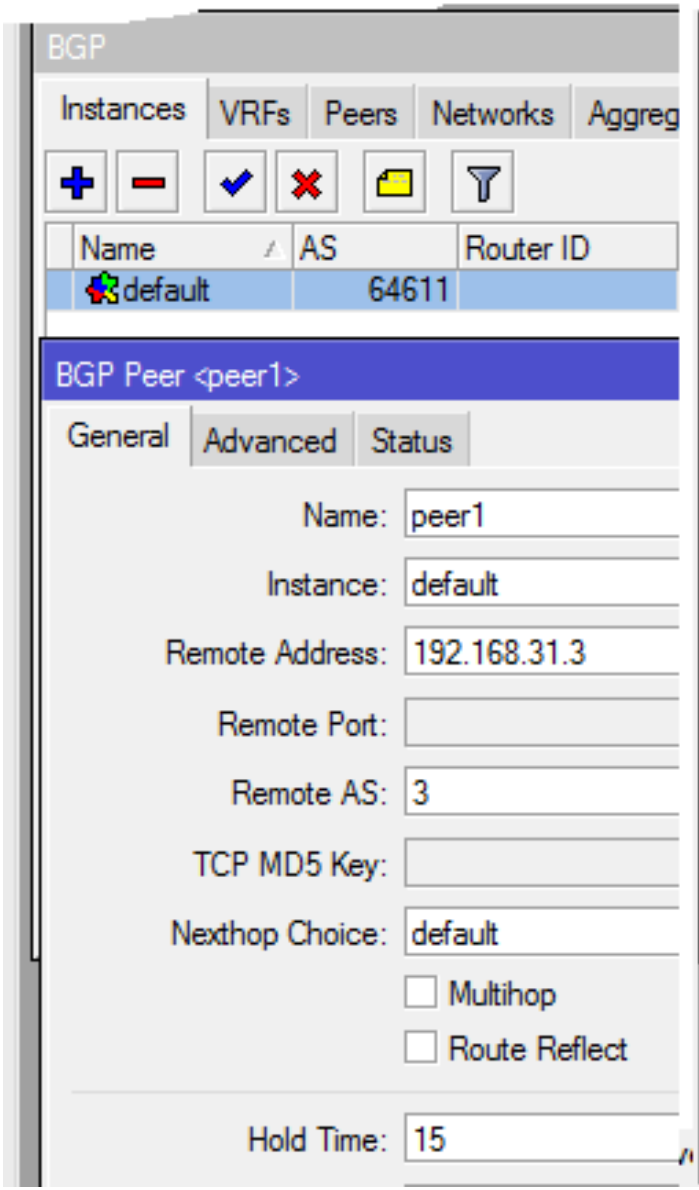
Point to Ponder:
TTL for eBGP & iBGP

Define your AS in instance

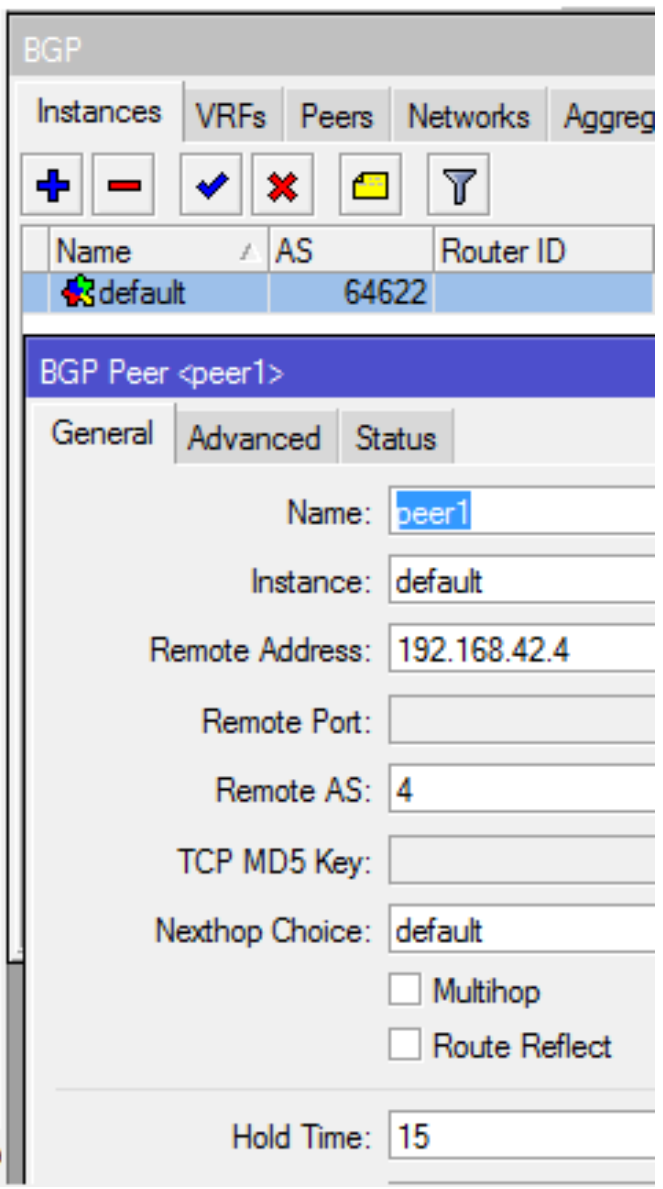
In peers define the neighbor parameters

- Instance (Own AS)
- Remote Address
- Remote AS

Site 1



Site 2



BGP

Point to Ponder:
Classless prefix advertisement in BGP

- Advertise the IP prefix in BGP.
- For internet, common practice for BGP scenario is given below
  - Upstream inject the default route to client
  - Upstream advertise a loopback to customer. Customer will add the default route towards that Loopback.

Point to Ponder:
Recursive routing

Routes

- Default Route towards the Loopback advertised by SP.
- For backup link, default route with higher administrative distance.

Site 1

Route List

Routes | Nexthops | Rules | VRF

Find

	Dst. Address	Gateway	Distance
AS	0.0.0.0/0	3.3.3.3 recursive via 192.168.31.3 ether1 - Primary	1
S	0.0.0.0/0	192.168.1.3 reachable ether2 - Backup	200
DAb	3.3.3.3	192.168.31.3 reachable ether1 - Primary	20

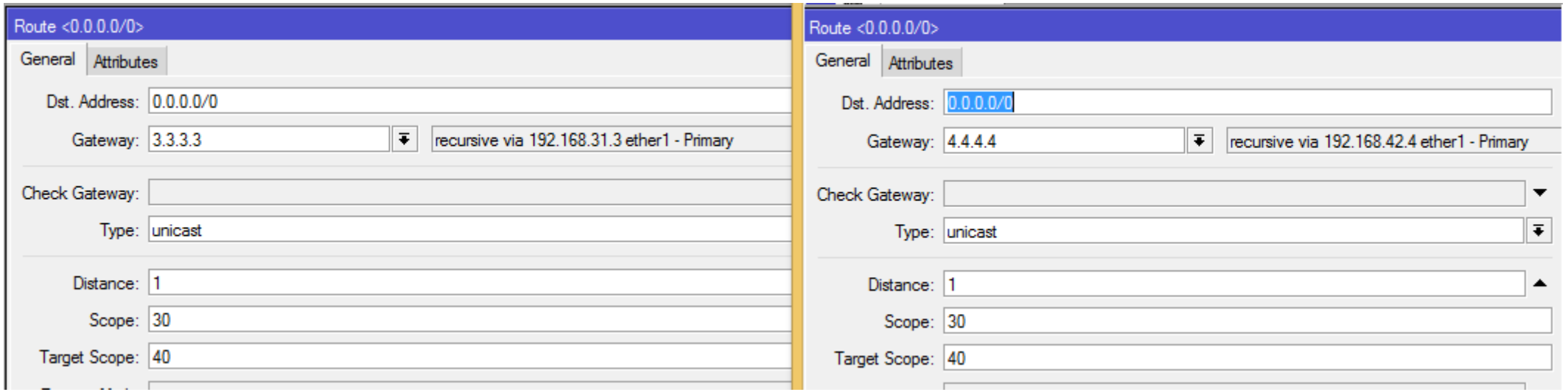
Site 2

Route List

Routes | Nexthops | Rules | VRF

	Dst. Address	Gateway	Distance
S	0.0.0.0/0	192.168.2.4 reachable ether2 - Backup	200
AS	0.0.0.0/0	4.4.4.4 recursive via 192.168.42.4 ether1 - Primary	1
DAb	4.4.4.4	192.168.42.4 reachable ether1 - Primary	20

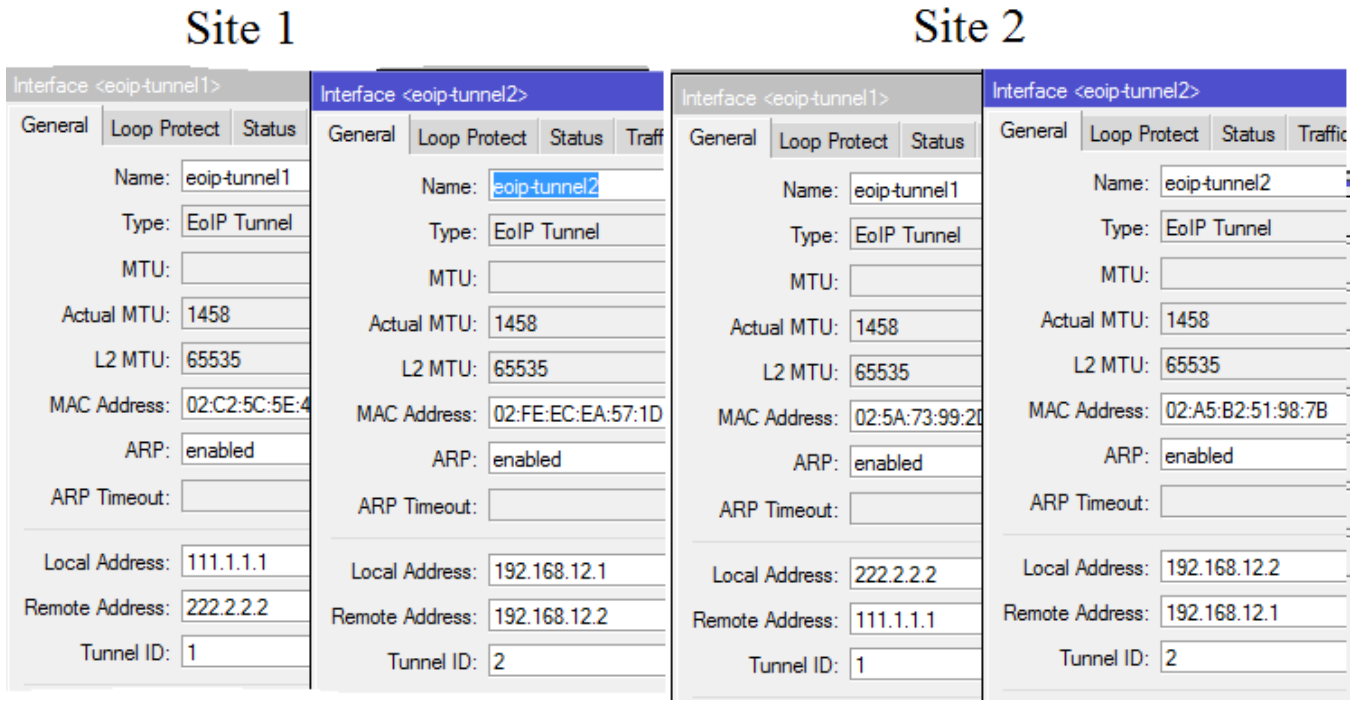
Routes (Recursive Routing)

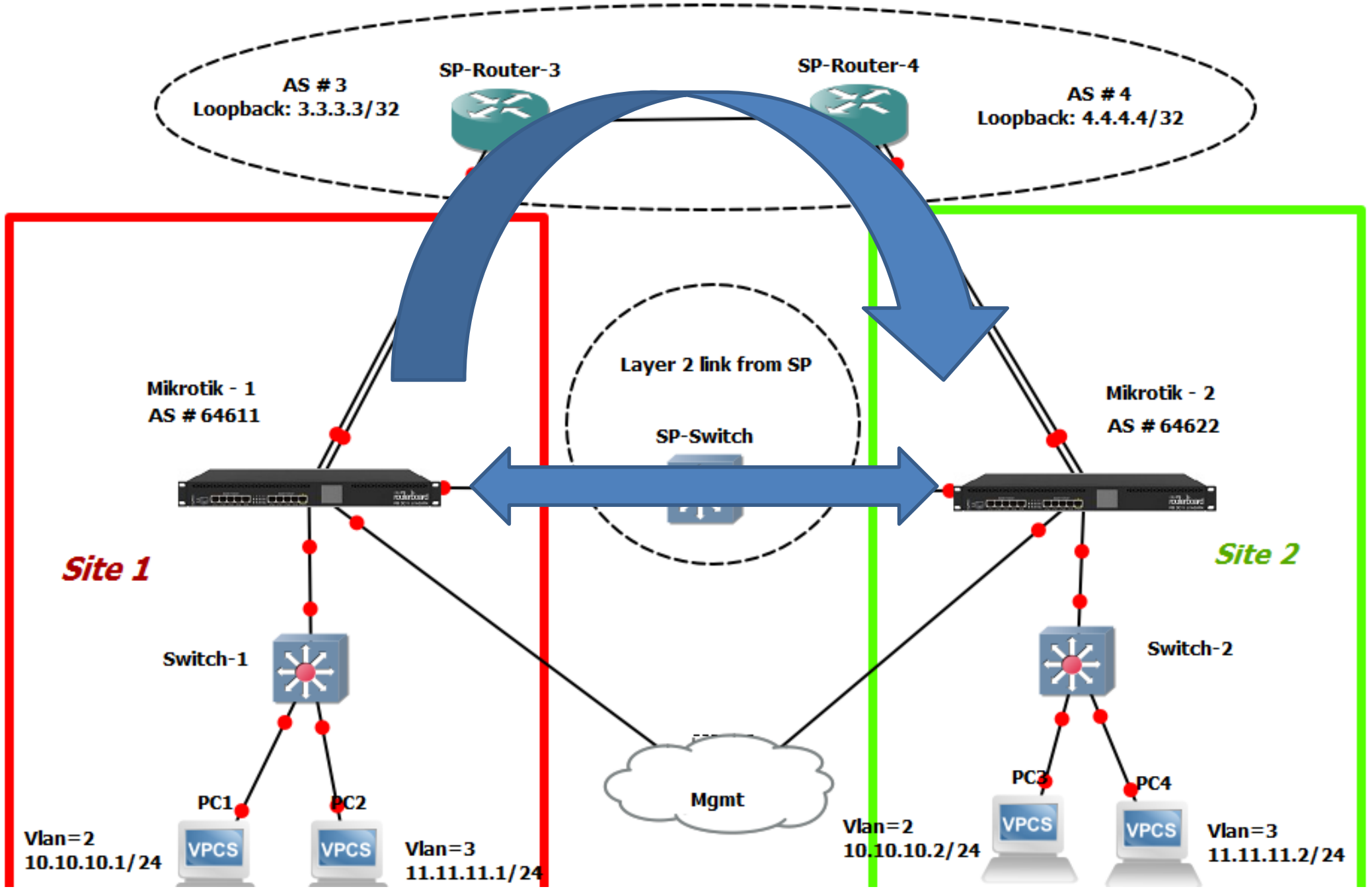


Food for thought:
Local Address in EOIP

Configuring EOIP

- Configure EOIP over Public IP
- Assign the IP address to Layer 2 link and configure the EOIP over it.




AS # 3
Loopback: 3.3.3.3/32
SP-Router-3
SP-Router-4
AS # 4
Loopback: 4.4.4.4/32
Layer 2 link from SP
SP-Switch
Mikrotik - 1
AS # 64611
Mikrotik - 2
AS # 64622
Site 1
Site 2
Switch-1
Switch-2
PC1
PC2
PC3
PC4
VPCS
VPCS
VPCS
VPCS
Mgmt
Vlan=2
10.10.10.1/24
Vlan=3
11.11.11.1/24
Vlan=2
10.10.10.2/24
Vlan=3
11.11.11.2/24

Food for thought:
Is it necessary to run STP

Bridge

- Call that EOIP in Bridge interface.
- Run STP on bridge interface and set the primary backup link using the cost of STP.

Site 1

Bridge

Bridge | Ports | Filters | NAT | Hosts

Interface	Bridge	Priority (hex)	Path Cost	I	Role	Root Path Cost
eoip-tunnel1	EOIO-B	80	10		alternate port	10
eoip-tunnel2	EOIO-B	80	5		root port	5
ether4 - LAN	EOIO-B	80	10		designated port	

Site 2

Bridge

Bridge | Ports | Filters | NAT | Hosts

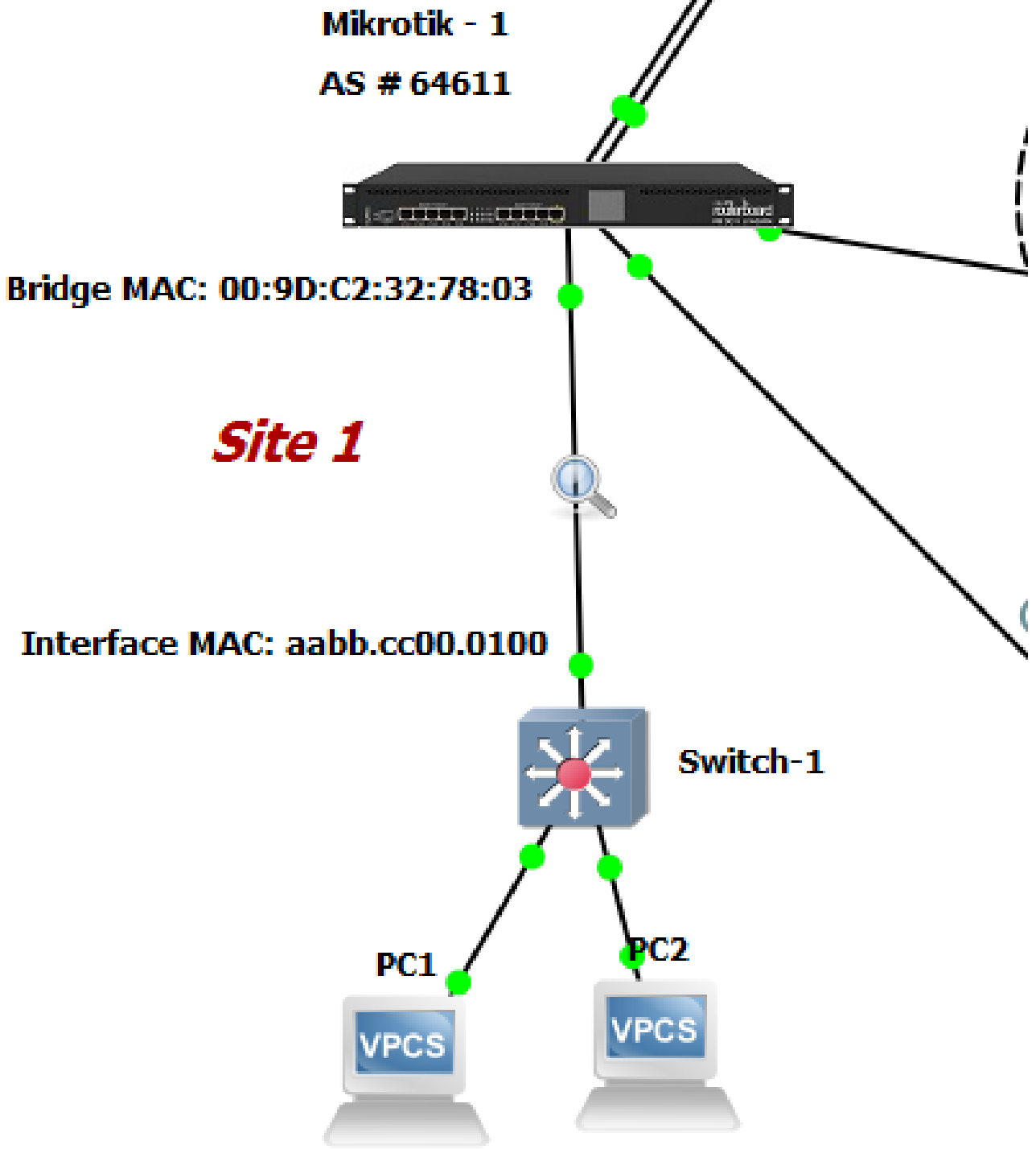
Interface	Bridge	Priority (hex)	Path Cost	I	Role	F
eoip-tunnel1	EOIO-B	80	10		designated port	
eoip-tunnel2	EOIO-B	80	10		designated port	
ether4 - LAN	EOIO-B	80	10		designated port	

Point to Ponder

- STP run on bridge don't need to leave Mikrotik.
- STP running at Network side encapsulate in EoIP tunnels and forwarded on both side.

STP Wireshark

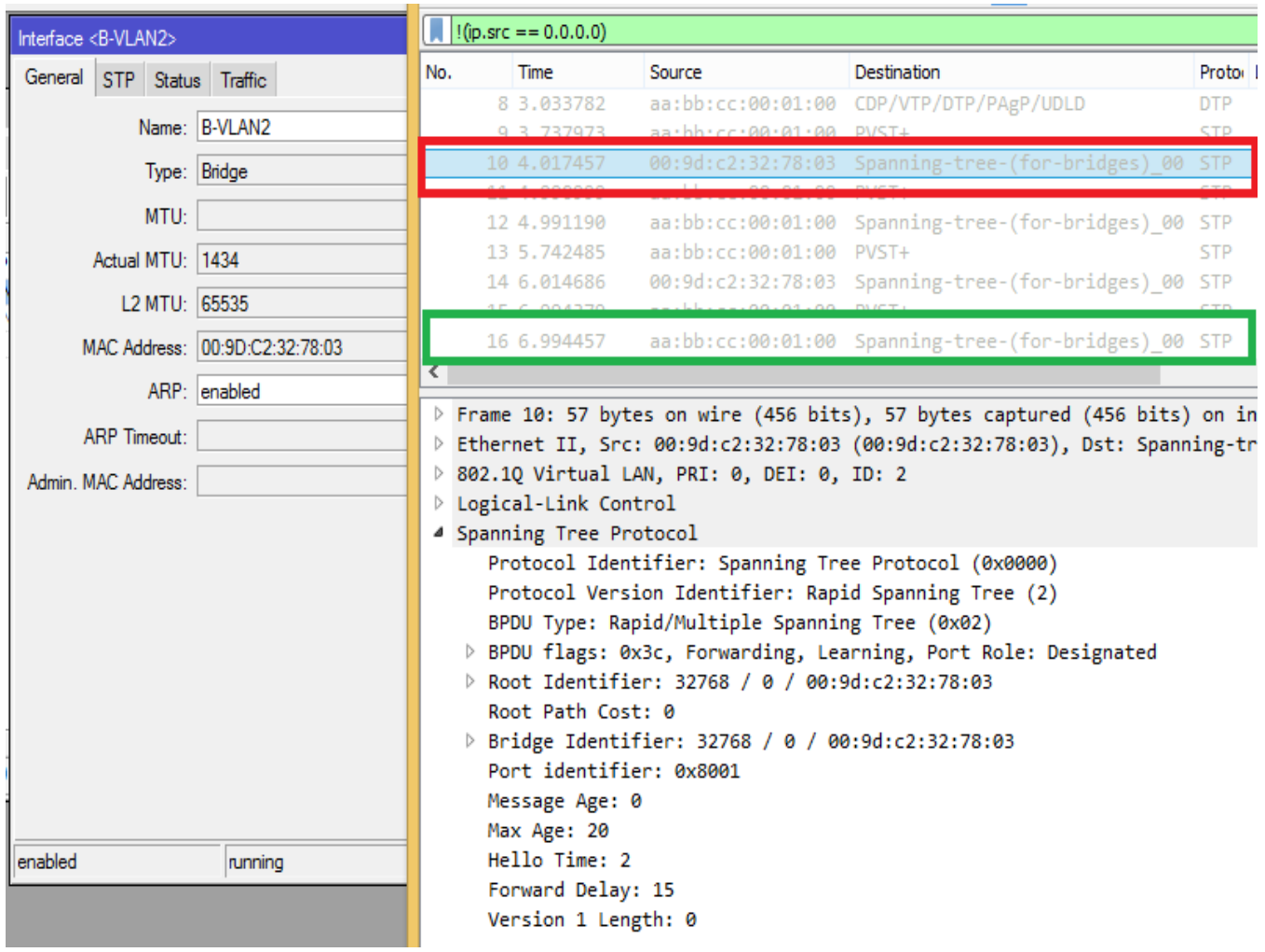
Capturing the packet
between
Router and Switch



STP for Bridges

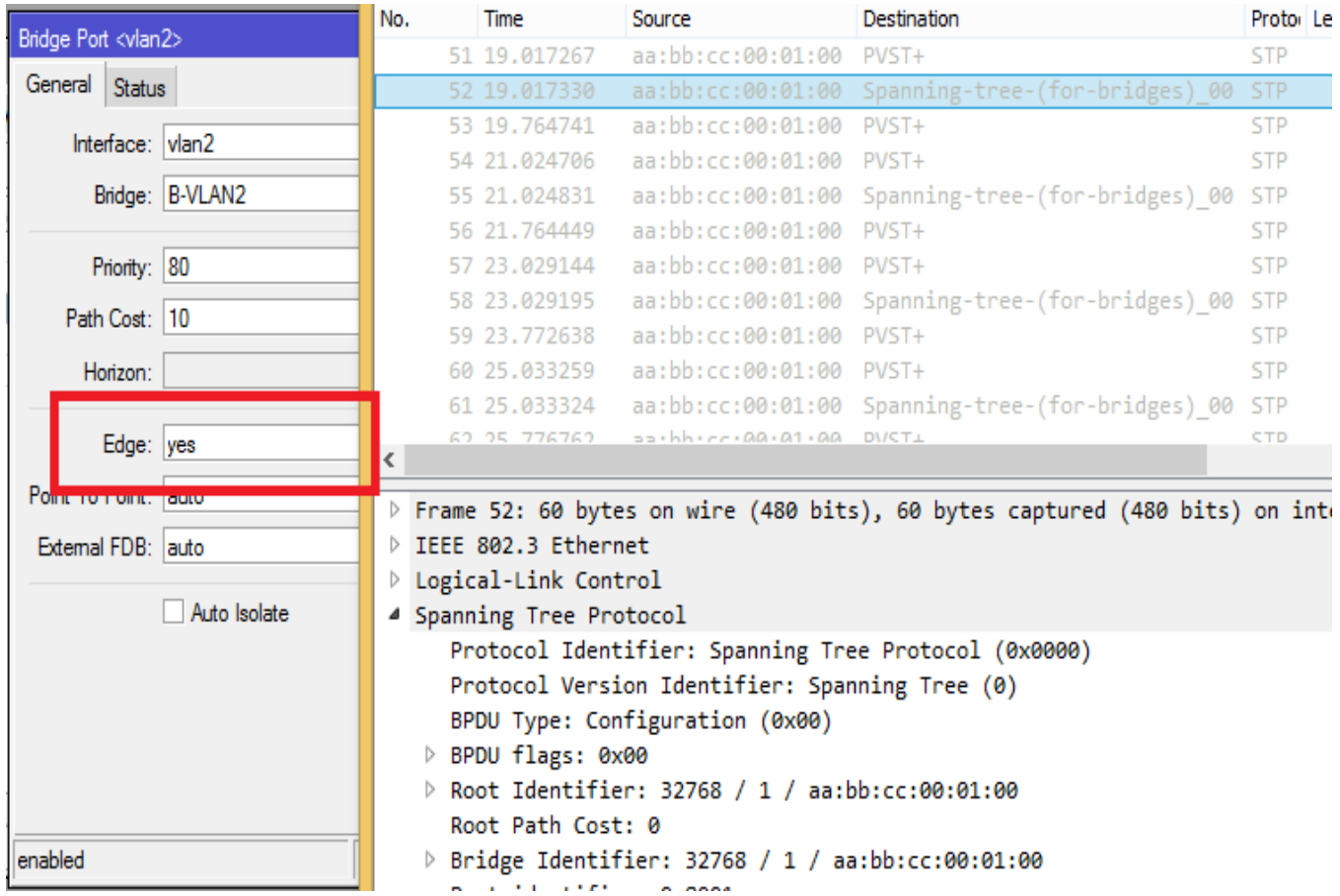
STP running on Bridge send BPDU's down to the Switch as-well. Which is don't need of it.

Mikrotik Bridge MAC: 00:9D:C2:32:78:03
Switch Interface MAC: aabb.cc00.0100



STP for Bridges

After configuring it to Edge there is no BPDU Coming down to network

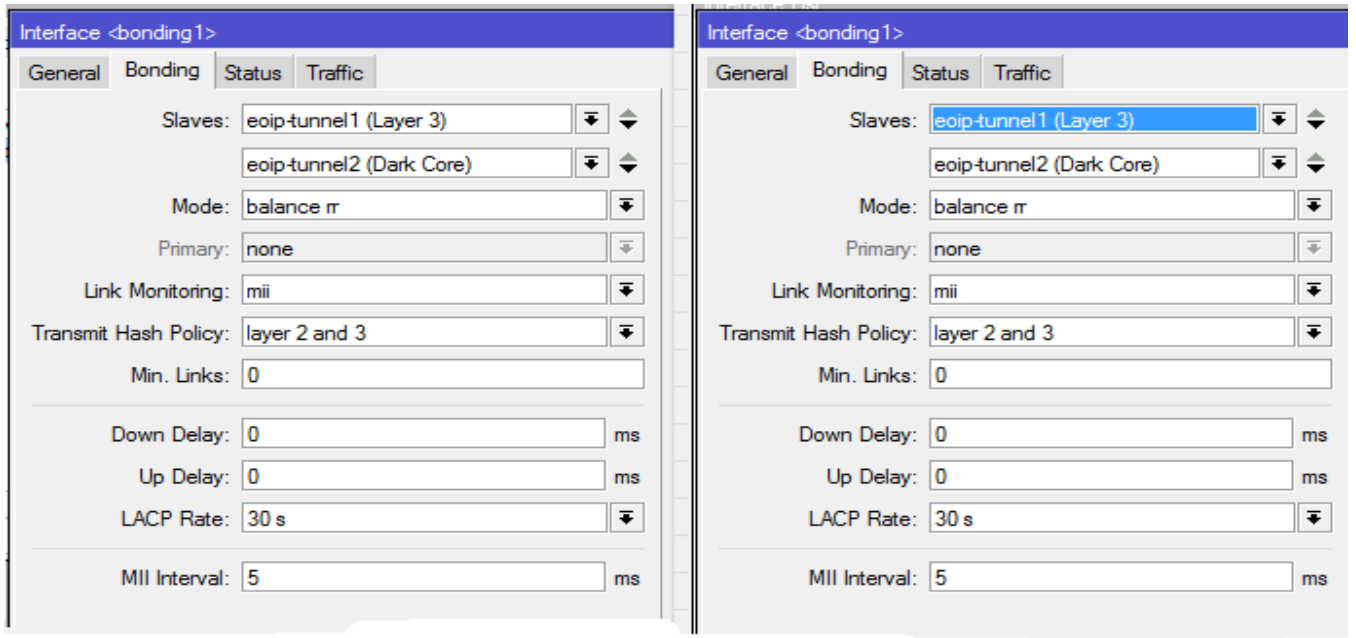


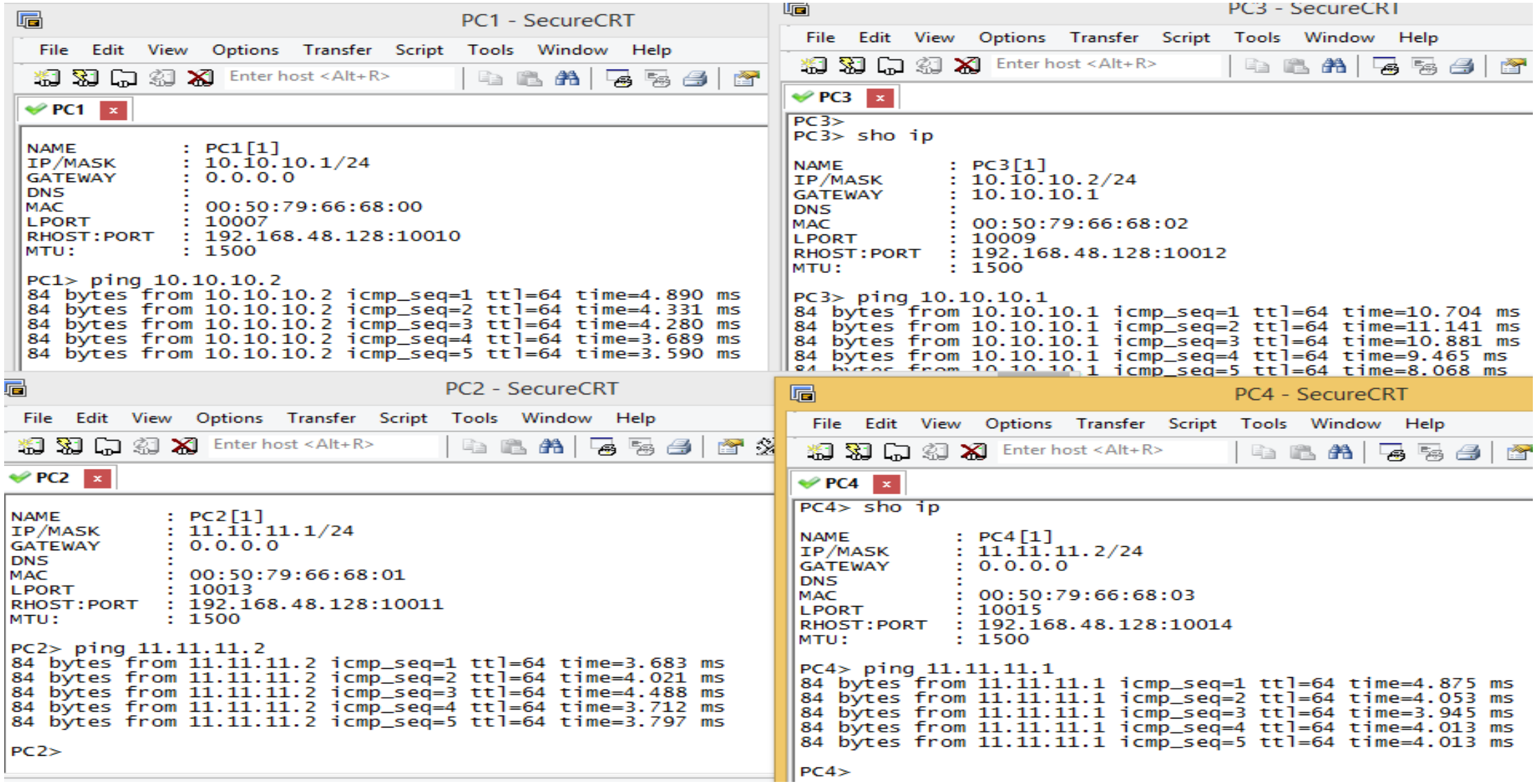
Second Solution: Bonding

- To increase the uptime and throughput, we use multiple links. And configure them in such a way that we achieve **Load Balance** alongside of **Failover**

Second Solution: Bonding

By using bonding, we can increase the throughput by utilizing all links alongside of failover.




PC1 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
PC1
NAME : PC1[1]
IP/MASK : 10.10.10.1/24
GATEWAY : 0.0.0.0
DNS :
MAC : 00:50:79:66:68:00
LPORT : 10007
RHOST:PORT : 192.168.48.128:10010
MTU: : 1500
PC1> ping 10.10.10.2
84 bytes from 10.10.10.2 icmp_seq=1 ttl=64 time=4.890 ms
84 bytes from 10.10.10.2 icmp_seq=2 ttl=64 time=4.331 ms
84 bytes from 10.10.10.2 icmp_seq=3 ttl=64 time=4.280 ms
84 bytes from 10.10.10.2 icmp_seq=4 ttl=64 time=3.689 ms
84 bytes from 10.10.10.2 icmp_seq=5 ttl=64 time=3.590 ms
PC3 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
PC3
PC3>
PC3> sho ip
NAME : PC3[1]
IP/MASK : 10.10.10.2/24
GATEWAY : 10.10.10.1
DNS :
MAC : 00:50:79:66:68:02
LPORT : 10009
RHOST:PORT : 192.168.48.128:10012
MTU: : 1500
PC3> ping 10.10.10.1
84 bytes from 10.10.10.1 icmp_seq=1 ttl=64 time=10.704 ms
84 bytes from 10.10.10.1 icmp_seq=2 ttl=64 time=11.141 ms
84 bytes from 10.10.10.1 icmp_seq=3 ttl=64 time=10.881 ms
84 bytes from 10.10.10.1 icmp_seq=4 ttl=64 time=9.465 ms
PC2 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
PC2
NAME : PC2[1]
IP/MASK : 11.11.11.1/24
GATEWAY : 0.0.0.0
DNS :
MAC : 00:50:79:66:68:01
LPORT : 10013
RHOST:PORT : 192.168.48.128:10011
MTU: : 1500
PC2> ping 11.11.11.2
84 bytes from 11.11.11.2 icmp_seq=1 ttl=64 time=3.683 ms
84 bytes from 11.11.11.2 icmp_seq=2 ttl=64 time=4.021 ms
84 bytes from 11.11.11.2 icmp_seq=3 ttl=64 time=4.488 ms
84 bytes from 11.11.11.2 icmp_seq=4 ttl=64 time=3.712 ms
84 bytes from 11.11.11.2 icmp_seq=5 ttl=64 time=3.797 ms
PC2>
PC4 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
PC4
PC4> sho ip
NAME : PC4[1]
IP/MASK : 11.11.11.2/24
GATEWAY : 0.0.0.0
DNS :
MAC : 00:50:79:66:68:03
LPORT : 10015
RHOST:PORT : 192.168.48.128:10014
MTU: : 1500
PC4> ping 11.11.11.1
84 bytes from 11.11.11.1 icmp_seq=1 ttl=64 time=4.875 ms
84 bytes from 11.11.11.1 icmp_seq=2 ttl=64 time=4.053 ms
84 bytes from 11.11.11.1 icmp_seq=3 ttl=64 time=3.945 ms
84 bytes from 11.11.11.1 icmp_seq=4 ttl=64 time=4.013 ms
84 bytes from 11.11.11.1 icmp_seq=5 ttl=64 time=4.013 ms
PC4>

EoIP Proposed Design

From SP Perspective

Additional things

- To extend a particular VLAN
  - Create a sub interface of that particular VLAN
  - Call that sub interface in the bridge
  - Apply the queue policy to EOIP interface to restrict the bandwidth.
- You can create multiple EOIP interface to extend multiple VLAN and apply the policy accordingly.

Question

Why are we creating multiple EoIP interface over different subnet?

We can create multiple EoIP tunnels by using the tunnel ID but you cannot apply the Queue policy in that scenario.

Multiple EoIP Interface

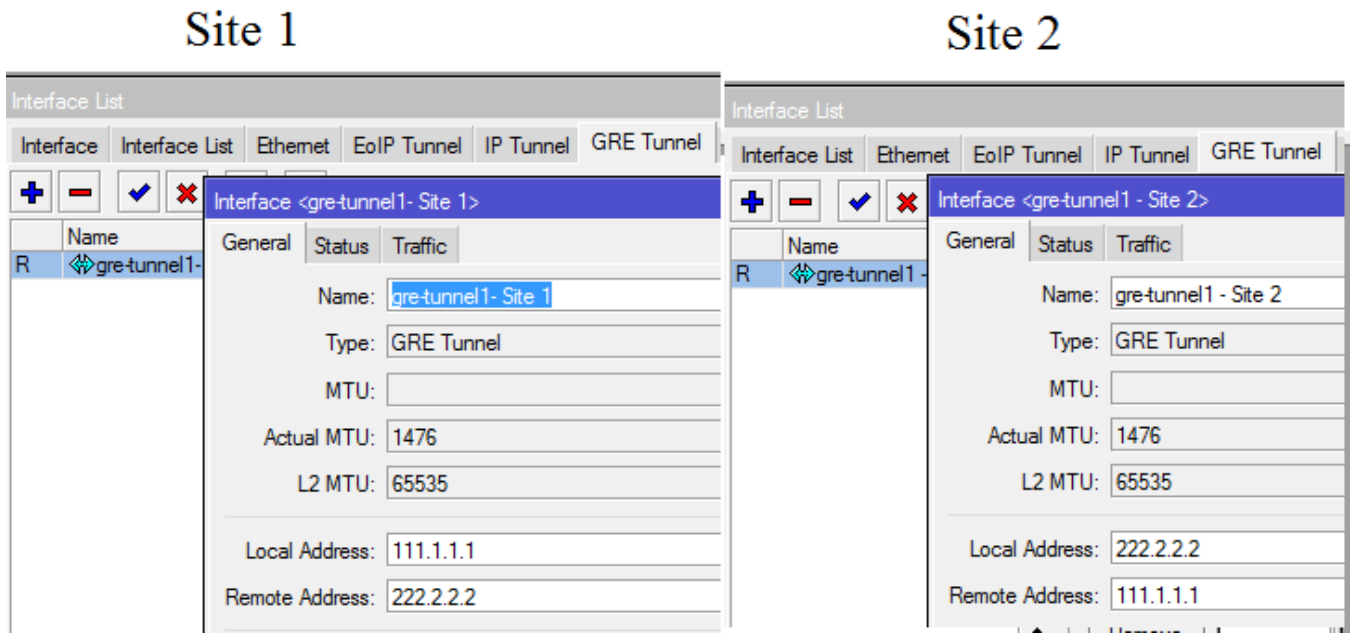
- There are many methods for multiple EOIP tunnels are to be reachable. Suggested method is given below.

Method 1: Configure GRE tunnel and run Routing Protocol on it

Method2: Configure GRE tunnel and add Static Routes

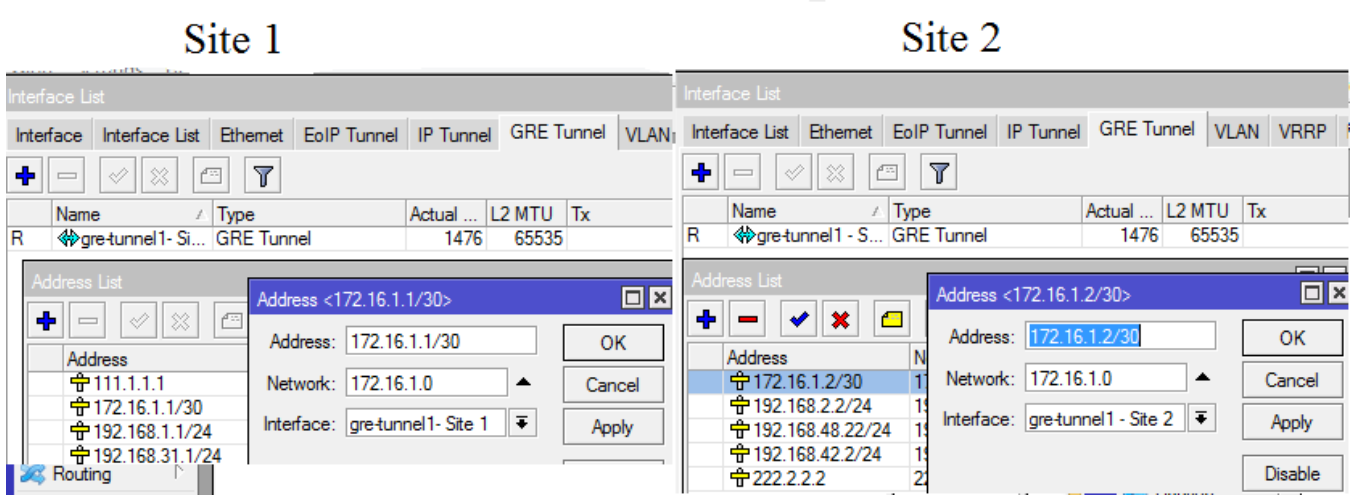
Creating GRE tunnel

Create a GRE tunnel over the Public IP



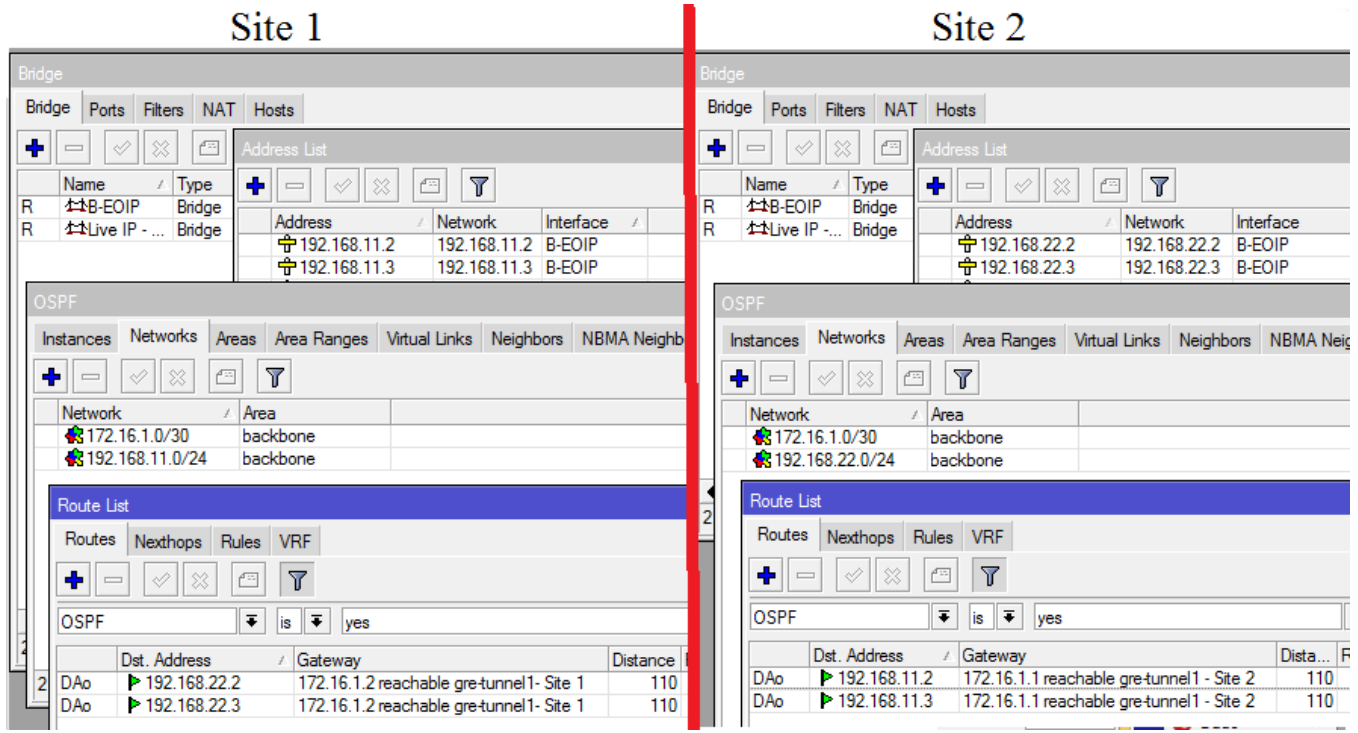
Assign IP address to GRE

Assign the Private IP to GRE tunnel



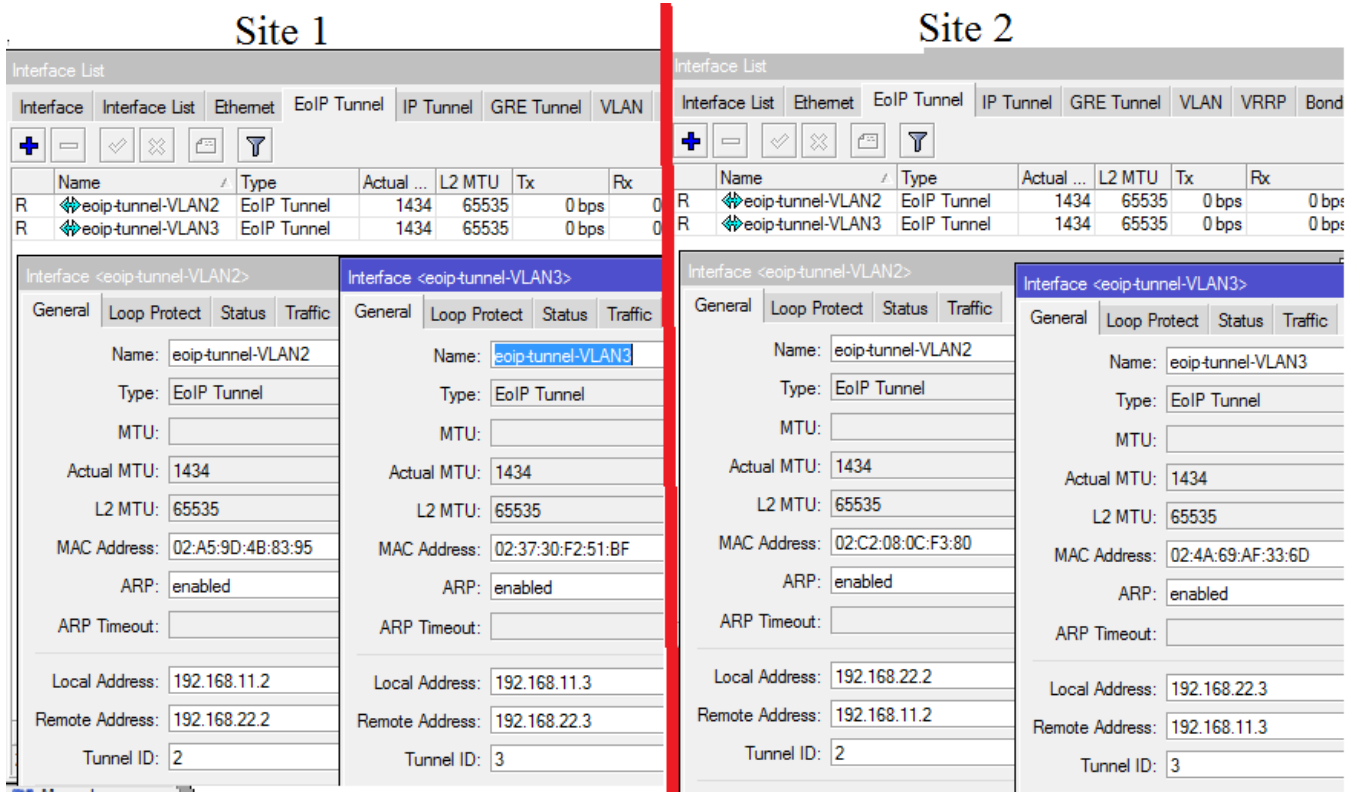
Method1: Create and assign IP address on Interface and advertise in OSPF

- Create one Bridge Interface
- Configure multiple /32 IP on it
- Advertise the subnet and GRE interface IP in OSPF



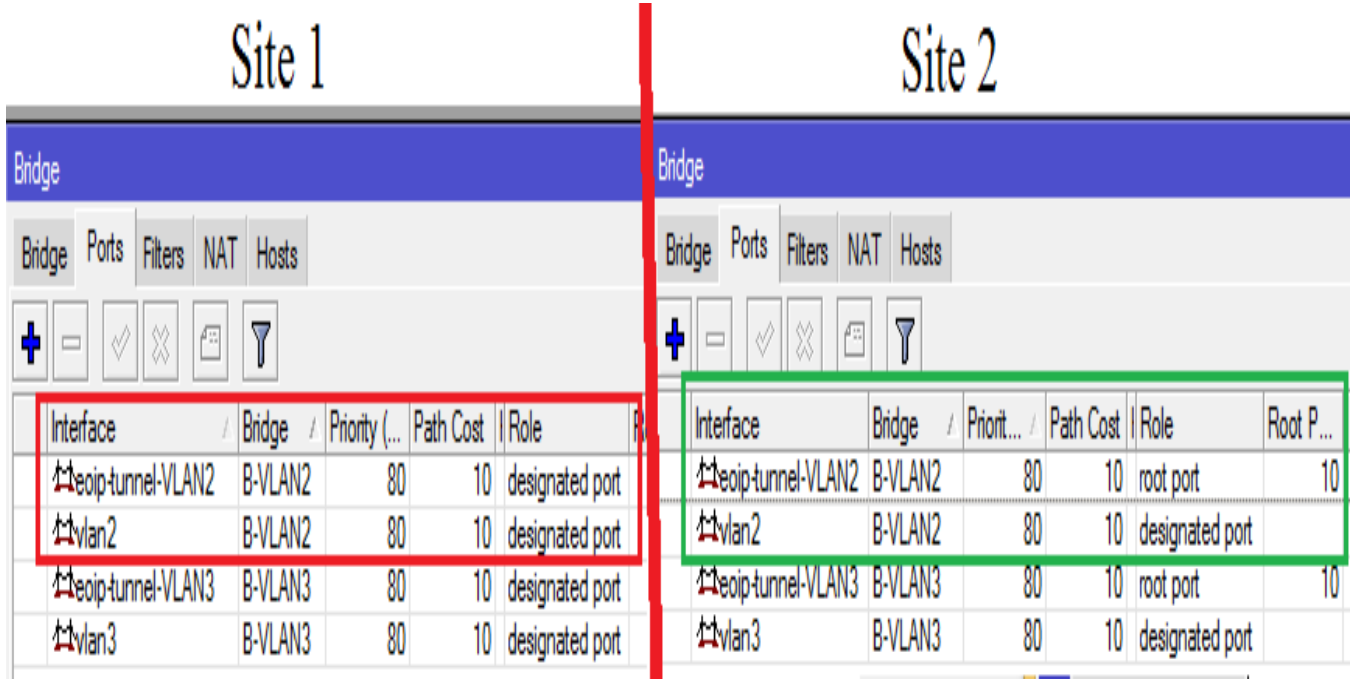
Create EOIP tunnels

Create multiple EoIP tunnels over the Loopback configure at both end



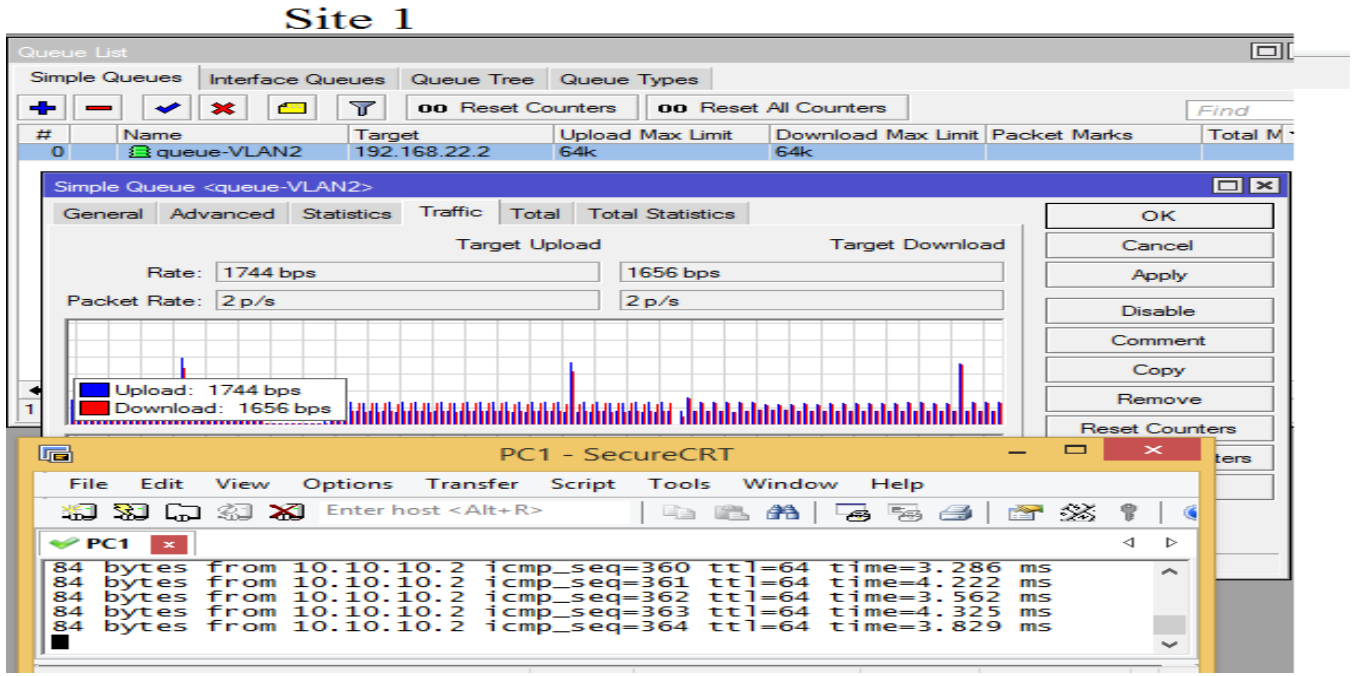
Creating the Bridge for particular VLAN

Create a Bridge Interface and allocate the particular VLAN and EoIP tunnel into it



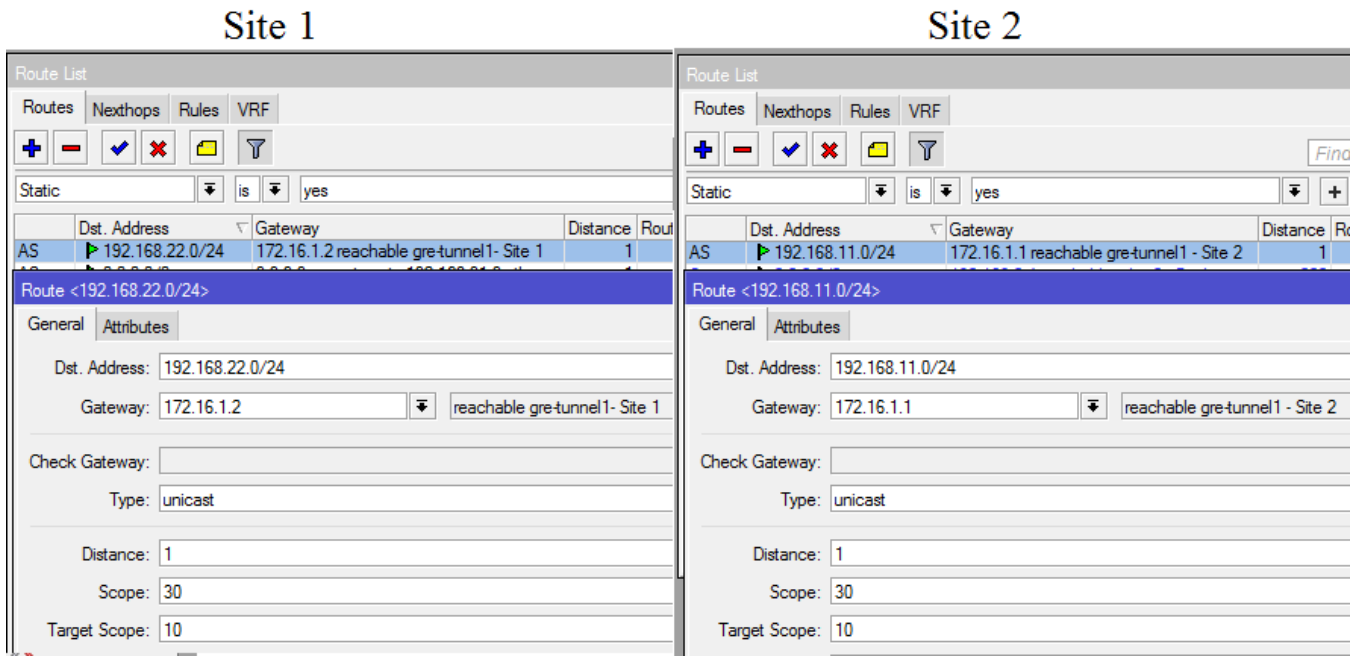
Apply the Queue Policy

Use the destination IP address (Loopback IP of other end) in Queue policy.

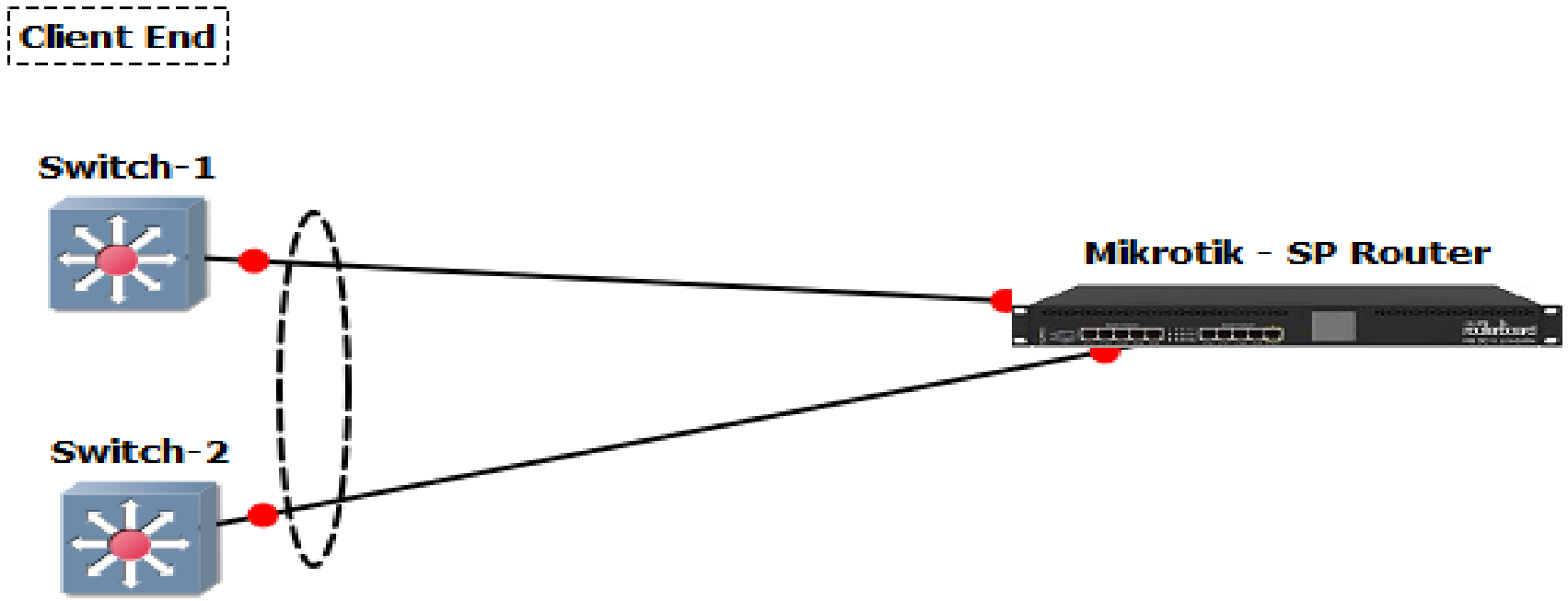


Method 2: By Static Route

Add the static for the subnet towards GRE tunnel destination



Home Assignment



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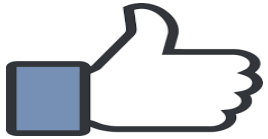
Bits & Bytes



fb.com/3Bits1Byte