Scenario-1
MLTG-360 (DN) to MLTG-360 (DN)

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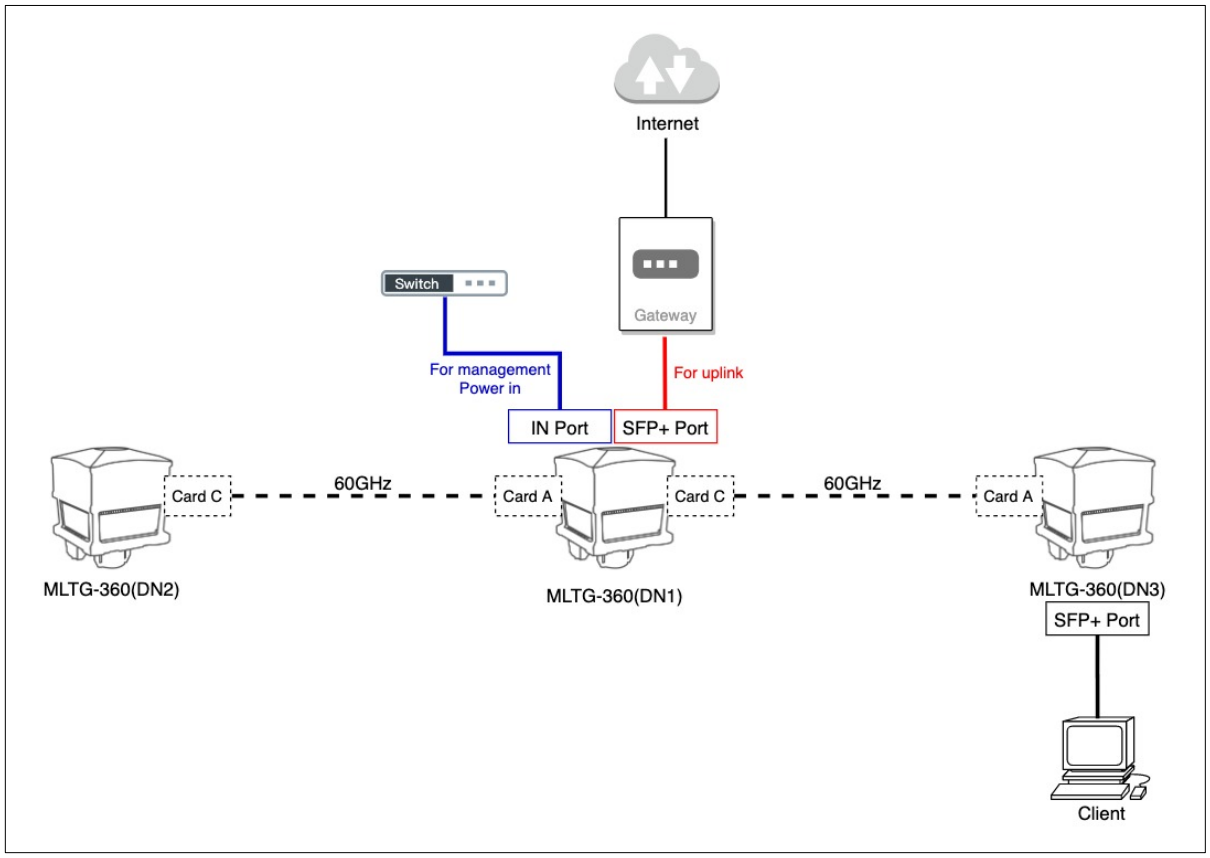
1. Test Environment

One MLTG-360 (**DN**) setup links with 2 MLTG-360 (**DN**) on 2 different radio cards.



2. Prerequisites

i. QR code scanner - Scan the QR code sticker to obtain the device's Serial number and MAC address.

ii. PoP (Point-of-Presence) Node - A DN that serves as the demarcation between the Terragraph network and the provider's backbone network. The PoP node is part of the Terragraph network.

iii. An **IPv6-compatible** router which can be configured for routing traffic to and from the Terragraph network prefix.

3. Hardware Setup

Quantity	Device	Description
3	DN	DN serves as the demarcation between the Terragraph network and the provider's backbone network. While Terragraph is a wireless technology, there must be at least one wired Terragraph PoP node that connects to an upstream IPv6-enabled network.
1	SFP+10Gbps Ethernet module	The SFP+ port is utilized to connect the Terragraph network into a provider's IP network and to the Client.
1	PC(Client)	Clients use PC to connect to DN's LAN port to use network

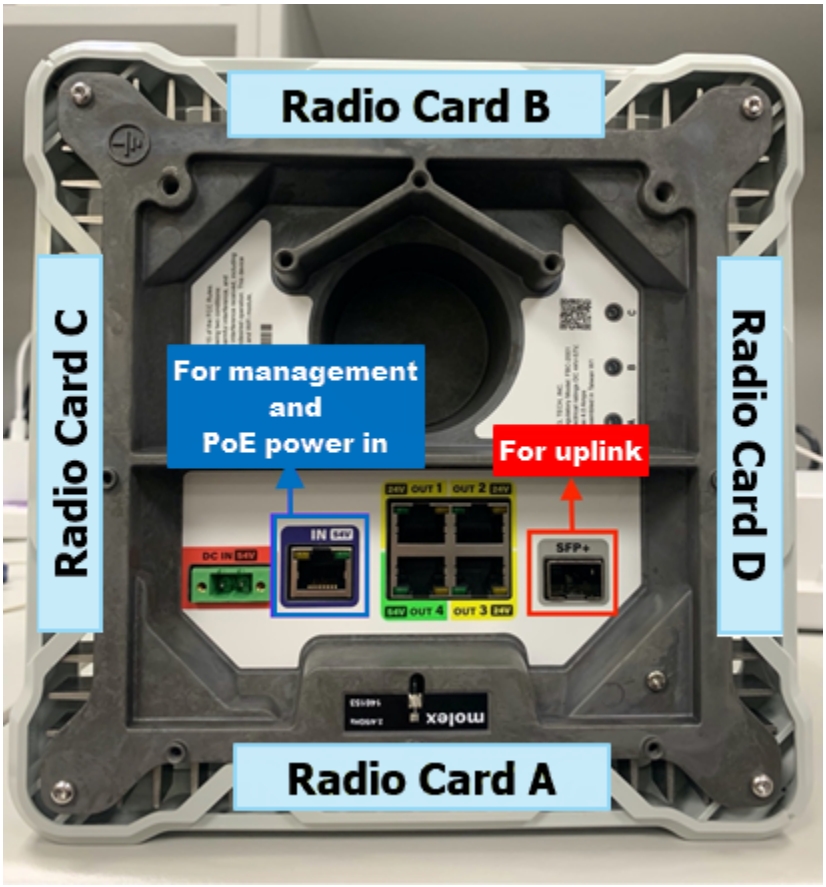
4. Use ports

Device	Port name	Description
MLTG-360	SFP+	The interface that the PoP node uses to communicate with the upstream router and the interface that the client uses to communicate with the upstream.
	IN	For management and PoE power in

5. Indication of radio card

DN

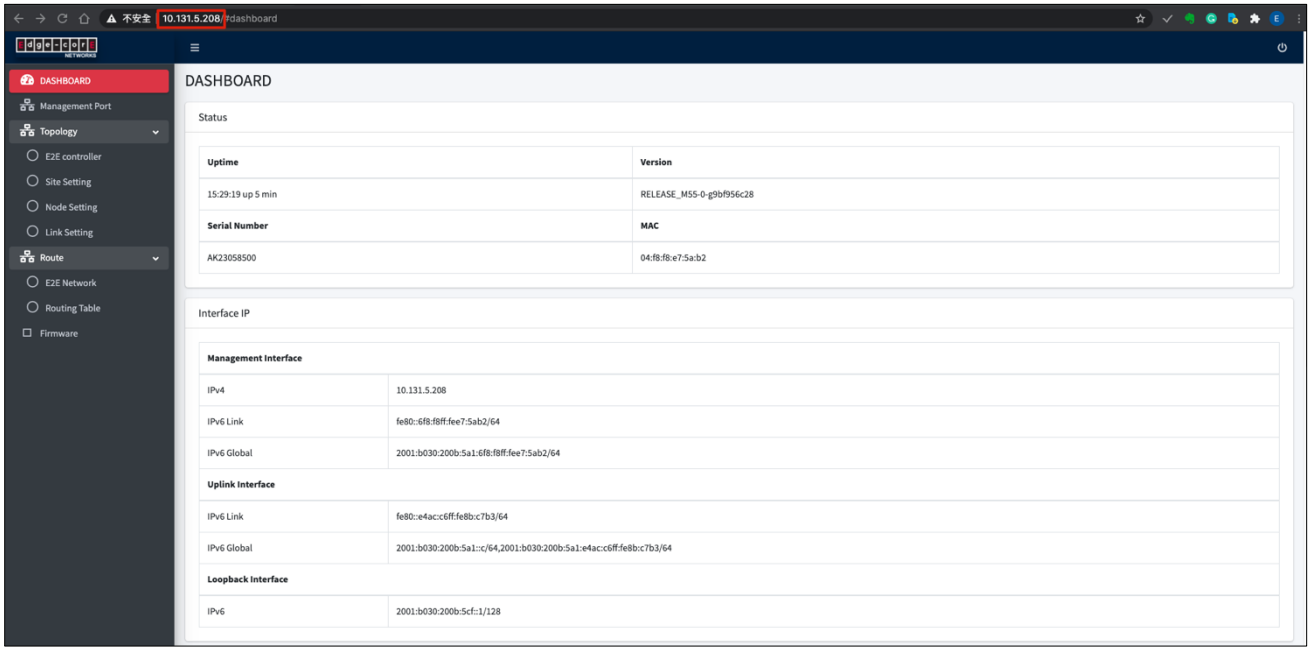
4x 60GHz Radio, supporting 360˚ (90˚ x 4)



6. Setup procedure

6.1. In order to configures and control the DN network, we have to enable the E2E(End-to-End) Controller on the PoP node (**DN1 in this setup**).
The E2E controller is a software application that communicates with and manages Terragraph nodes in the network. It also provides service that bring-up wireless links.

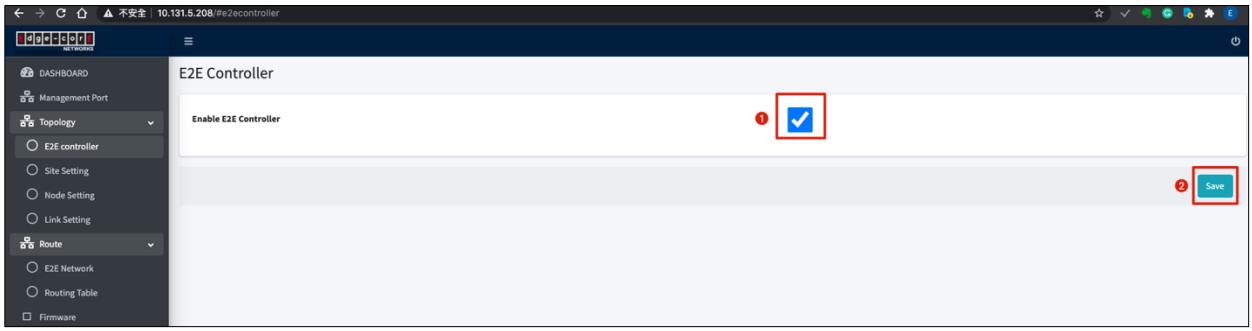
a. To access the PoP Node's web management interface, follow the steps below:
Enter the "management IP address" on the address bar of a web browser. The management port is set to operate by default in DHCP mode. If no DHCP server is available for management port, the device has a fall-back management IP address of 192.168.1.20 with a subnet mask of 255.255.255.0. You must set your PC's IP address to be on the same subnet with the PoP Node.



6.1.1. On the left-hand panel, Navigate to Topology and click on E2E controller

b. Enable E2E Controller *(*No need to enable E2E controller for other DN*).

c. Click 'Save' button



6.2. After enabling the E2E controller, you have to setup the site by entering site information for each of the Nodes deployed.
In this scenario, there will be 3 sites for each of the 3 DN nodes used in this deployment.

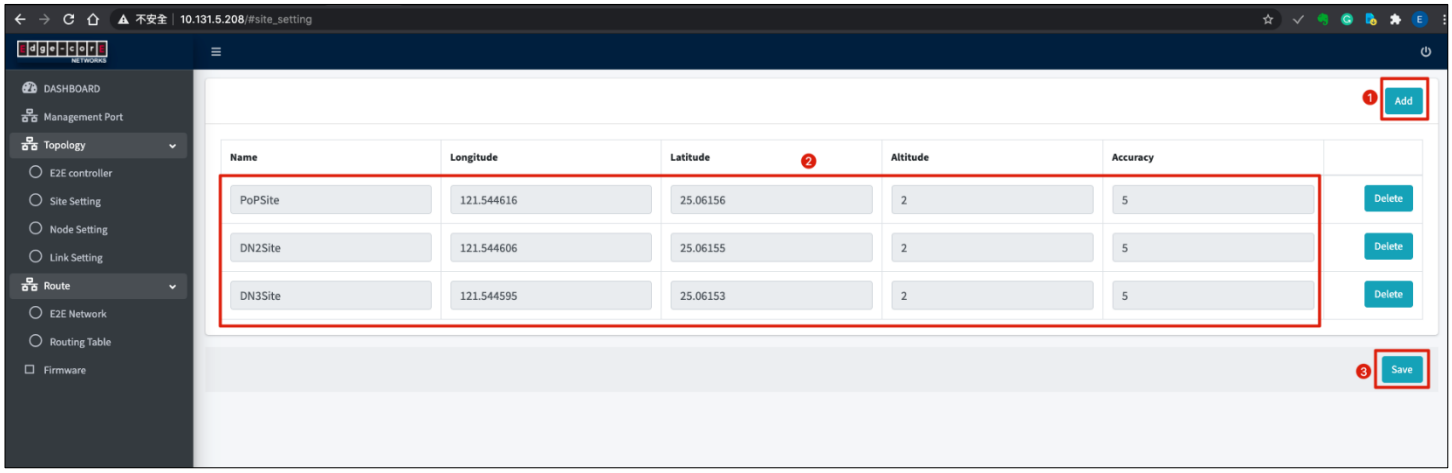
6.2.1. Under Topology, click on Site Setting and follow the below examples:

a. Click 'Add' button
   i. Site name: **POPSite**
   ii. Longitude: **121.544616**
   iii. Latitude: **25.06156**
   iv. Altitude: **2**
   v. Accuracy: **5**

b. Click 'Add' button
   i. Site name: **DN2Site**
   ii. Longitude: **121.544606**
   iii. Latitude: **25.06155**
   iv. Altitude: **2**
   v. Accuracy: **5**

c. Click 'Add' button
   i. Site name: **DN3Site**
   ii. Longitude: **121.544612**
   iii. Latitude: **25.06154**
   iv. Altitude: **2**
   v. Accuracy: **5**

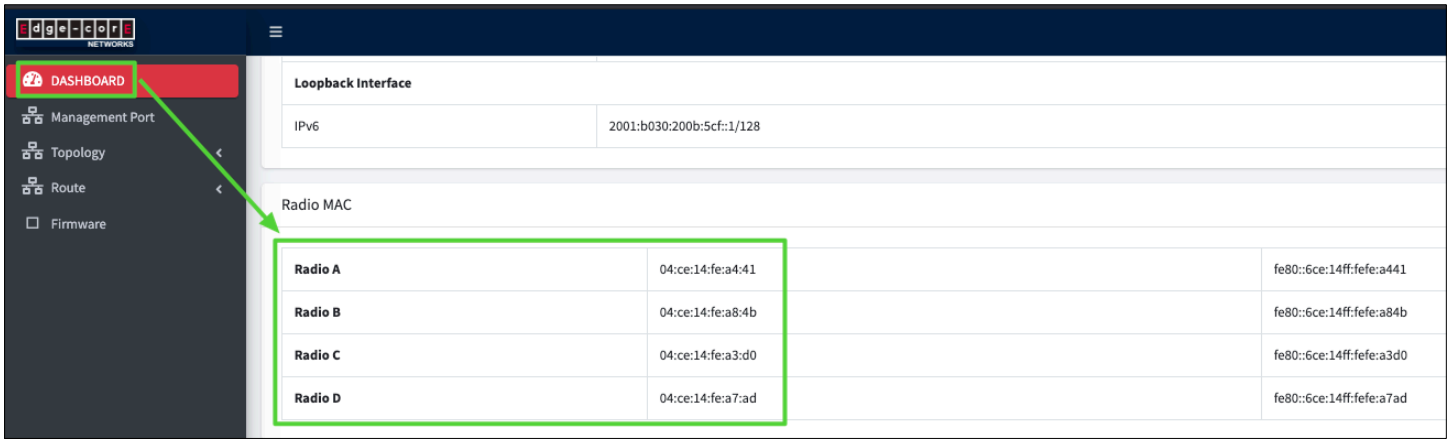
d. Click 'Save' button



6.3. Next, proceed to Note settings to set up Node MAC and Radios MACs of each particular Nodes.

6.3.1. Under Topology, click on Node Setting

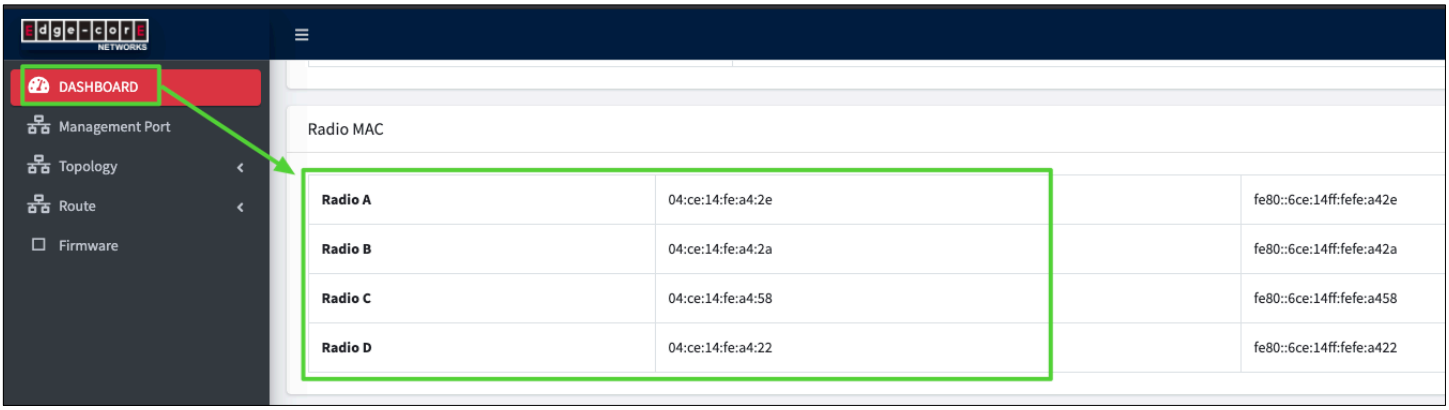
a. On each Node, take note of the Node MAC and the Radio MAC of 4 radio cards and the NODE MAC address on the dashboard page. You will be entering this information in the following step:



Here is an example setting:

i. Click 'Add' button
ii. Name: **POP**
iii. Node MAC: **04:f8:f8:e7:5a:b2**
iv. Radio MAC: *Must be entered in order (RadioA,RadioB,RadioC,RadioD) and to be separated by a comma
04:ce:14:fe:a4:41,04:ce:14:fe:a8:4b,04:ce:14:fe:a3:d0,04:ce:14:fe:a7:ad
v. Site: **POPSite**

b. Add DN node according to Radio mac of 4 radio cards and node mac address on the dashboard page.



Here is an example setting:

i. Click 'Add' button
ii. Name: **DN2**
iii. Node MAC: **{DN2's node mac}**
iv. Radio MAC: **{DN2's radio_cardA_mac,radio_cardB_mac,radio_cardC_mac,radio_cardD_mac}**
v. Site: **DN2Site**
vi. Click 'Add' button
vii. Name: **DN3**

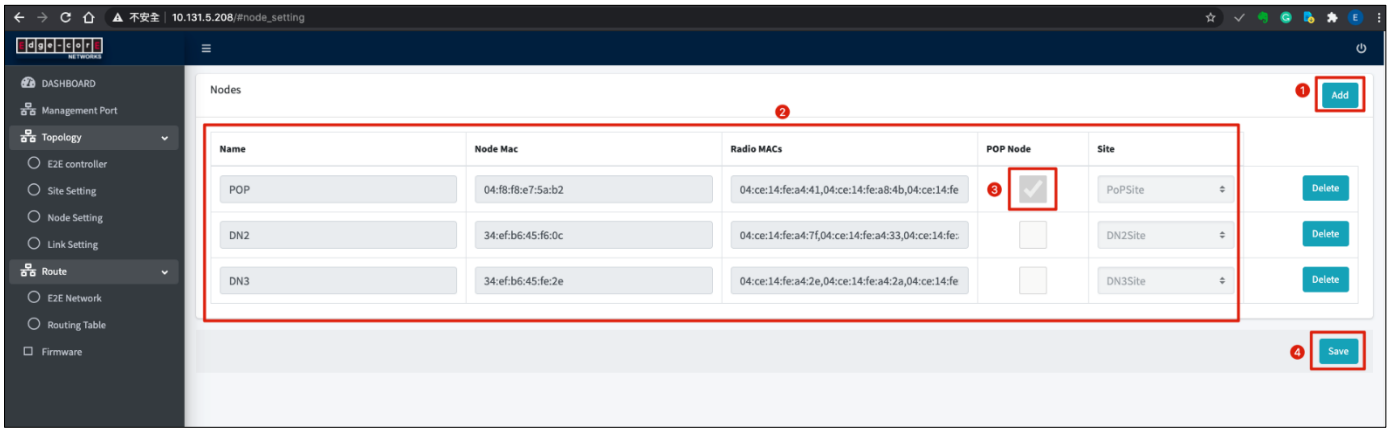
viii. Node MAC: **{DN3's node mac}**

ix. Radio MAC: **{DN3's radio_cardA_mac,radio_cardB_mac,radio_cardC_mac,radio_cardD_mac}**

x. Site: **DN3Site**

c. Assign DN1 as PoP node and Click 'Save' button

Here is an example setting:



6.4. Proceed to Link Setting to configure the wireless connection between the different Nodes.

6.4.1. Under Topology, click on Link Settings:

a. Add links between 3 DN nodes.

In this scenario, use different radio card to add 2 links between 3 DN nodes.

i. Adding 1 link between the DN2 node and the PoP node.

DN2(Radio card C: **04:ce:14:fe:a4:49**)----60GHz----PoP(Radio_card A: **04:ce:14:fe:a4:41**)

Here is an example setting:

1. Select "**DN2**" in **Peer** field, and select "**04:ce:14:fe:a4:49**" in **Peer Radio MAC** field
2. Select "**PoP**" in **Initiator** field, and select "**04:ce:14:fe:a4:41**" in **Initiator Radio MAC** field. (* Must select PoP node in Initiator Radio MAC)

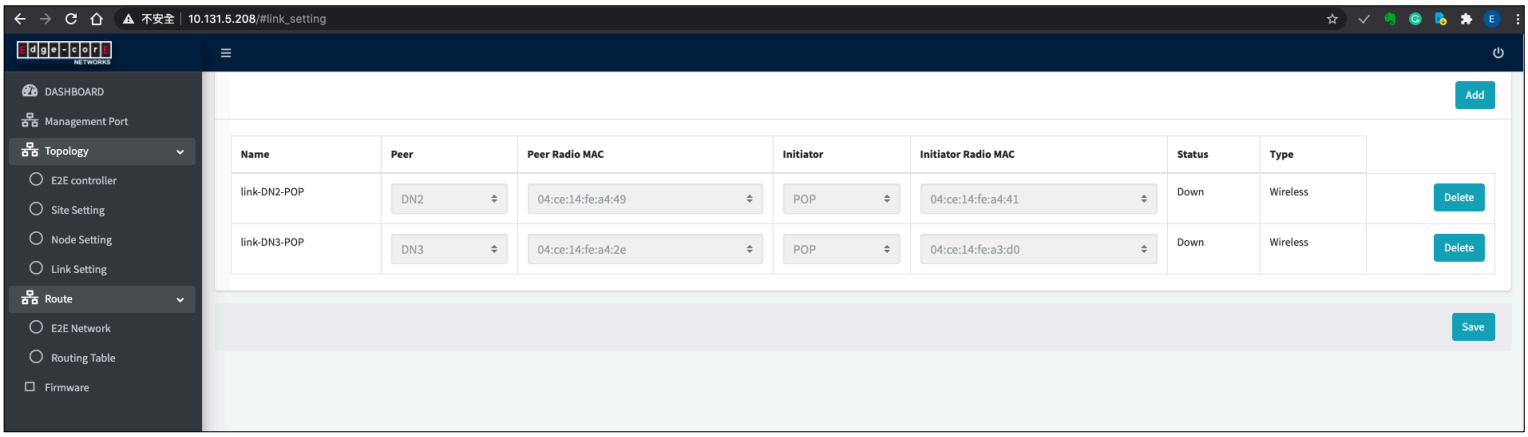
ii. Adding 1 link between the DN3 node and the PoP node.

DN3(Radio card A: **04:ce:14:fe:a4:2e**)----60GHz----PoP(Radio_card C: **04:ce:14:fe:a3:d0**)

Here is an example setting:

1. Select "**DN3**" in **Peer** field, and select "**04:ce:14:fe:a4:2e**" in **Peer Radio MAC** field.

2. Select “**PoP**” in **Initiator** field, and select “**04:ce:14:fe:a3:d0**“ in **Initiator Radio MAC** field. (* Must select PoP node in Initiator Radio MAC)



6.5. To route traffic to external network outside of the Terragraph network we need to setup the PoP node routing to configure the default routing either static routing.
In this scenario, this can be configured from using the following section on the PoP node:

Field	Description
E2E Network Prefix	The network prefix in Terragraph is usually a /56 allocation, which is further divided into /64 prefixes to be assigned to individual nodes. The network prefix bounds the maximum possible number of radios in the deployment. Each Terragraph node is assigned an IPv6 /64 prefix as the loopback interface. This loopback interface address is used by the E2E controller to address the node. Prefix allocation to the nodes can be done randomly or centrally through the E2E controller. In this scenario, fixed /64 prefix as the loopback interface, so the network prefix space should be larger than /64.

6.5.1. Take our IPv6 network environment as an example:

1. Our gateway IPv6 address is 2001:B030:200B:05A1::1/64
2. We configure specific IPv6 routes in the gateway to achieving the network prefix space larger than /64
3. The rule for specific routing is “2001:B030:200B:05C0::/60 via 2001:B030:200B:05A1::C”

6.5.2. On the PoP node(DN1), go to [Route] > [E2E Network]
Here is an example setting:

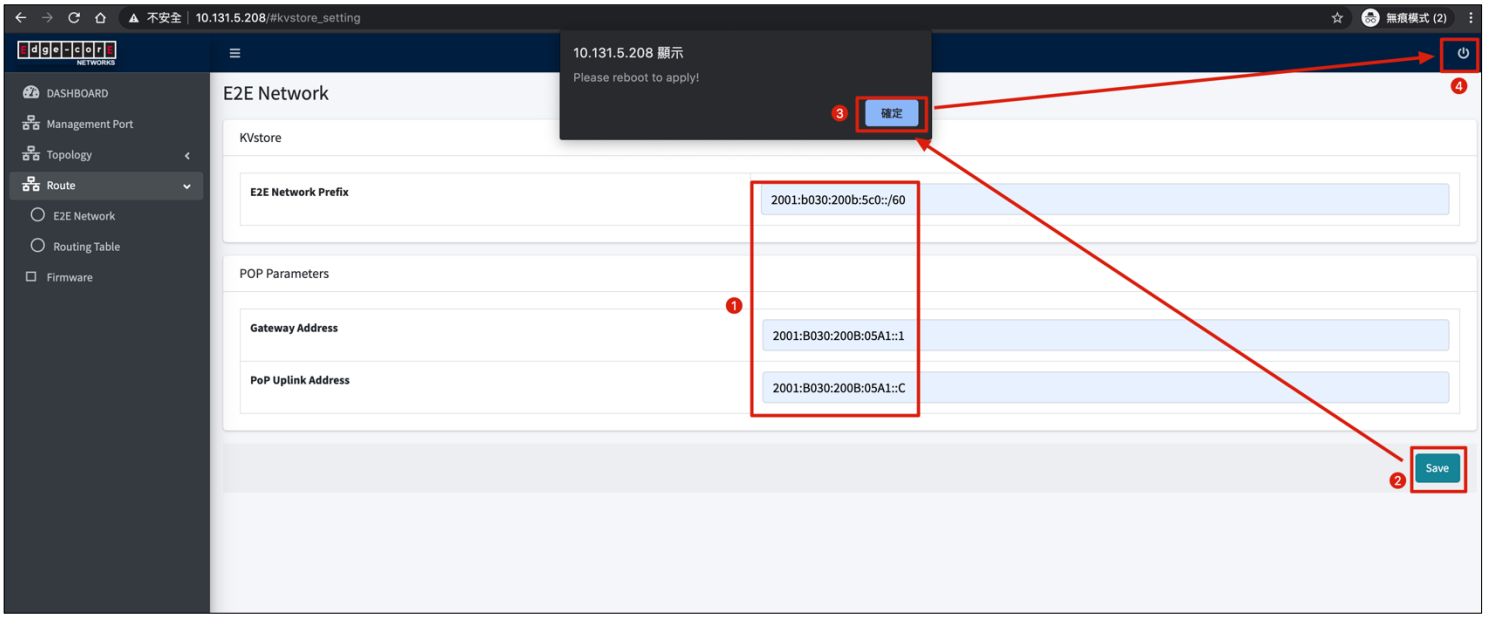
a. E2E Network Prefix: **2001:B030:200B:05C0::/60**

6.5.3. Set the interface on which you want to configure the default route. Usually, it’s on the 10G interface (SFP+ port). Give the gateway address, static address being assigned to the 10G interface is given as “**POP Uplink Address**” and static address assigned to uplink interface on the PoP node.
Here is an example setting:

a. Gateway Address: **2001:B030:200B:05A1::1**

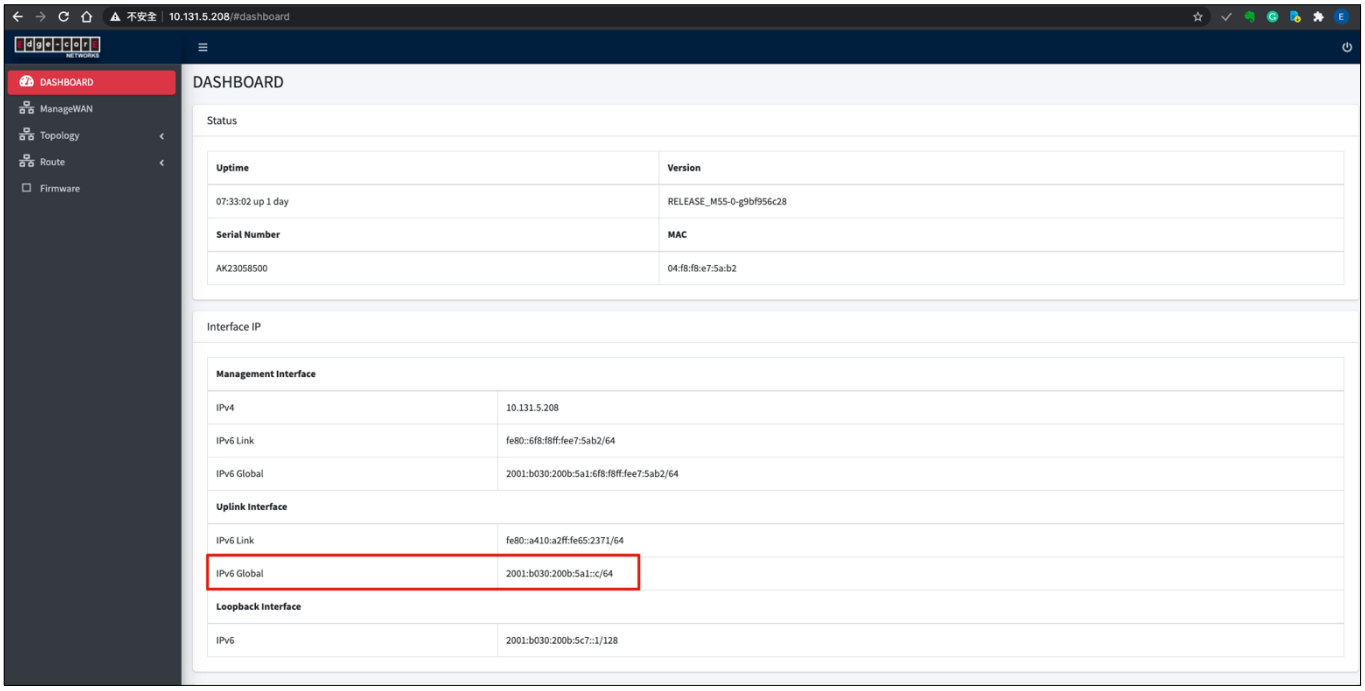
b. POP Uplink Address: **2001:B030:200B:05A1::C**

c. Click "Save" button and Reboot



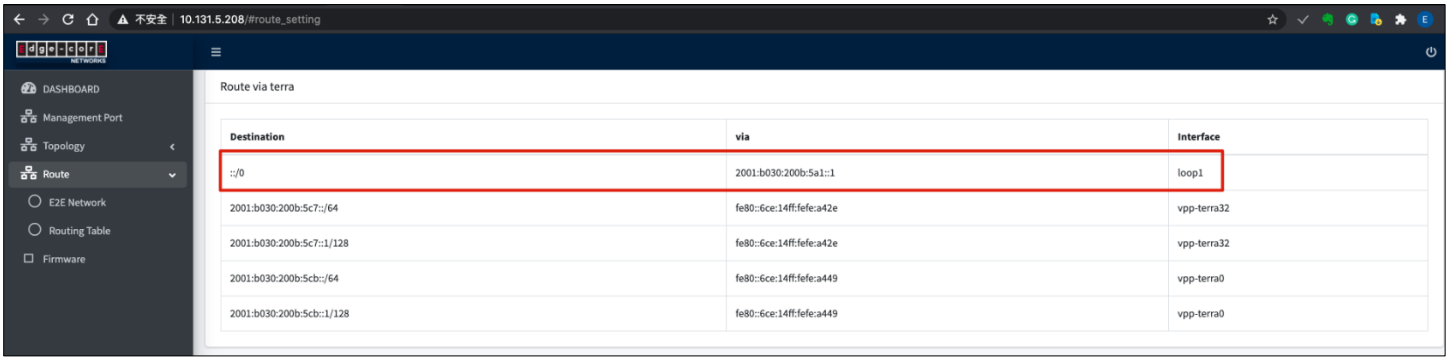
6.6. Once this config is configured and node is rebooted. You should see static IP address configured on the uplink interface on Dashboard

6.6.1. Go to [Dashboard]



6.7. You will see default route being configured over gateway address on Routing Table:

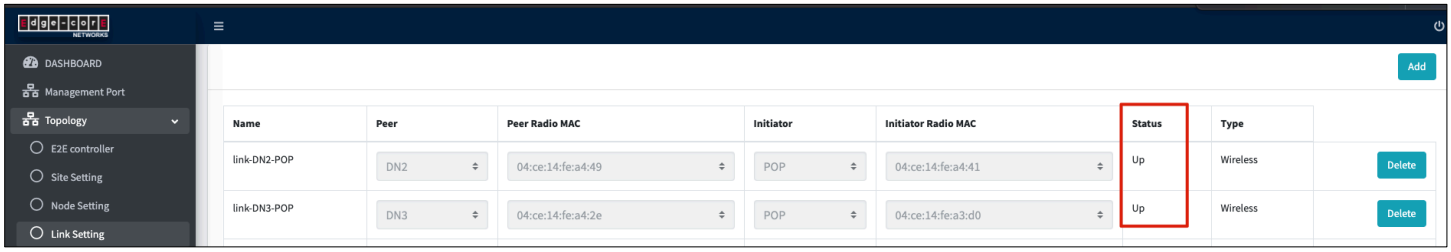
6.7.1. Go to [Route] > [Routing Table]



6.8. Then the PoP node start igniting the links, you can check the status of link and node.

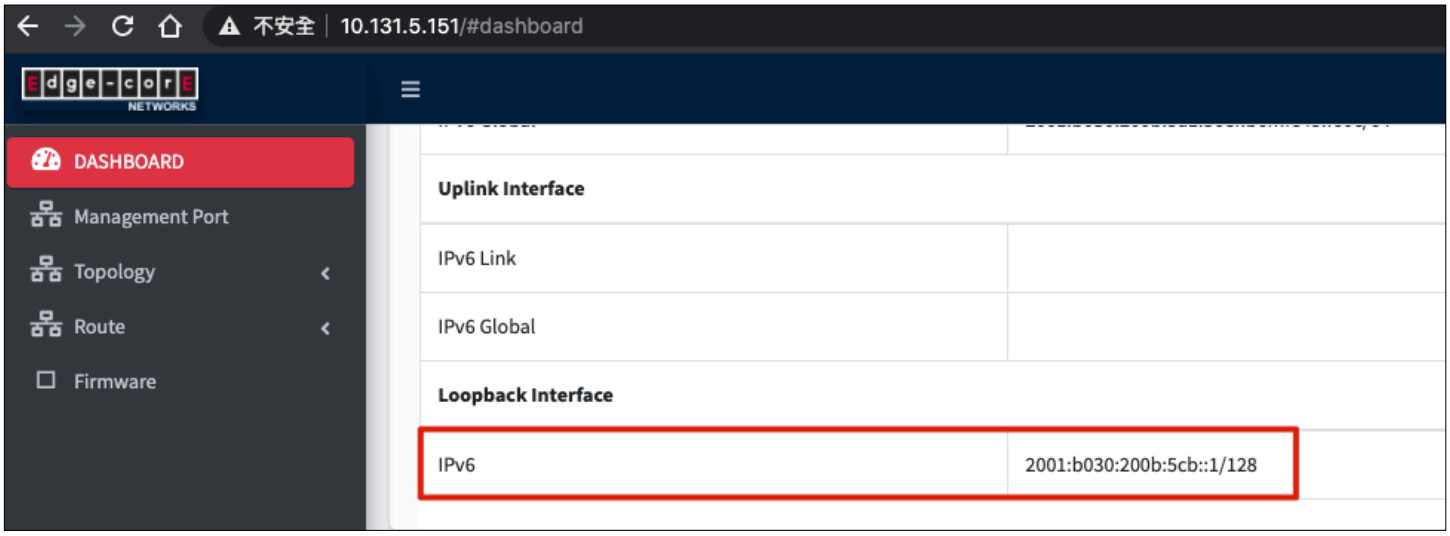
6.8.1. Go to [Topology] > [Link setting]

a. Check if all links status becomes "Up"



6.9. Make sure that each DN node has got the loopback IPv6 address

6.9.1. On DN2 and DN3, go to [Dashboard]



6.10. After checking that all link status have become "Up", set the route between DN3 and Client.

For example, DN3's OUT1 port is ethernet linked PC(Client).

DN3(SFP+ port)————PC(Ethernet port)

So we need to set up 1 route for the link between DN3 and PC.

6.10.1. **On DN3**, go to [Route] > [Routing Table]

Add link-DN3-PC route:

a. Action: Add

b. Destination Radio MAC: **{PC's ethernet interface mac}**

c. Destination Global IP: **{PC's global IPv6/128}**

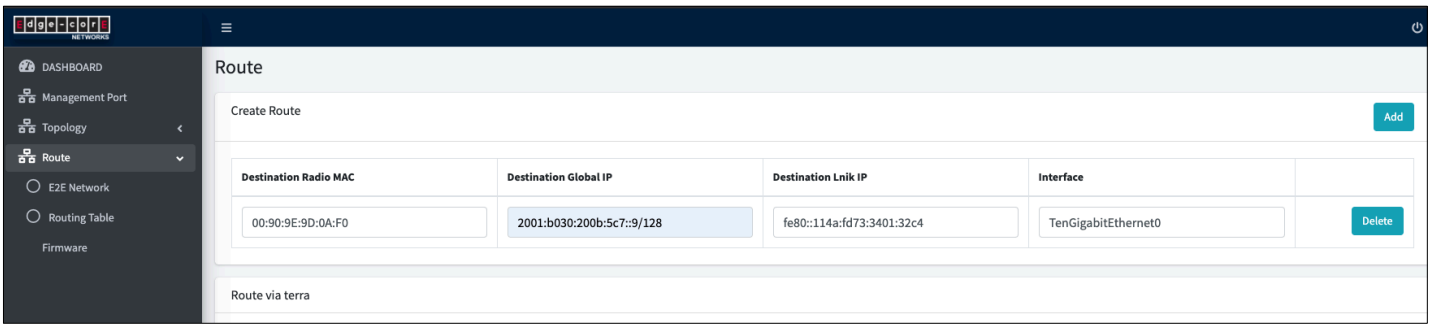
d. Destination Link IP: **{PC's link-local IPv6}**

e. Interface: **TenGigabitEthernet0**

```
tester@tester-aspire-e5:~$ ifconfig enx00909e9d0af0
enx00909e9d0af0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 fe80::114a:fd73:3401:32c4  prefixlen 64  scopeid 0x20<link>
        inet6 2001:b030:200b:5c7::9  prefixlen 128  scopeid 0x0<global>
        ether 00:90:9e:9d:0a:f0  txqueuelen 1000  (Ethernet)
        RX packets 3663774  bytes 4850406127 (4.8 GB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 481780  bytes 46750535 (46.7 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

You can check the mac, link-local address and global IPv6 address of PC's ethernet interface on PC.

Here is an example setting:



6.10.2. On PC(Linux)

a. Set static IPv6 address which is in the same subnet (prefix) as IPv6 address of DN3's loopback interface.

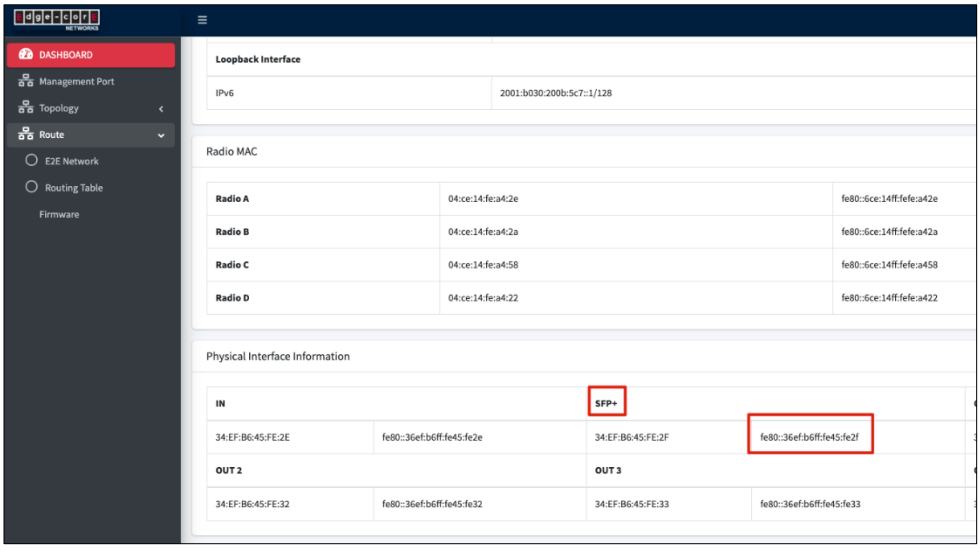
ip -6 addr add {the same subnet (prefix) as IPv6 IP address}/128 dev interface}

Here is an example setting:

```
ip -6 addr add 2001:b030:200b:5c7::9/128 dev enx00909e9d0af0
```

b. Set default gateway to link local-address of SFP+ interface of DN3.

You can find the local-address of SFP+ interface on the DN3's dashboard.



ip -6 ro add default via {SFP+ link-address} dev {ethernet interface}

```
ip -6 ro add default via fe80::36ef:b6ff:fe45:fe2f dev enx00909e9d0af0
```

c. Setup DNS server.

```
vi /etc/resolv.conf
```

Modify nameserver to the gateway IPv6 address

```
nameserver 2001:b030:200b:5a1::1
```

6.11. Verification results on Client

6.11.1. We need to verify that this topology can be used by customers to connect to external network.

a. PC access website(www.google.com)