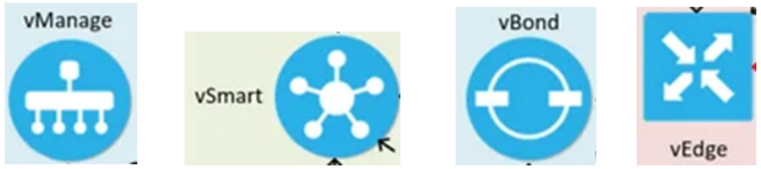
Introduction to Cisco SD WAN

The **Cisco SD WAN** solution is a distributed architecture, which means Cisco has separated the data plane from the control plane and management plane. This architecture differs from traditional networking in that it allows you to support large-scale networks while reducing operational and computational overhead. This solution separates the data plane, control plane, and management plane from each other.

Cisco SD WAN Components



vManage was introduced as the management plane, where all Day 0, Day 1, and Day N functions will be performed, including WAN Edge configuration, routing and control policies, troubleshooting, and monitoring.

vSmart is the brain of the Cisco SD WAN fabric and is responsible for calculating and deploying all control and data policies as well as handling the distribution of encryption keys for data plane connectivity.

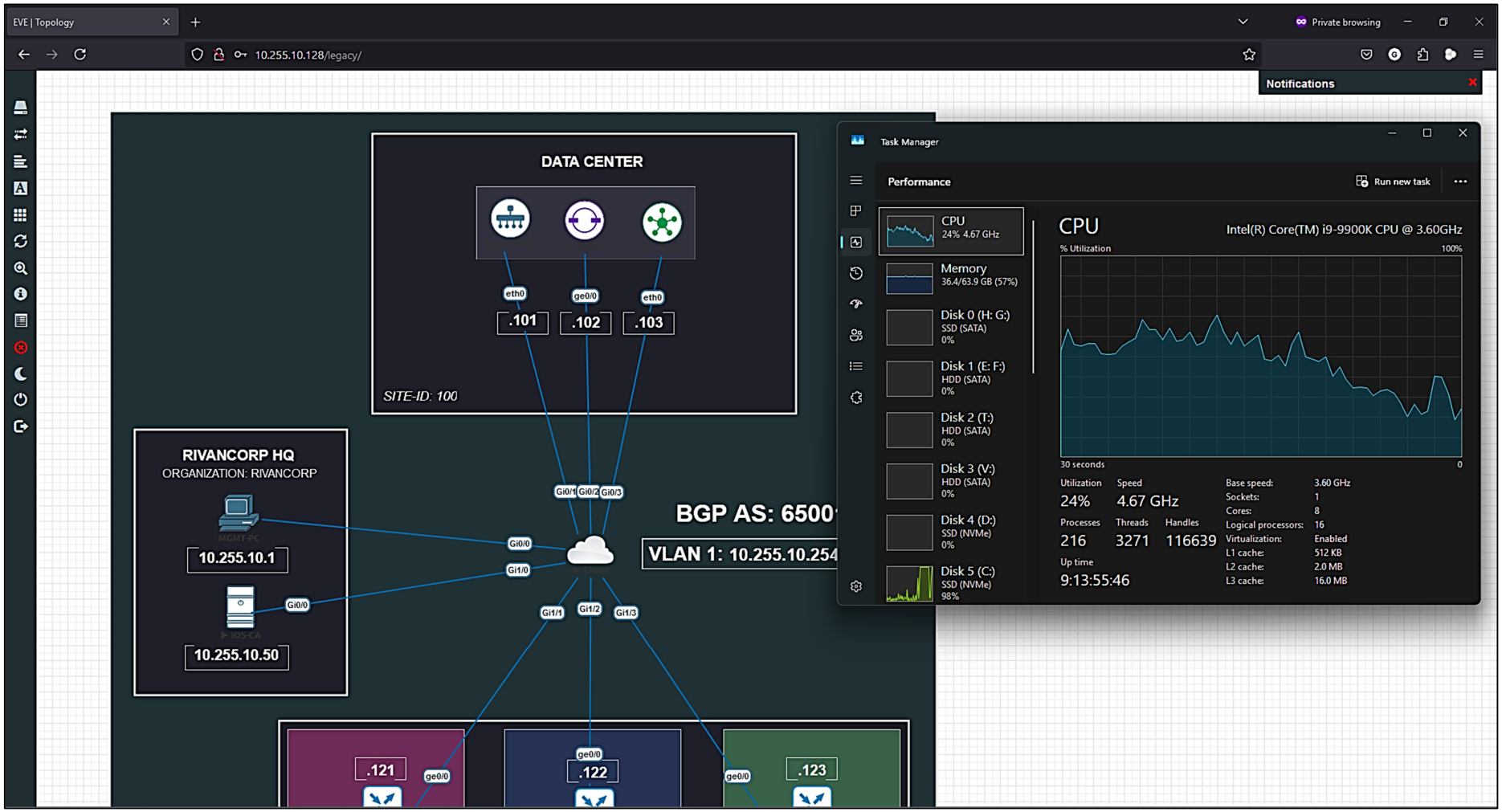
vBond makes up the orchestration plane and is responsible for authenticating components on the fabric in addition to distributing control and management plane information to the WAN Edges. The vBond is the component that aids in discovery of the fabric for all other components (such as when devices are behind **NAT**). The vBond then distributes the connectivity information for the vSmart and vManage to the WAN Edge.

vEdge handles the data plane is where user traffic will be routed and forwarded across the WAN. The data plane is similar to routers that would be deployed in a traditional WAN, though in Cisco SD WAN, these are referred to as WAN Edges.

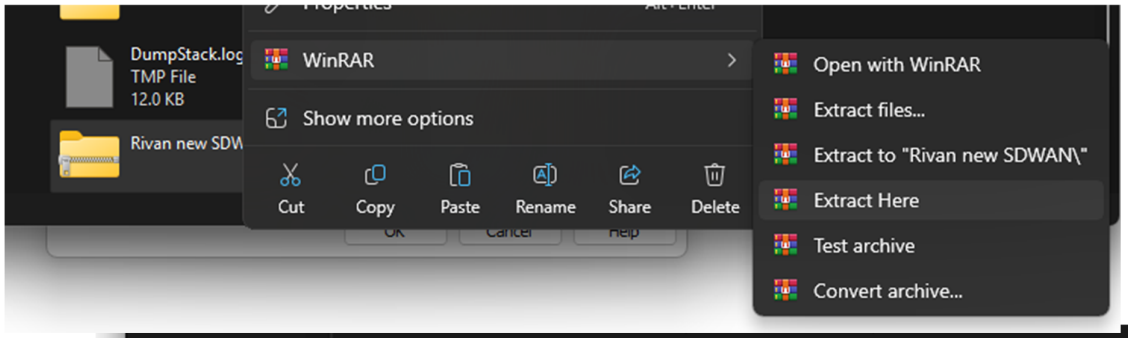
Each component authenticates each other and if successful, a ***Datagram Transport Layer Security (DTLS)*** tunnel is established. Separating the control plane from the data and management plane, the protocol that vSmart uses to communicate all the WAN Edge routing is called ***Overlay Management Protocol (OMP).***

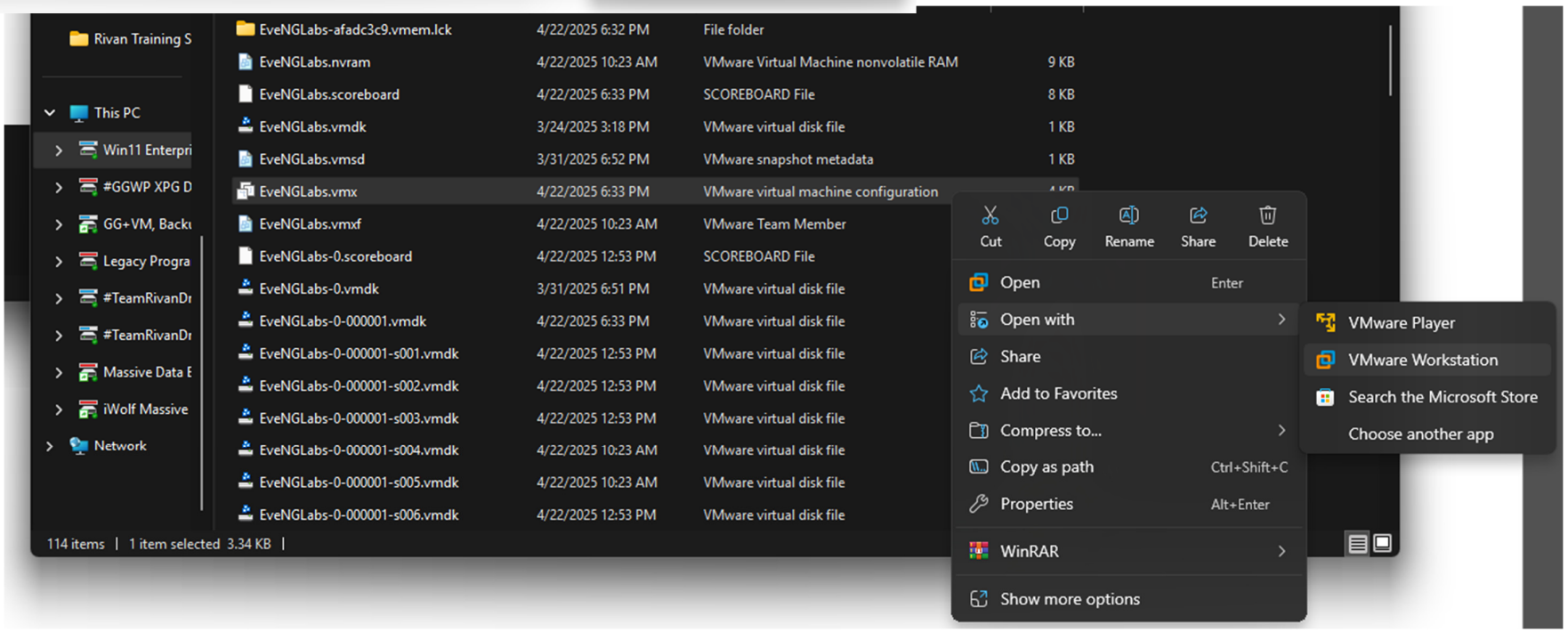
FULL PROCEDURES OF SD-WAN IMPLEMENTATION

Prior to setup and running SDWAN thru VMWare, Minimum RAM must at least 32GB and Intel i5 CPU to run. The SDWAN VM Package really consumes a lot of Resources, example to the indicated screenshot below runs on Intel i9-9900K and 64GB RAM DDR4-2666 with XMP.

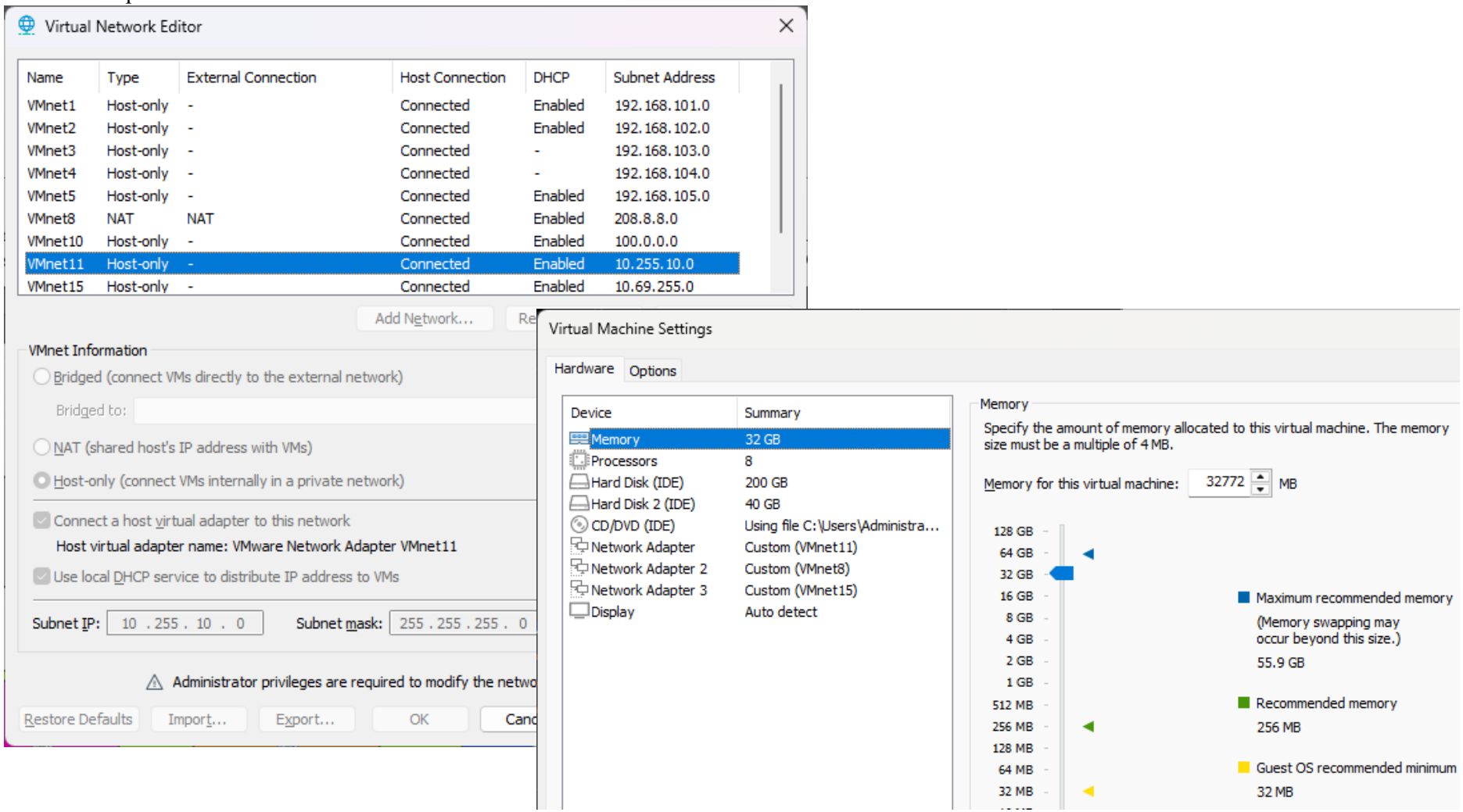


To begin with, extract the provided SDWAN Package (.zip / .rar / .7zip file) to the drive which having the biggest space.
Launch the VMWare App and open its .vmx file from the extracted path.





Let's configure its Virtual Networking first… Add and set (or check) VMNet11 in Virtual Network Editor, the first Network Adapter is set to VMNet11 with its subnet IP 10.255.10.0. The second Network Adapter is set to NAT (VMNet8) with its subnet ip is 208.8.8.0, and the Third Network Adapter is set to VMNet15 with the subnet IP of 10.69.255.0

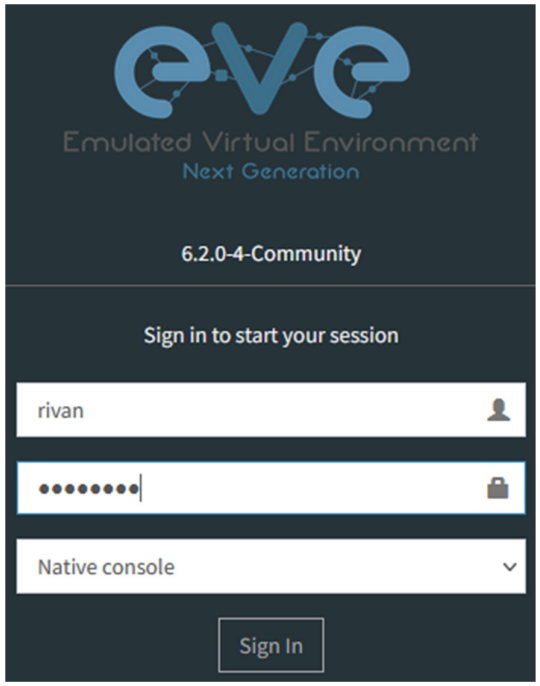


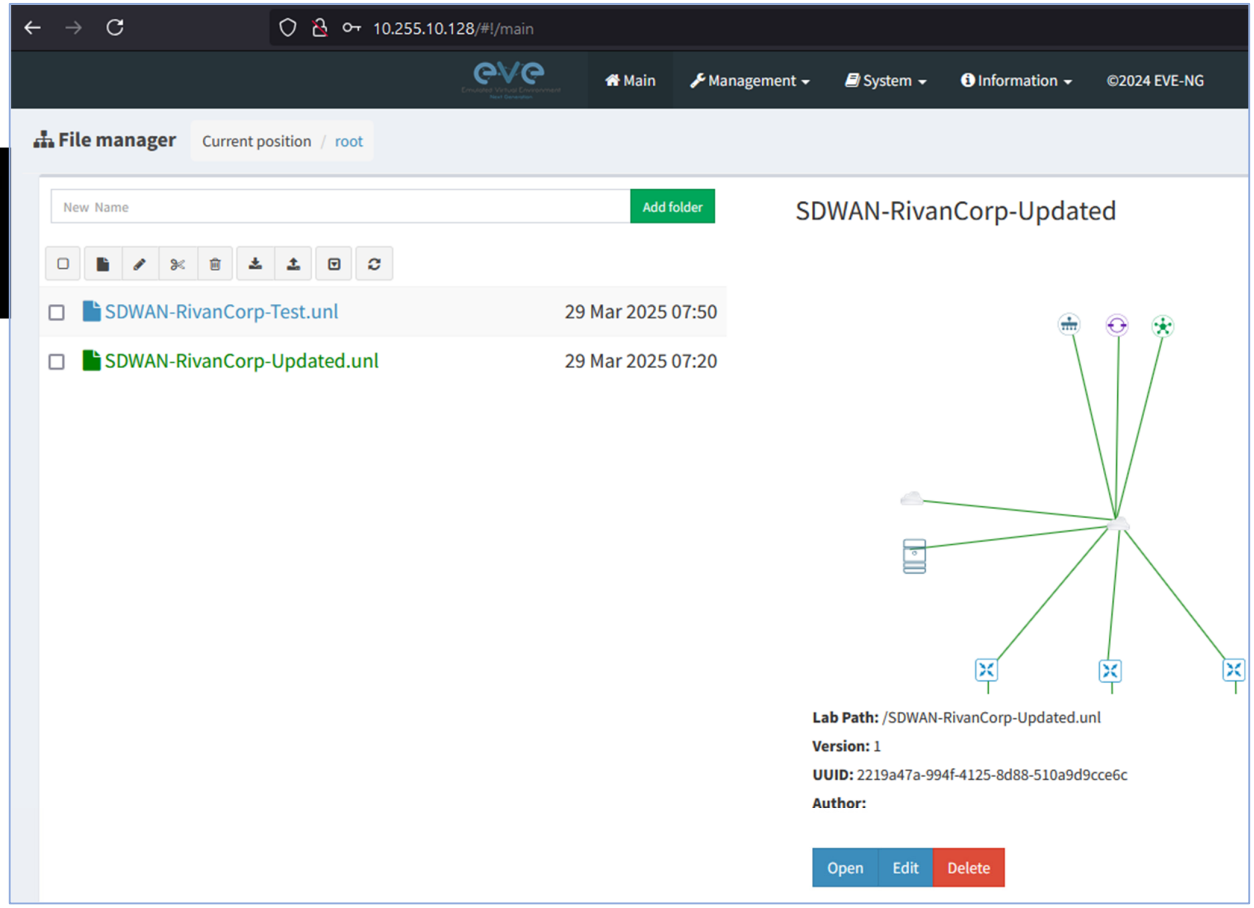
When VM is running, activate all the virtual devices via browser > 10.255.10.xxx (depending on what IP assigned after its boot), **WAIT AT LEAST 10 MINS** then you may ping check 10.255.10.1 and 100.0.0.xxx to confirm. ***Preferably the Internet temporarily since VMNet8 is using a Public IP Address.***

Open a browser and access the 10.255.10.xxx, and do the following…

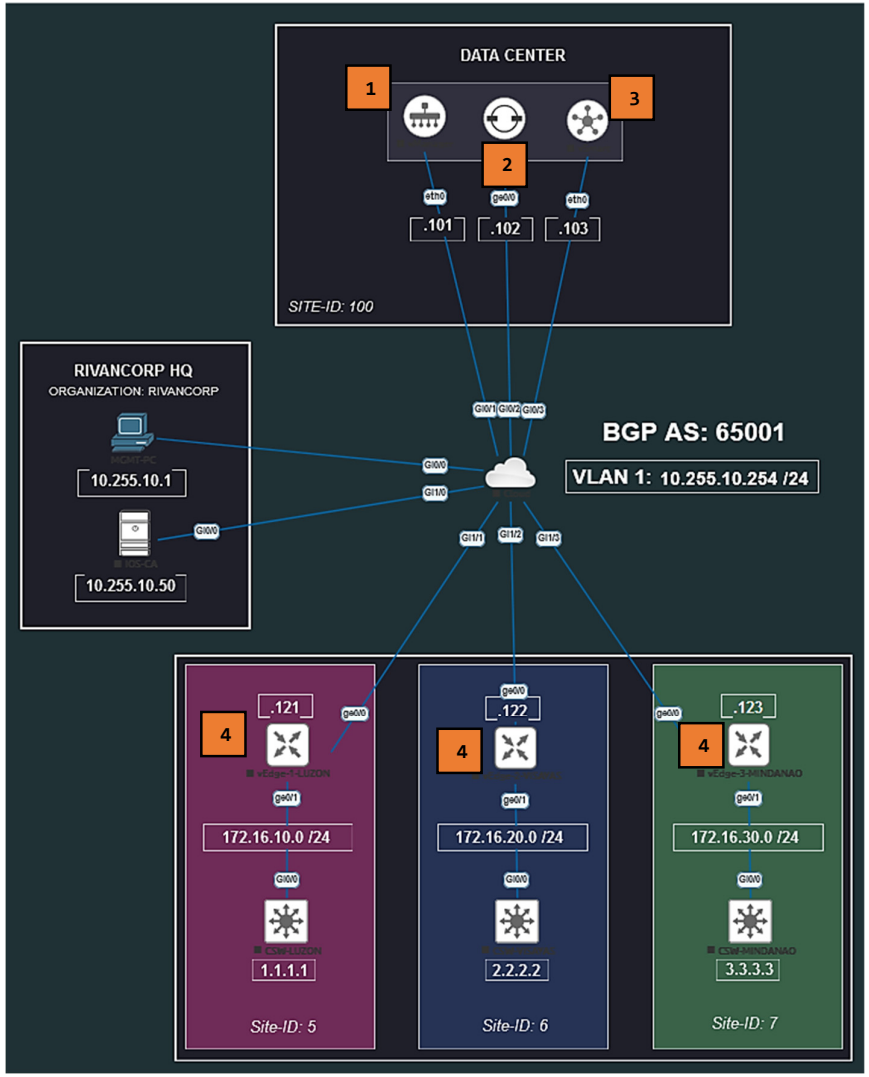
→ *Login (browser):* ***rivan / C1sc0123***

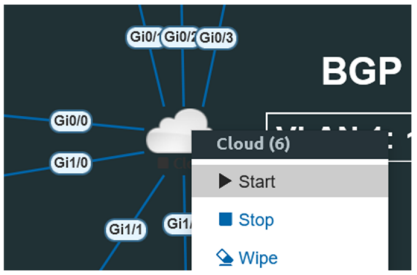
→ *Select and Open* ***SDWAN-RivanCorp-Updated***

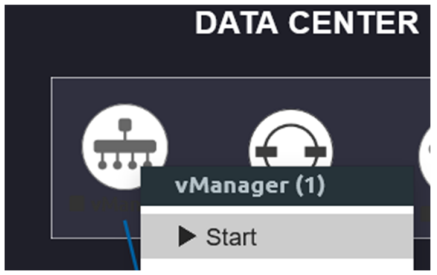


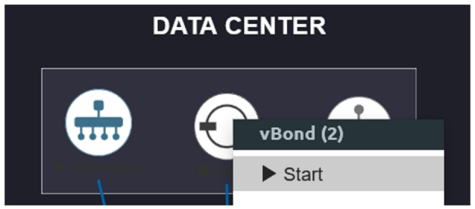


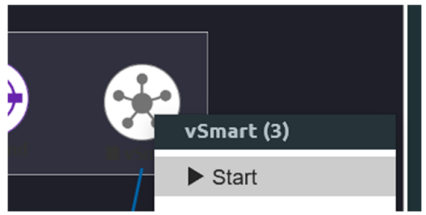
The full topology of SDWAN will show, run the following virtual SDWAN devices **in-order:** CLOUD, VManage, VBond, VSmart, and vEdge.

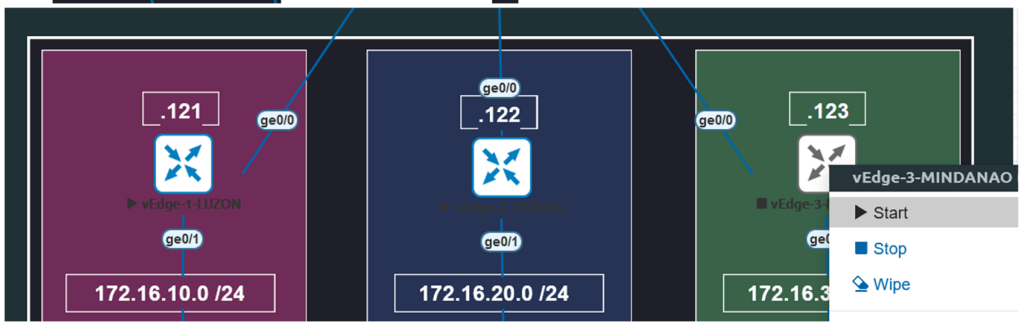




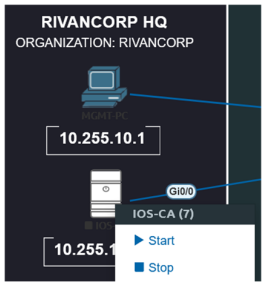






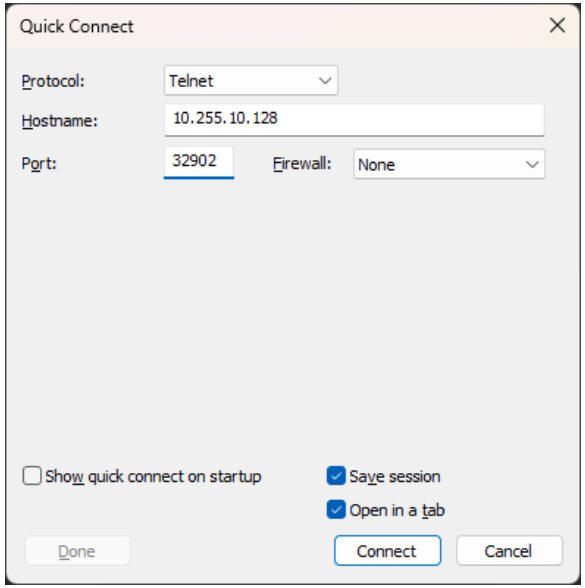


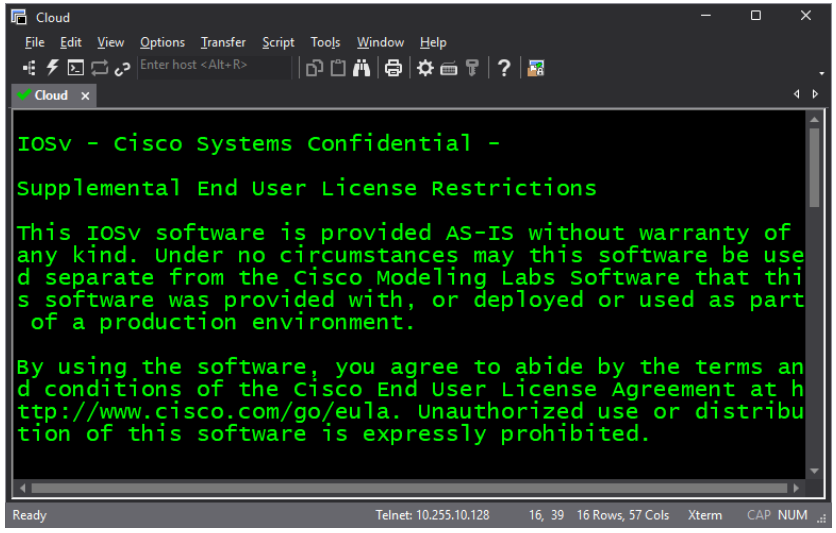
Also turn on the IOS-CA



Prepared by: GGener

Launch SecureCRT and telnet 10.255.10.xxx : 32902 (cloud)

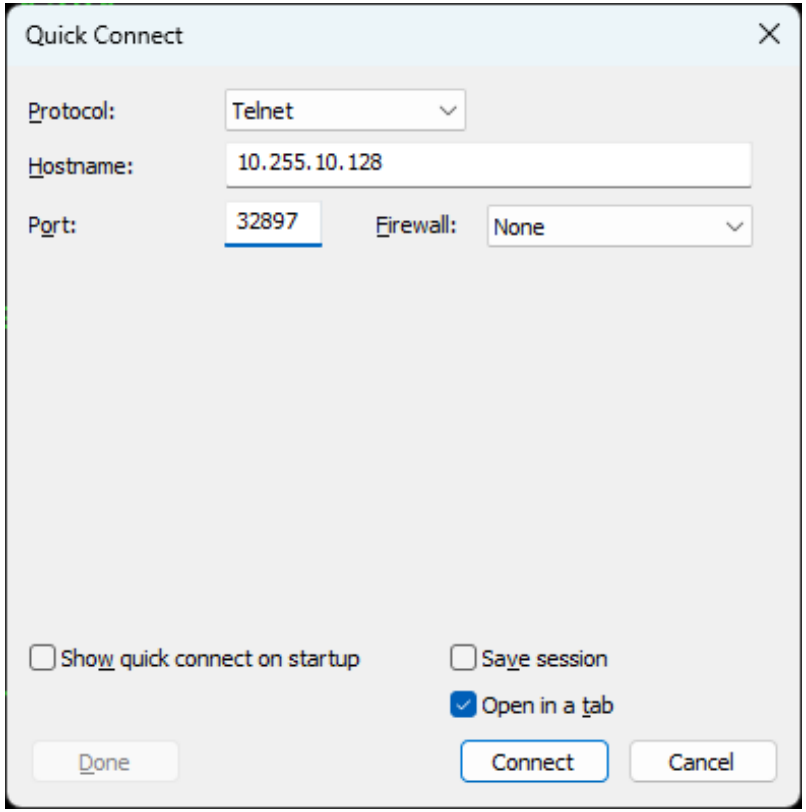


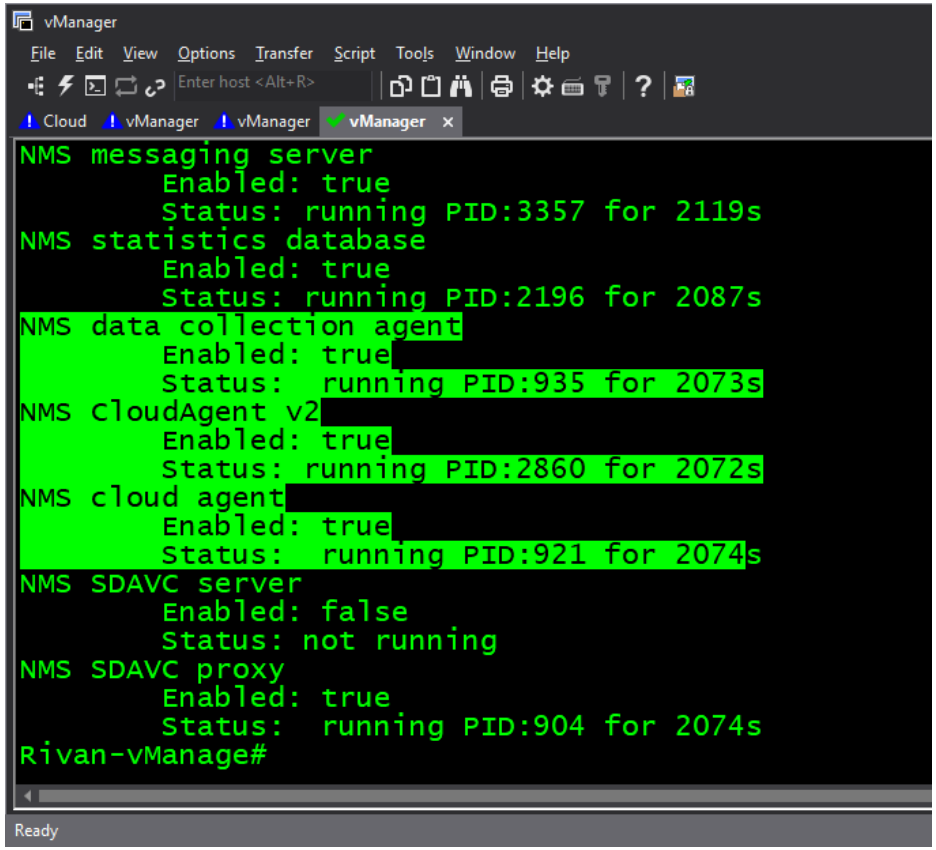


CLI Initial Configuration:

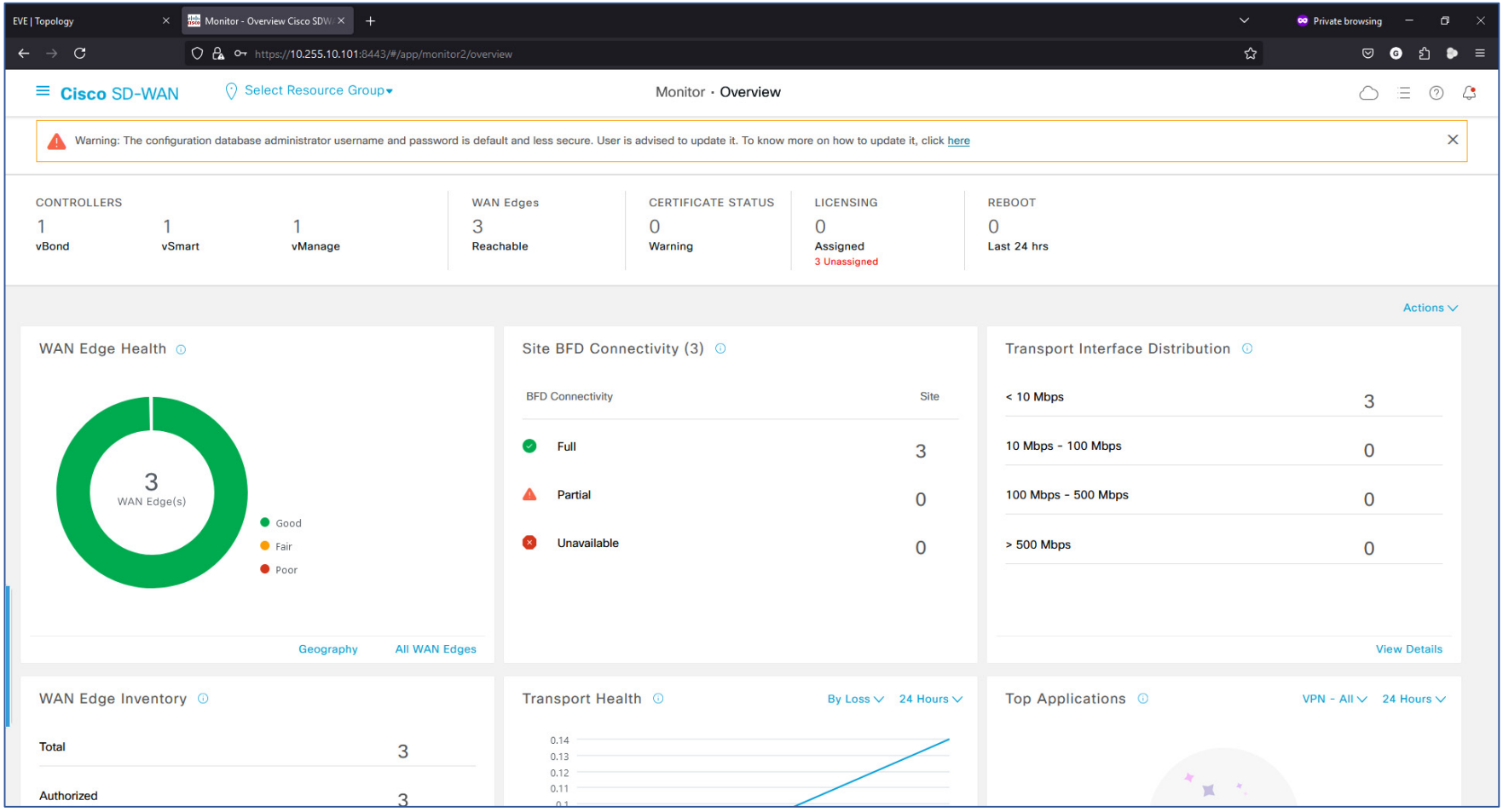
```
conf t
 hostname Cloud
 int lo0
  ip add 10.100.10.10 255.255.255.255

 int lo8
  ip add 8.8.8.8 255.255.255.255

 vlan 10
  name SDWAN-Controllers

  int vlan 10
  ip add 10.255.10.254 255.255.255.0
  no shut

 int range g0/0-3,g1/0-3
  swi mode acc
  swi acc vlan 10

 router bgp 65001
  no synchro
  bgp log-neighbor-changes
 network 10.100.10.10 mask 255.255.255.255
 network 8.8.8.8 mask 255.255.255.255
 network 10.255.10.0 mask 255.255.255.0
 neighbor 10.255.10.121 remote-as 65001
 neighbor 10.255.10.122 remote-as 65001
 neighbor 10.255.10.123 remote-as 65001
 no auto-summary
end
wr
```

Booting all Virtual SDWAN devices may take at least 10 minutes (depending to the specs of the host machine), optionally you may check their booting status by accessing the CLI of vManage (via Telnet 10.255.10.128 port 32897, login: admin / C1sc0123) and entering the ***request nms all status*** command. Repeat the said command until the ***NMS Data Collection Agent*** and ***NMS Cloud Agents*** are in running status.

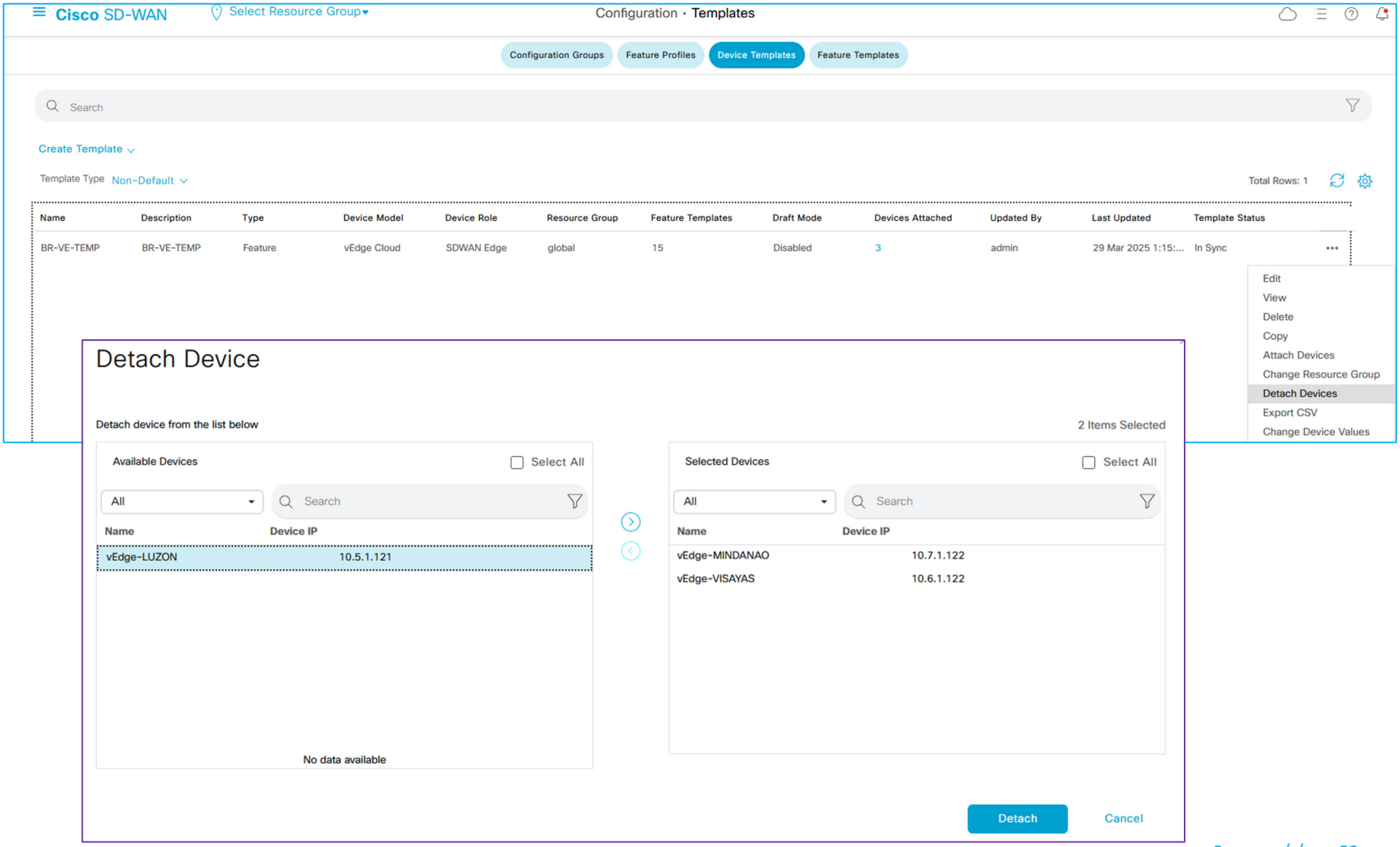




To determine if the vManage is fully initialized (at least 10 to 15 minutes after started), ping 10.255.10.101, if it pings… Launch the vManage GUI on a separate browser https://10.255.10.101 login: ***admin / C1sc0123***

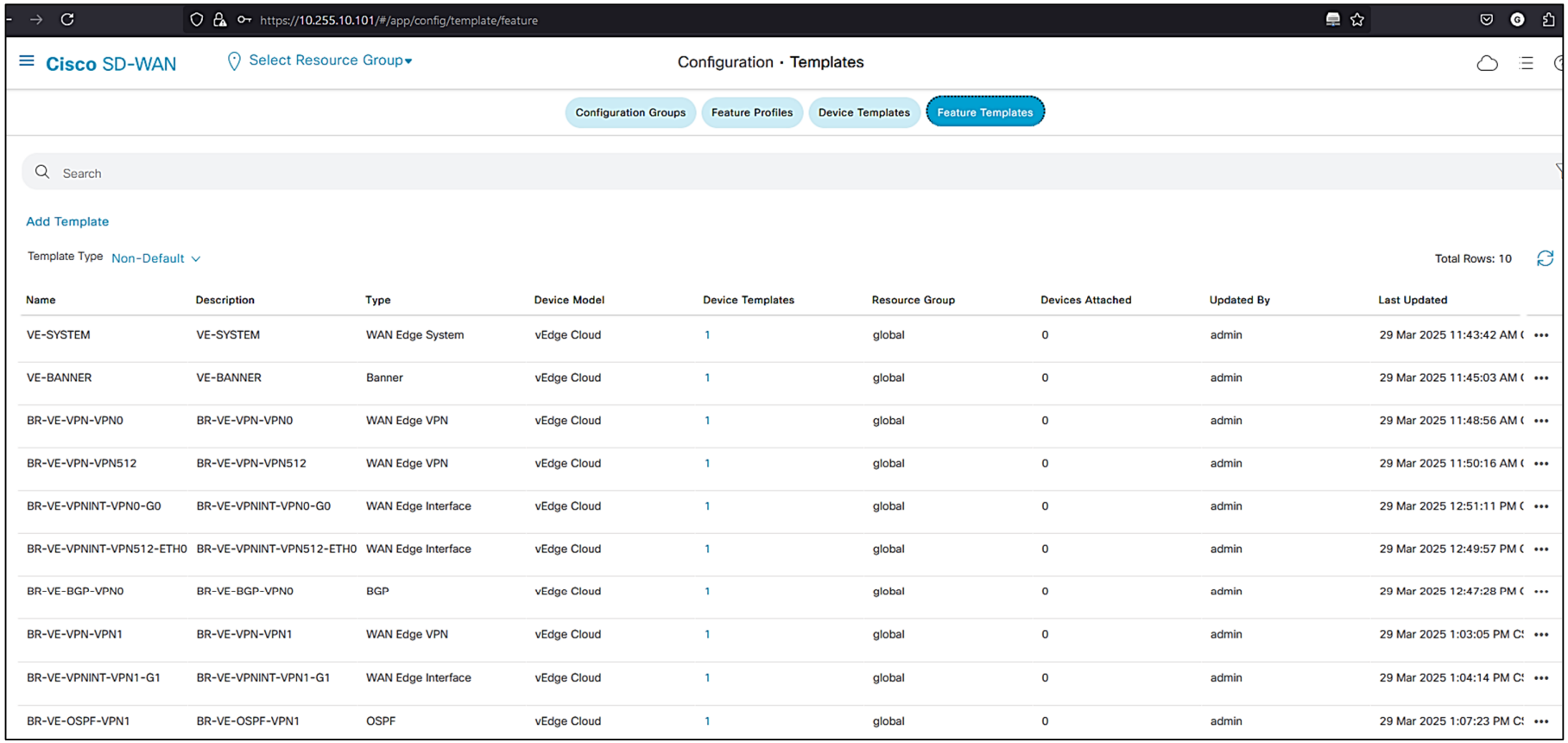


Upon SDWAN Maintenance, we have to detach the vEdges before configuring… Click the ☰ > Configuration > Templates > DeviceTemplates > ••• (triple dots of BR-VE-TEMP) > Select All Rivan vEdges then Detach , and wait for the detachment completion.



Prepared by: GGener

SDWAN Configuration are composed of "**Templates",** instead of using CLI commands or scripting, these are the somewhat called "configuration sheets" that defines the complete operational configuration for a specific component. It's essentially a container for a collection of feature templates that define specific aspects of the device's operation, therefore SDWAN Templates are composed thru GUI.

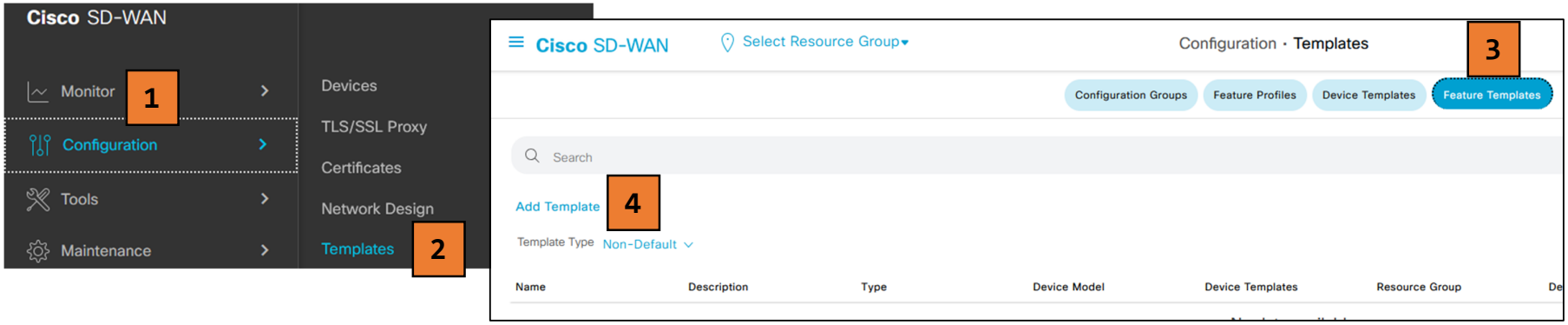


Name	Description	Type	Device Model	Device Templates	Resource Group	Devices Attached	Updated By	Last Updated
VE-SYSTEM	VE-SYSTEM	WAN Edge System	vEdge Cloud	1	global	0	admin	29 Mar 2025 11:43:42 AM (
VE-BANNER	VE-BANNER	Banner	vEdge Cloud	1	global	0	admin	29 Mar 2025 11:45:03 AM (
BR-VE-VPN-VPN0	BR-VE-VPN-VPN0	WAN Edge VPN	vEdge Cloud	1	global	0	admin	29 Mar 2025 11:48:56 AM (
BR-VE-VPN-VPN512	BR-VE-VPN-VPN512	WAN Edge VPN	vEdge Cloud	1	global	0	admin	29 Mar 2025 11:50:16 AM (
BR-VE-VPNINT-VPN0-G0	BR-VE-VPNINT-VPN0-G0	WAN Edge Interface	vEdge Cloud	1	global	0	admin	29 Mar 2025 12:51:11 PM (
BR-VE-VPNINT-VPN512-ETH0	BR-VE-VPNINT-VPN512-ETH0	WAN Edge Interface	vEdge Cloud	1	global	0	admin	29 Mar 2025 12:49:57 PM (
BR-VE-BGP-VPN0	BR-VE-BGP-VPN0	BGP	vEdge Cloud	1	global	0	admin	29 Mar 2025 12:47:28 PM (
BR-VE-VPN-VPN1	BR-VE-VPN-VPN1	WAN Edge VPN	vEdge Cloud	1	global	0	admin	29 Mar 2025 1:03:05 PM C:
BR-VE-VPNINT-VPN1-G1	BR-VE-VPNINT-VPN1-G1	WAN Edge Interface	vEdge Cloud	1	global	0	admin	29 Mar 2025 1:04:14 PM C:
BR-VE-OSPF-VPN1	BR-VE-OSPF-VPN1	OSPF	vEdge Cloud	1	global	0	admin	29 Mar 2025 1:07:23 PM C:

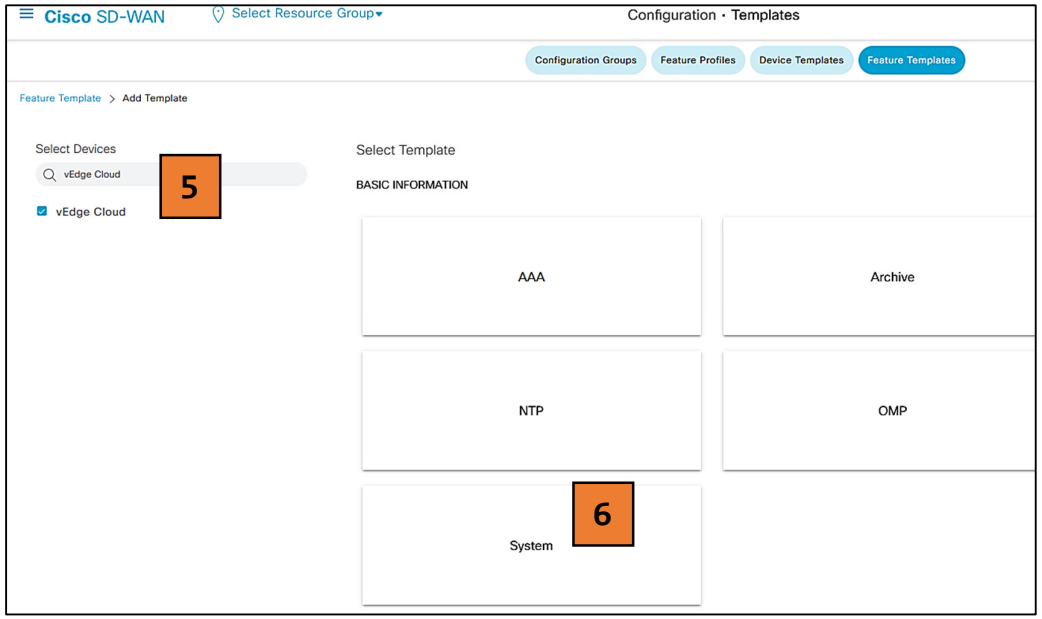
At the end of the activity… these are the templates that are required to compose to run the minimum SDWAN System.

Let's begin composing the template for SYSTEM, follow the steps/procedure in composing the said template:

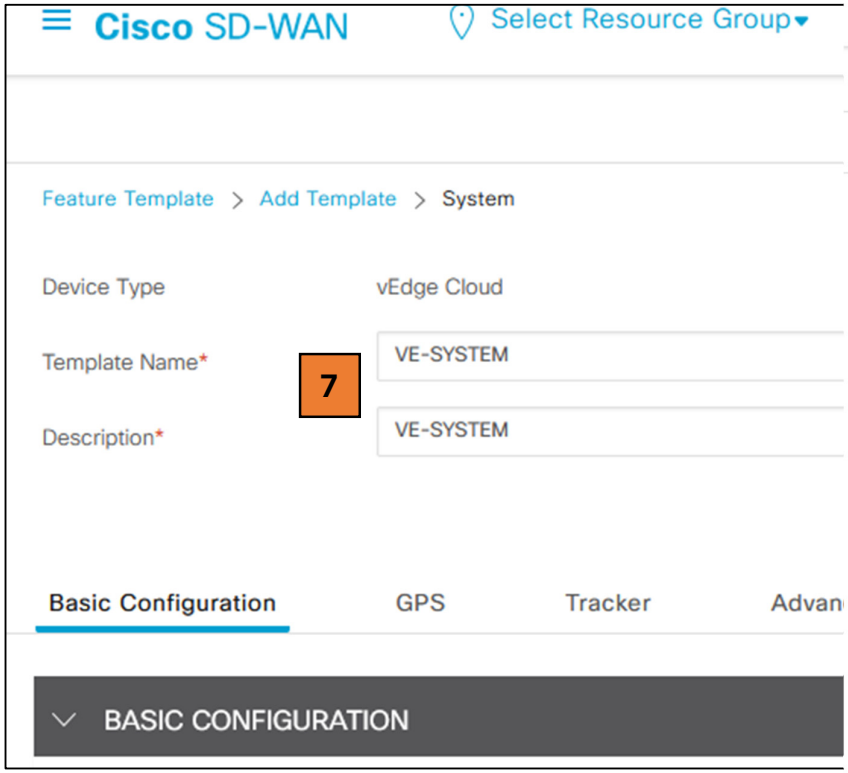
1. Configuration > 2. Templates > 3. Feature Templates > 4. Add Template



5. Type in search and check "vEdge Cloud" > 6. System

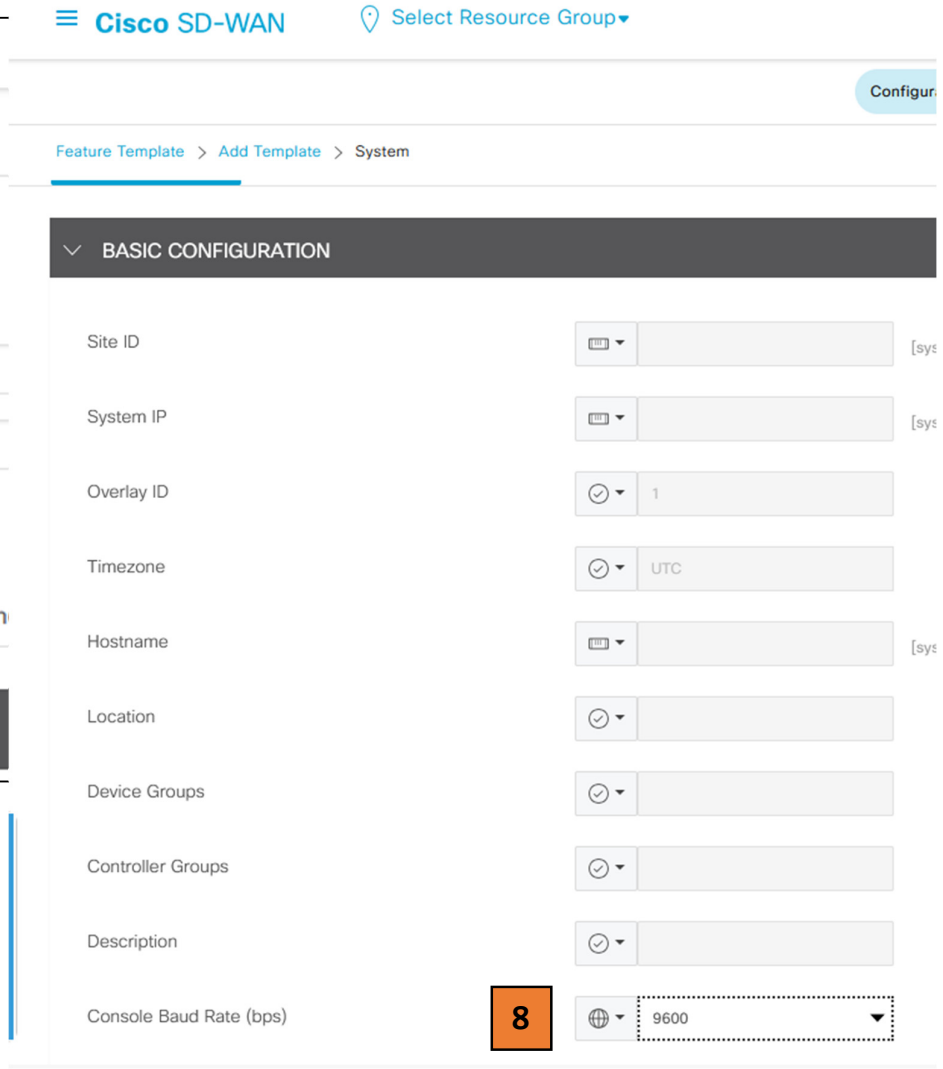


7. Template Name & Description: VE-SYSTEM



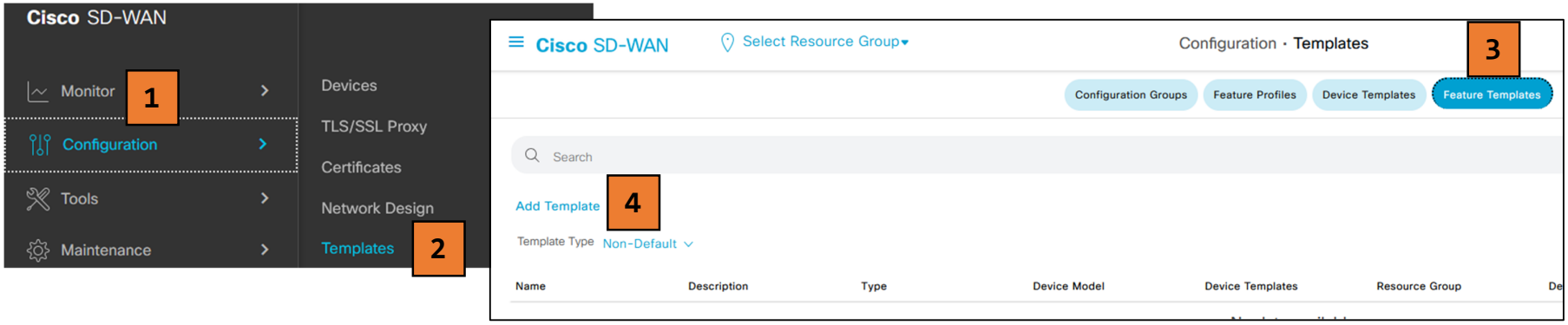
8. (scroll under Basic Configuration) set Console Baud Rate: 9600 (This is similar in configuring the serial console.),

and click SAVE. (First Template is saved.)

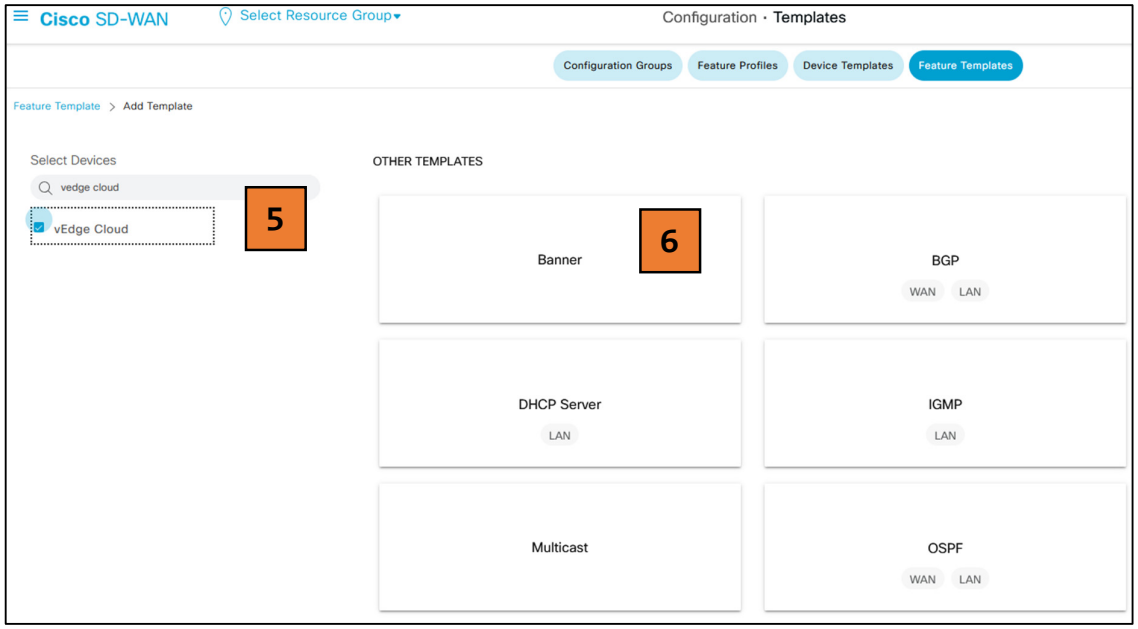


Composing the template for BANNER that show some kind of welcome messages in the CLI, follow the steps/procedure in composing the said template:

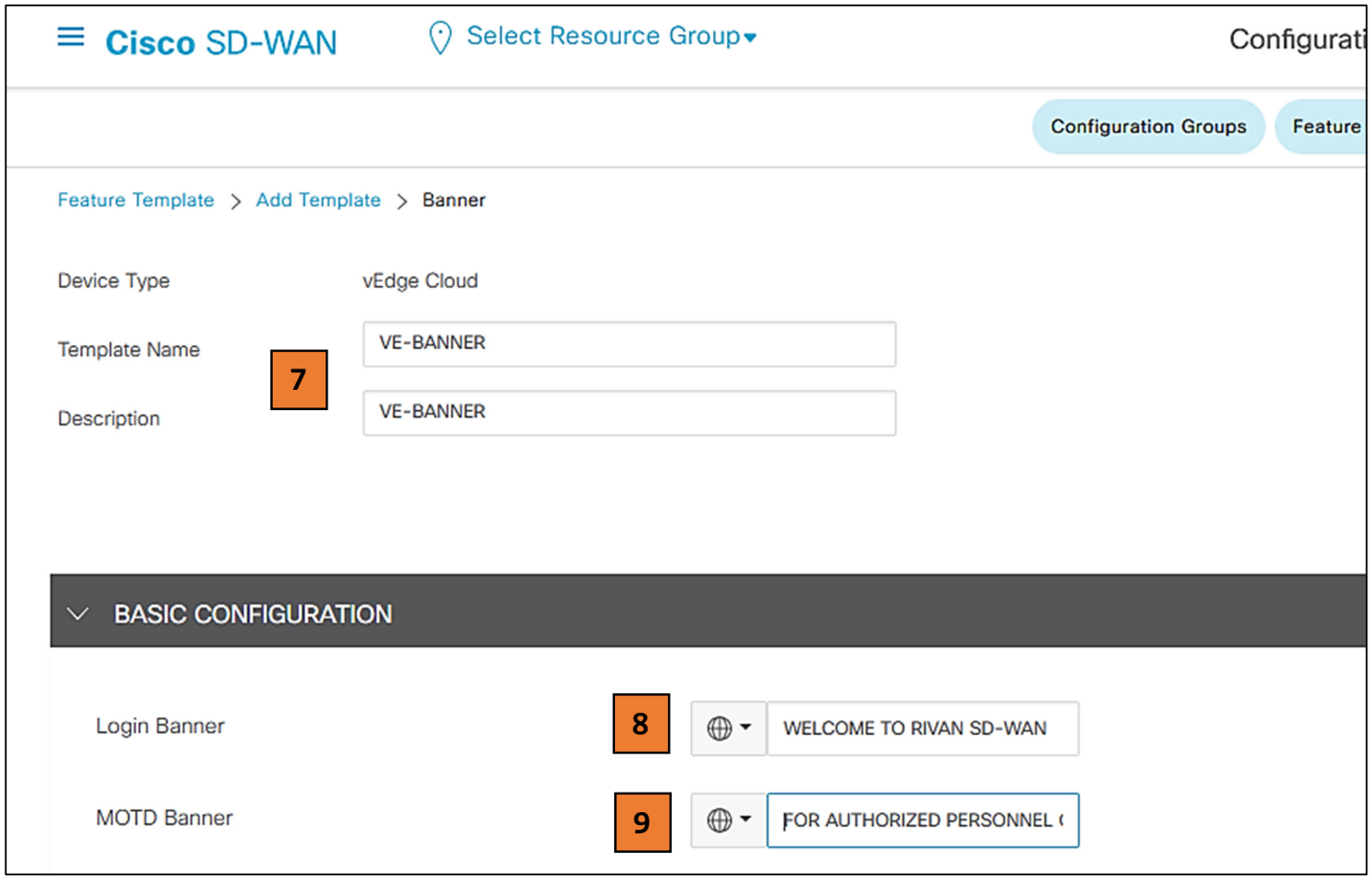
1. Configuration > 2. Templates > 3. Feature Templates > 4. Add Template



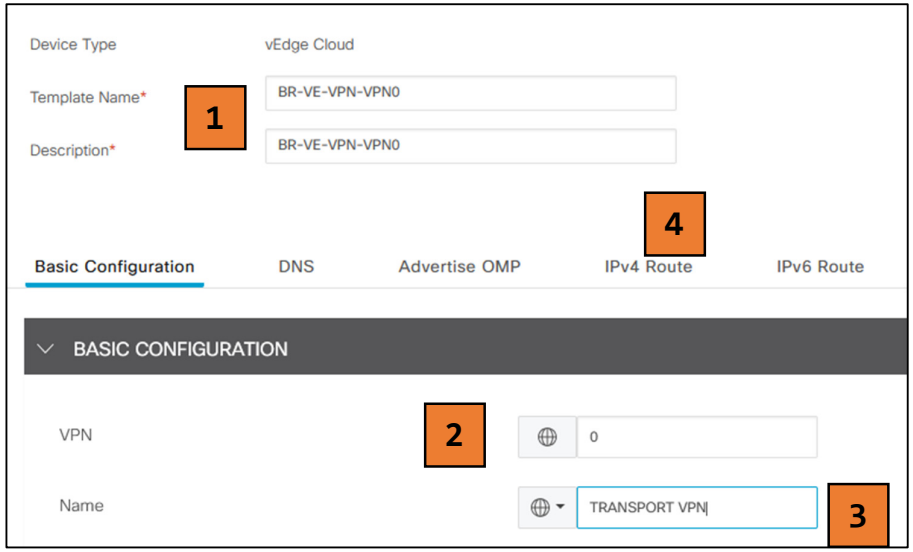
5. Type in search and check “vEdge Cloud” > 6. Banner



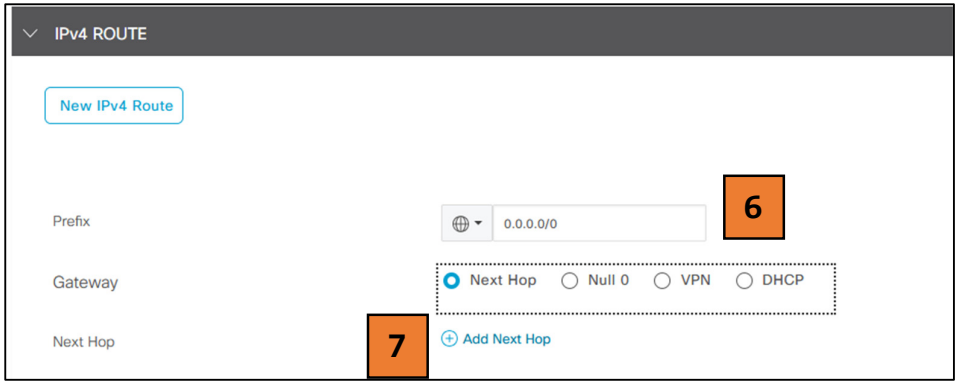
7. Template Name: VE-BANNER
8. Login Banner > Global > WELCOME TO RIVAN SD-WAN
9. MOTD Banner > Global > FOR AUTHORIZED PERSONNEL ONLY, and SAVE



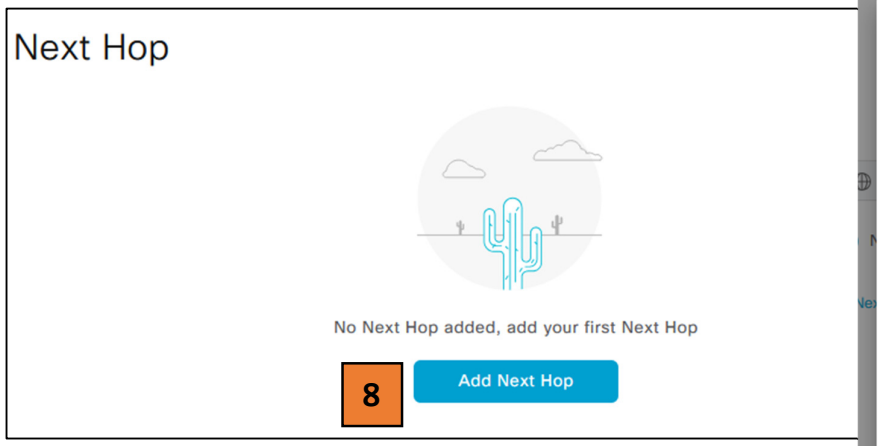
(for setting up VPN-0 Config: Add Template > vEdge Cloud > VPN)
1. Template Name: BR-VE-VPN-VPN0 : 2. VPN > Global: 0 > 3. Name: Transport VPN > 4. Click IPv4 Route > 5. New IPv4 Route

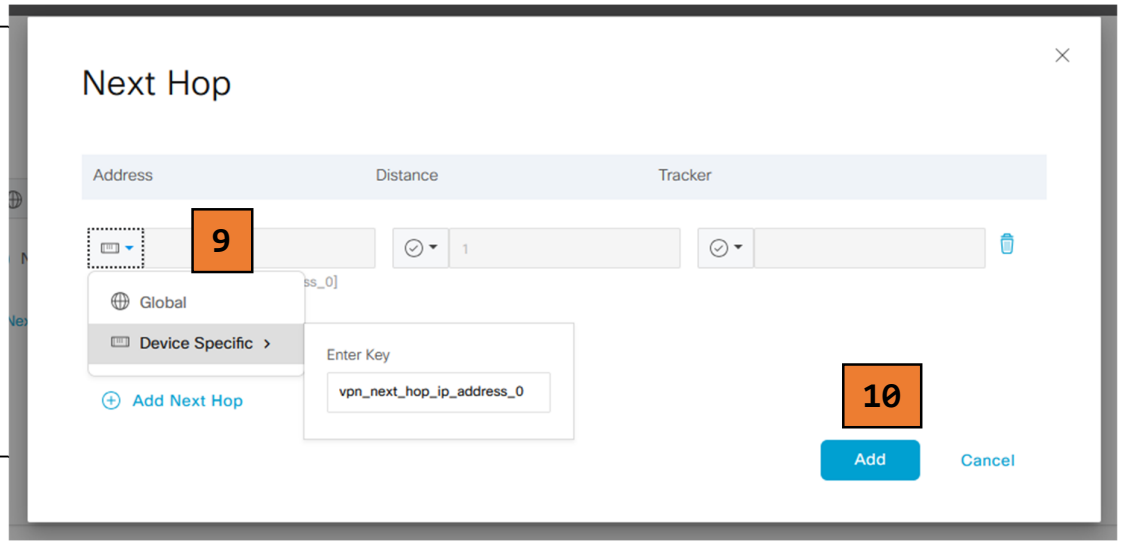


6. Prefix > Global 0.0.0.0/0 > 7 & 8. Add Next Hop +

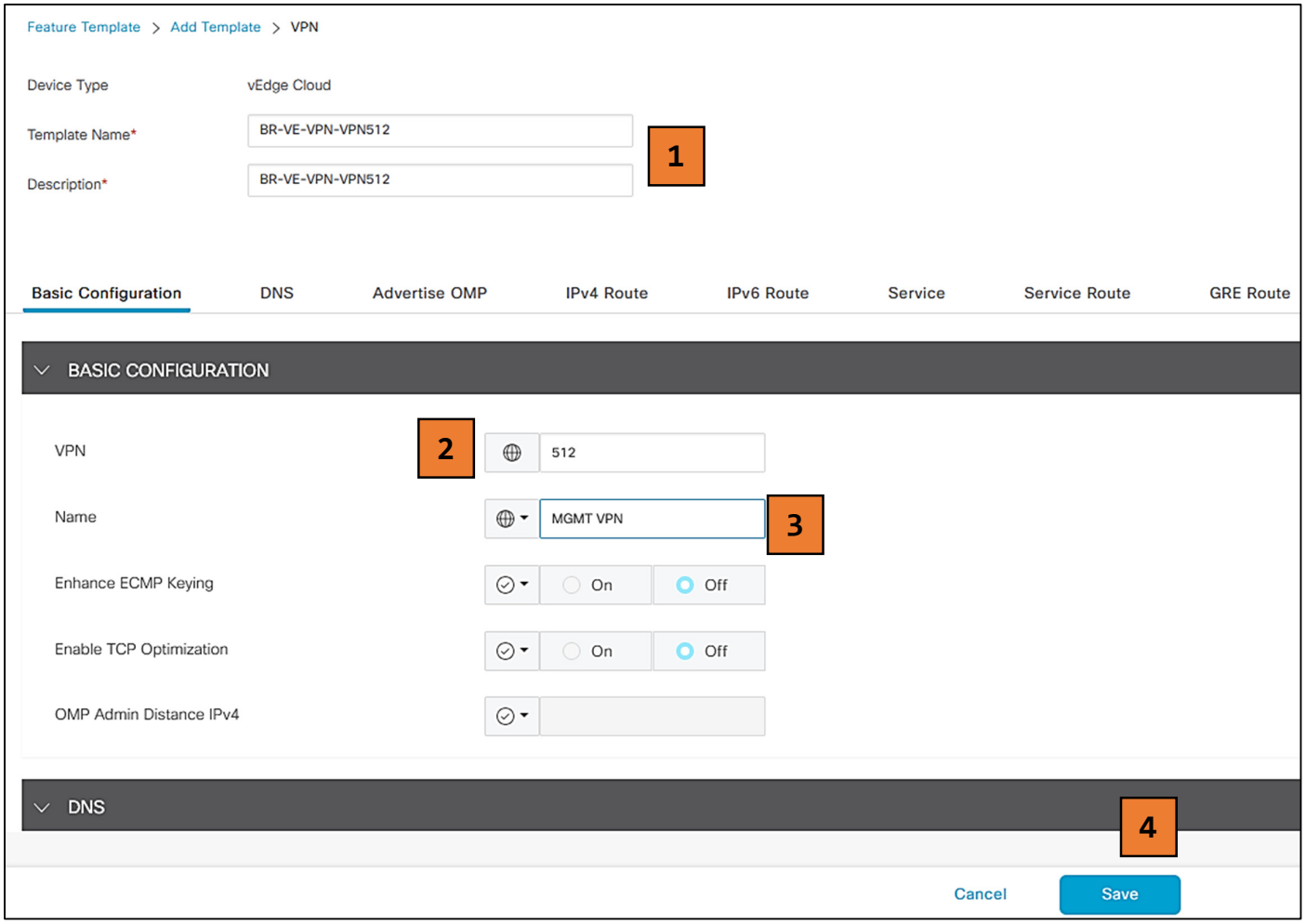


9. Address: Device Specific(default). *!device specific because of different next hops per site, it will be set to* ***[vpn_next_hop_ip_address_0]***, and 10. ADD(twice) then **SAVE**



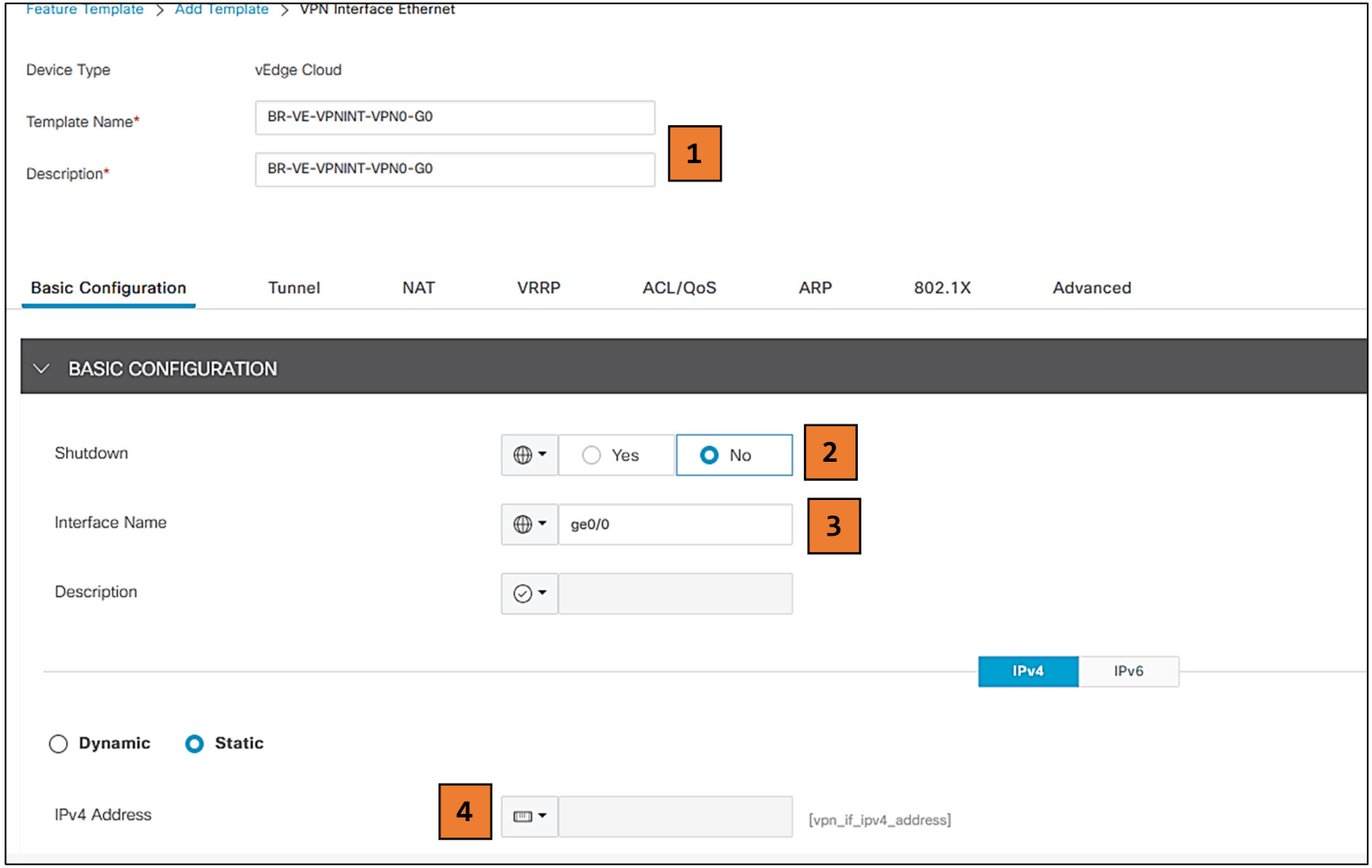


(for setting up VPN-0 Config: Add Template > vEdge Cloud > VPN)
1. Template Name: BR-VE-VPN-VPN512 : 2. VPN > Global: 512 > 3. Name: MGMT VPN > 4. SAVE

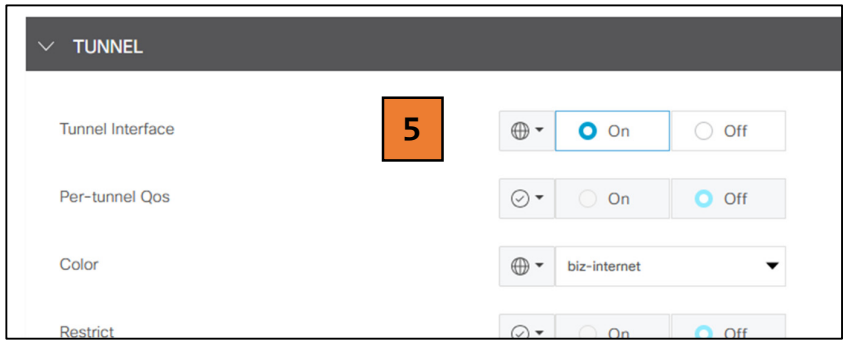


(for setting up VPN0 Interface as its ethernet connector: Add Template > vEdge Cloud > VPN INTERFACE ETHERNET)

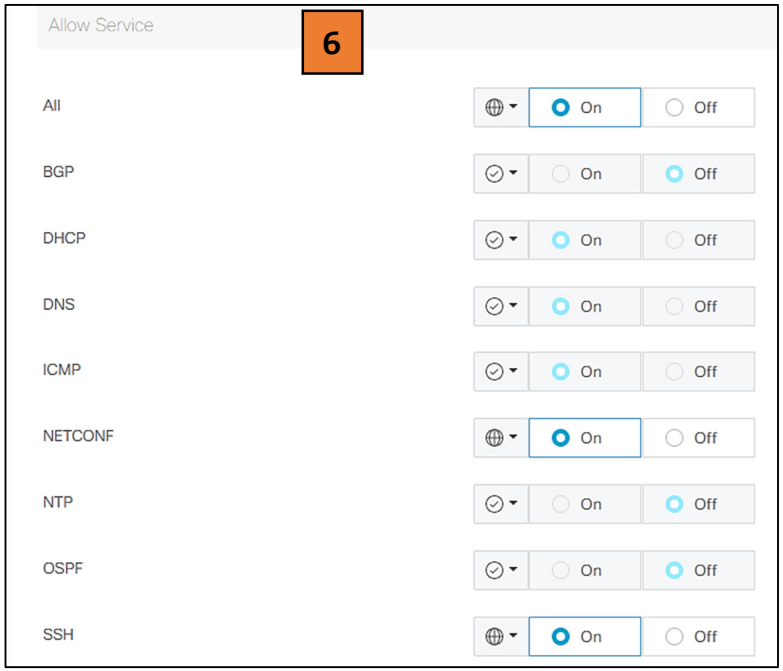
1. Template Name: BR-VE-VPNINT-VPN0-G0 > 2. Shutdown: Global NO > 3. Interface Name > Global: ge0/0
4. IPv4 Address > Device Specific: (***default***, IP Addresses are different in the offices)

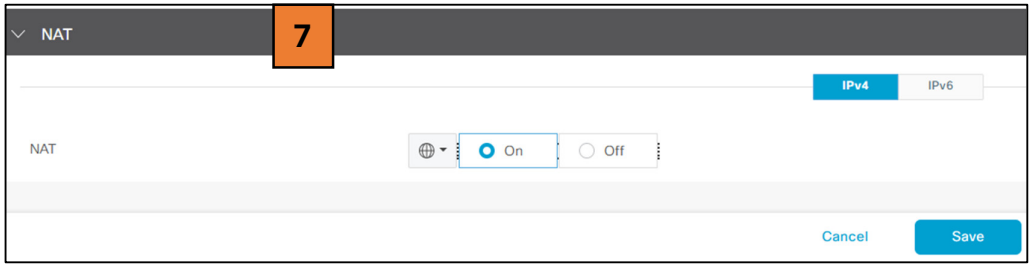


5. (scroll)… Tunnel Interface > Global: ON > Color: biz_Internet (*required for referencing VPN Connections)*



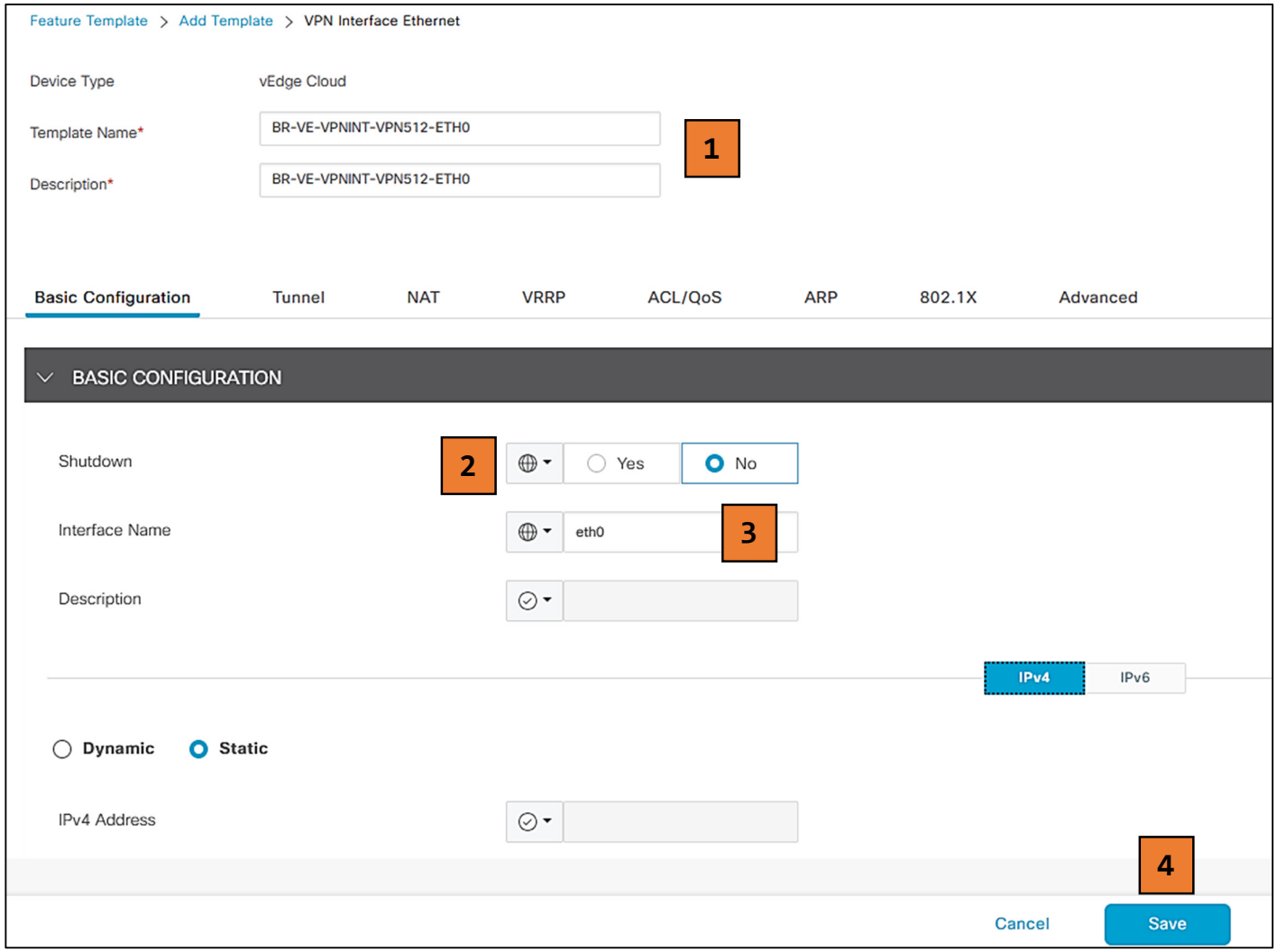
6. (Scroll to ***Allow Service***) Global ON for: ALL, SSH (for security), NETCONF (!for postman-like) > 7. (Scroll) NAT > Global: ON > SAVE





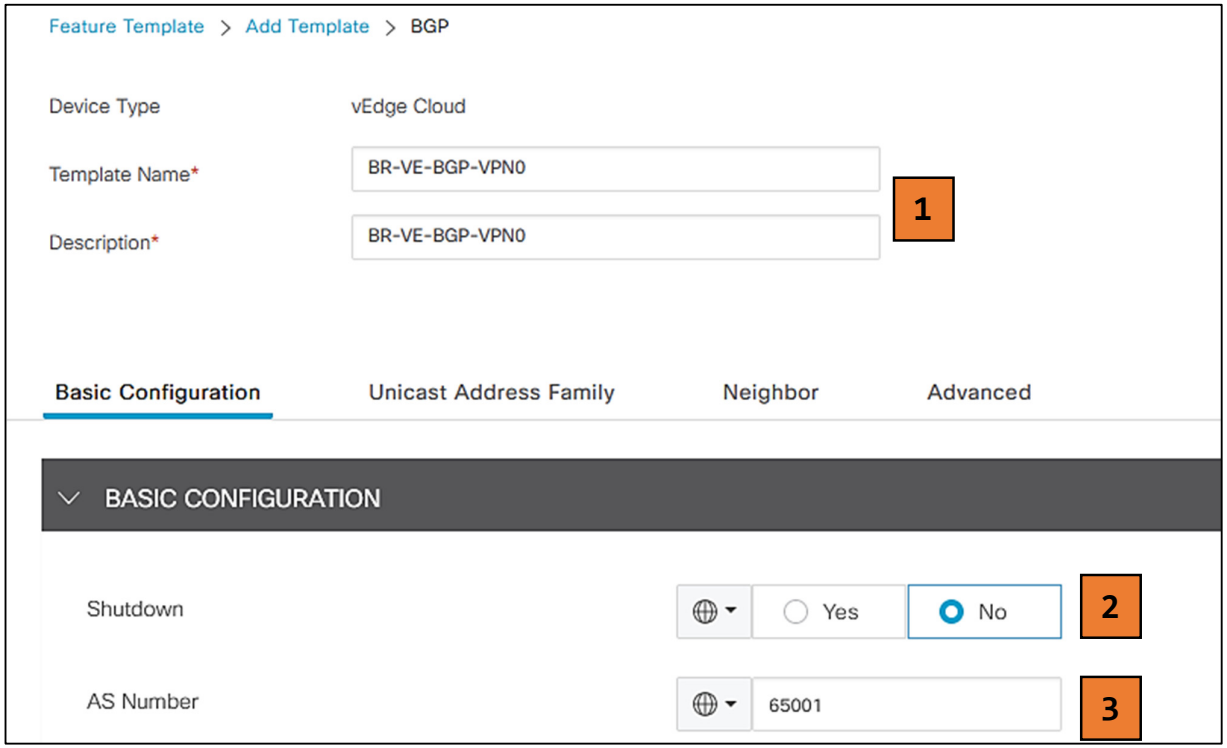
(for setting up VPN512 Interface as its ethernet connector: Add Template > vEdge Cloud > VPN INTERFACE ETHERNET)

1. Template Name: BR-VE-VPNINT-VPN512-ETH0 : 2. Shutdown > Global: NO > 3. Interface Name: eth0 > 4. SAVE

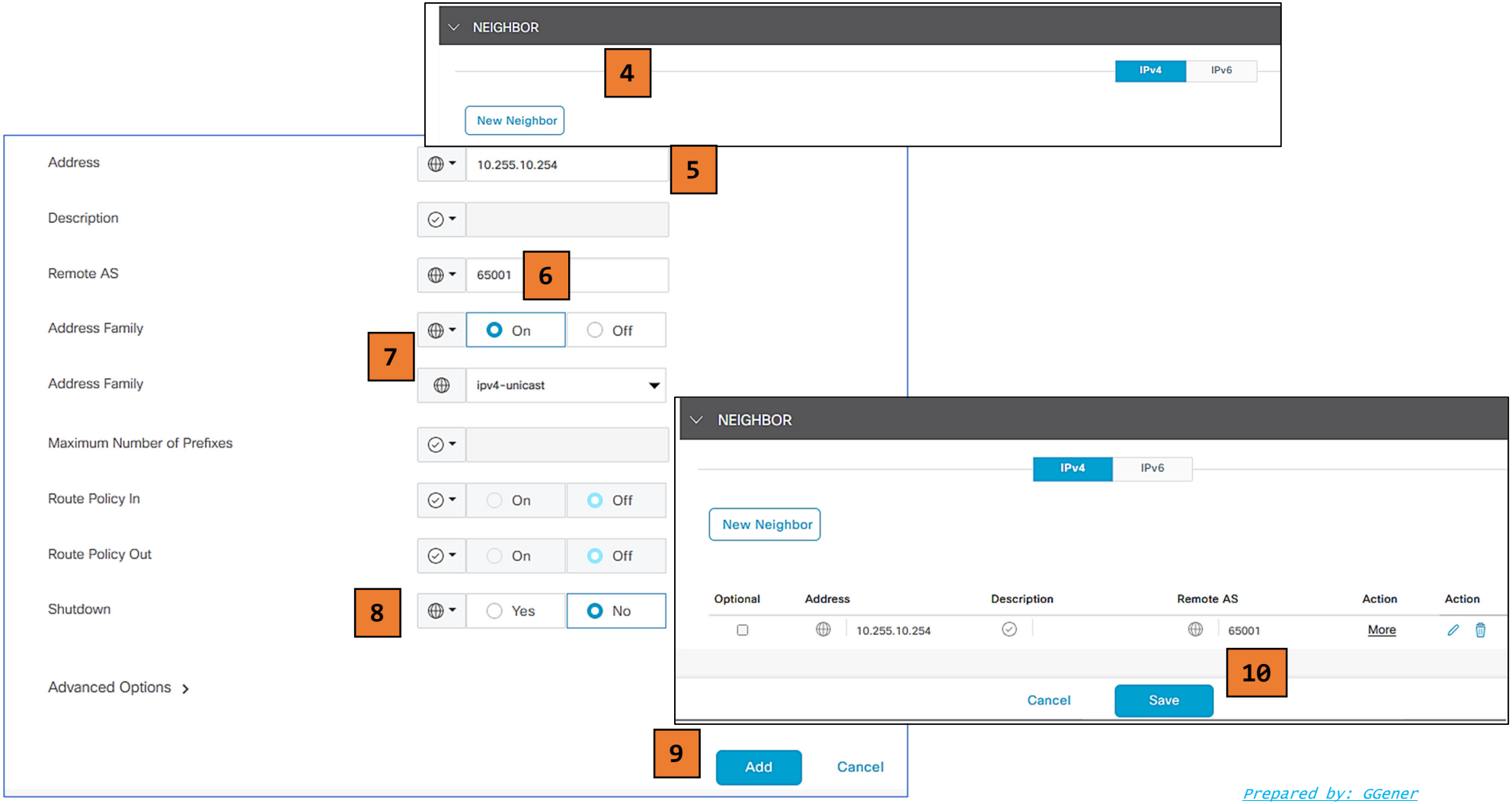


(for setting up ***new template*** for **BGP** across Cloud: Add Template > vEdge Cloud > (other) BGP

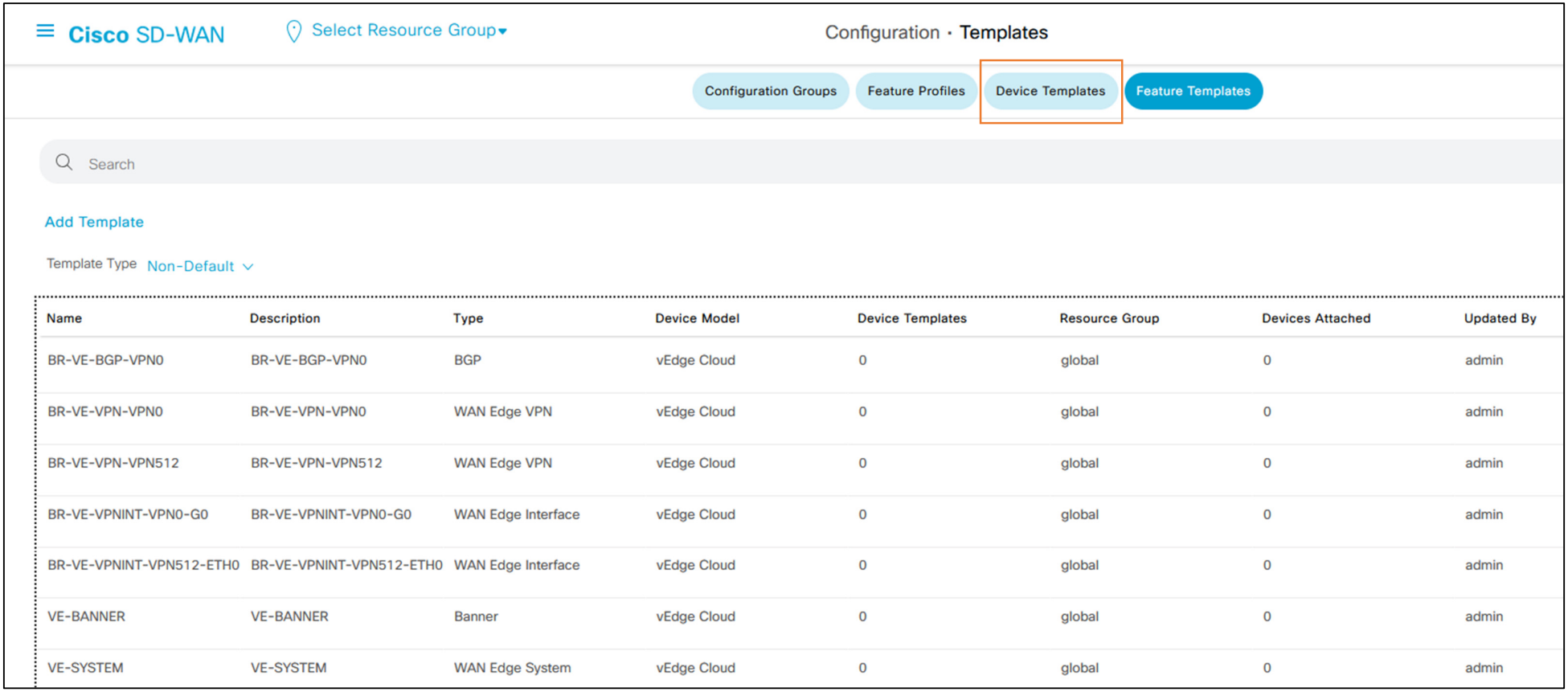
1. Template Name: BR-VE-BGP-VPN0 : 2. Shutdown> Global: NO >> 3.AS Number > Global: 65001



4. (scroll) NEW NEIGHBOR > 5. Address: 10.255.10.254 > 6. Remote-AS: Global 65001 > 7. Address Family: Global ON > Global ipv4-unicast > 9. ADD > and 10. SAVE



So far way almost half-way through, it is expected that 7 templates are properly composed before proceeding to the next phase (see the illustration).

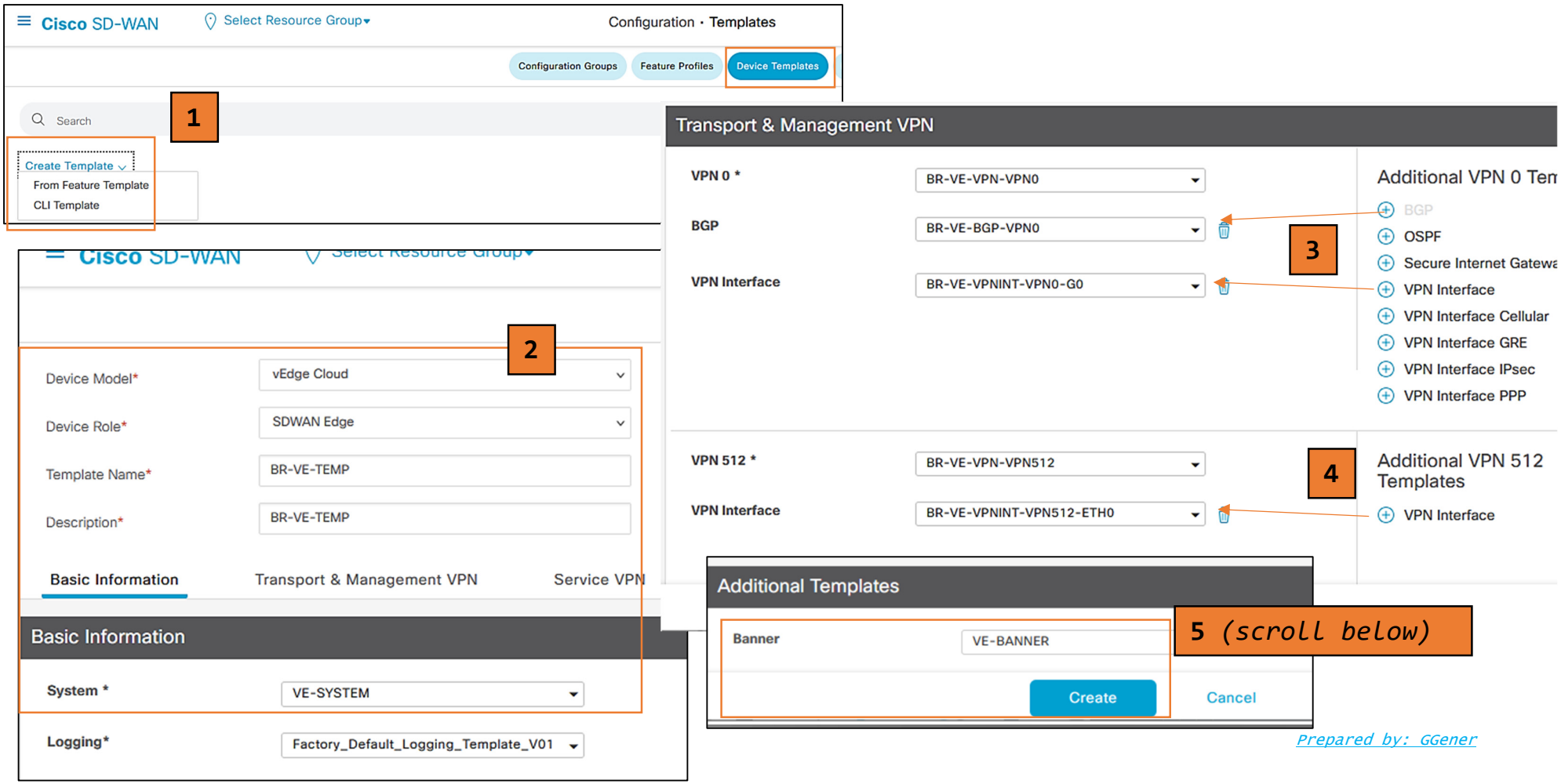


Name	Description	Type	Device Model	Device Templates	Resource Group	Devices Attached	Updated By
BR-VE-BGP-VPN0	BR-VE-BGP-VPN0	BGP	vEdge Cloud	0	global	0	admin
BR-VE-VPN-VPN0	BR-VE-VPN-VPN0	WAN Edge VPN	vEdge Cloud	0	global	0	admin
BR-VE-VPN-VPN512	BR-VE-VPN-VPN512	WAN Edge VPN	vEdge Cloud	0	global	0	admin
BR-VE-VPNINT-VPN0-G0	BR-VE-VPNINT-VPN0-G0	WAN Edge Interface	vEdge Cloud	0	global	0	admin
BR-VE-VPNINT-VPN512-ETH0	BR-VE-VPNINT-VPN512-ETH0	WAN Edge Interface	vEdge Cloud	0	global	0	admin
VE-BANNER	VE-BANNER	Banner	vEdge Cloud	0	global	0	admin
VE-SYSTEM	VE-SYSTEM	WAN Edge System	vEdge Cloud	0	global	0	admin

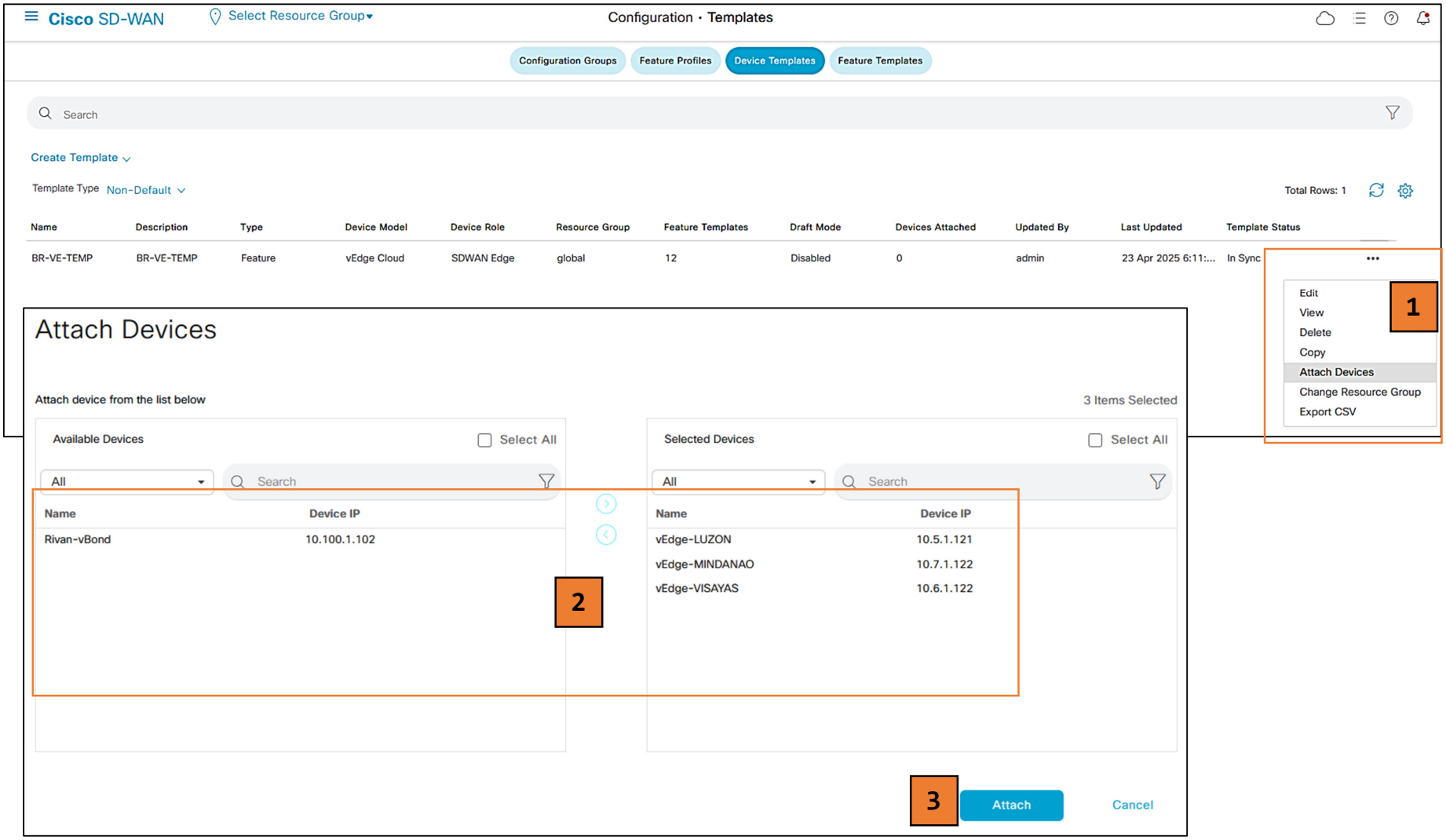
To proceed to the next phase… Click DEVICE TEMPLATES.

In this part we setup a ***Device Template*** for re-attachment of SDWAN Devices with applying the composed templates.

1. Device Templates > Create Template > From Feature Template >>> 2. Device Model: vEdge Cloud > Device Role: SDWAN Edge > Template Name: BR-VE-TEMP > System: VE-SYSTEM >>> 3. Transport & Manage VPN > VPN 0: BR-VE-VPN-VPN0 > +BGP > BR-VE-BGP-VPN0 >>> VPN Interface: BR-VE-VPNINT-VPN0-G0 >>> 4. VPN 512: BR-VE-VPN-VPN512 > +VPN Int: BR-VE-VPNINT-VPN512-ETH0 *(VPN 0 and VPN 512 are needed to talk to each other)* >> *5.* Banner: VE-BANNER > CREATE

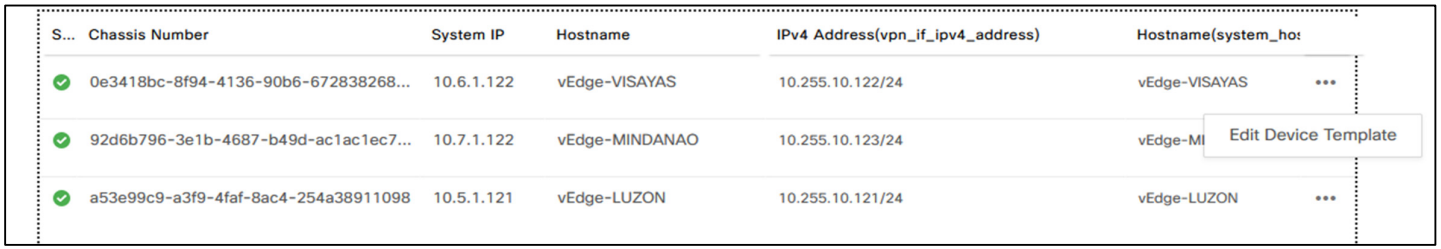


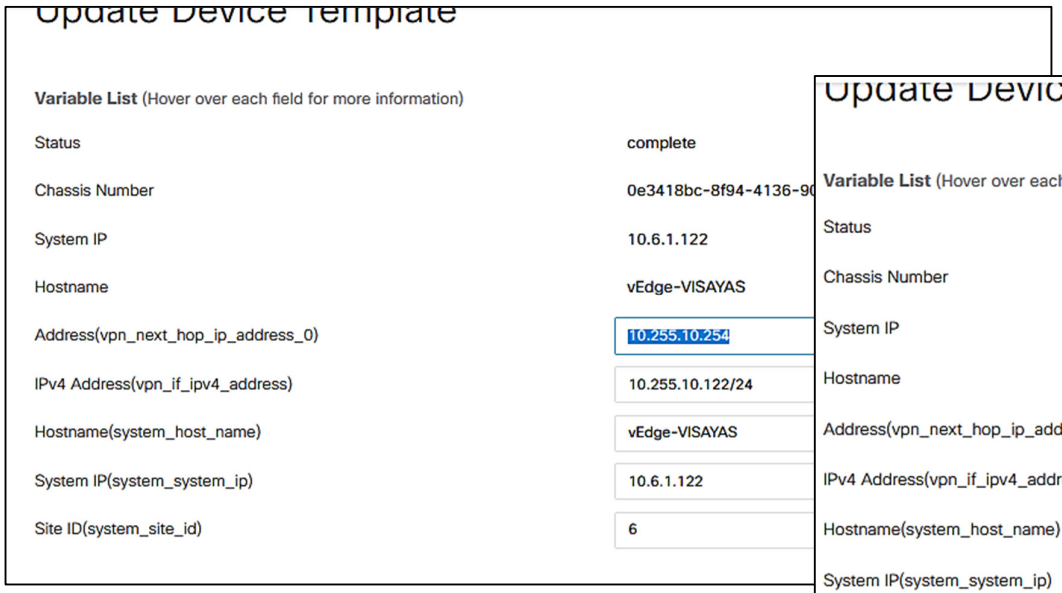
!(Deployment Time) 1. click ••• (BR-VE-TEMP) > Attach Devices >> 2. Select the vEdges of LUZON-VISAYAS-MINDANAO >> 3. Attach

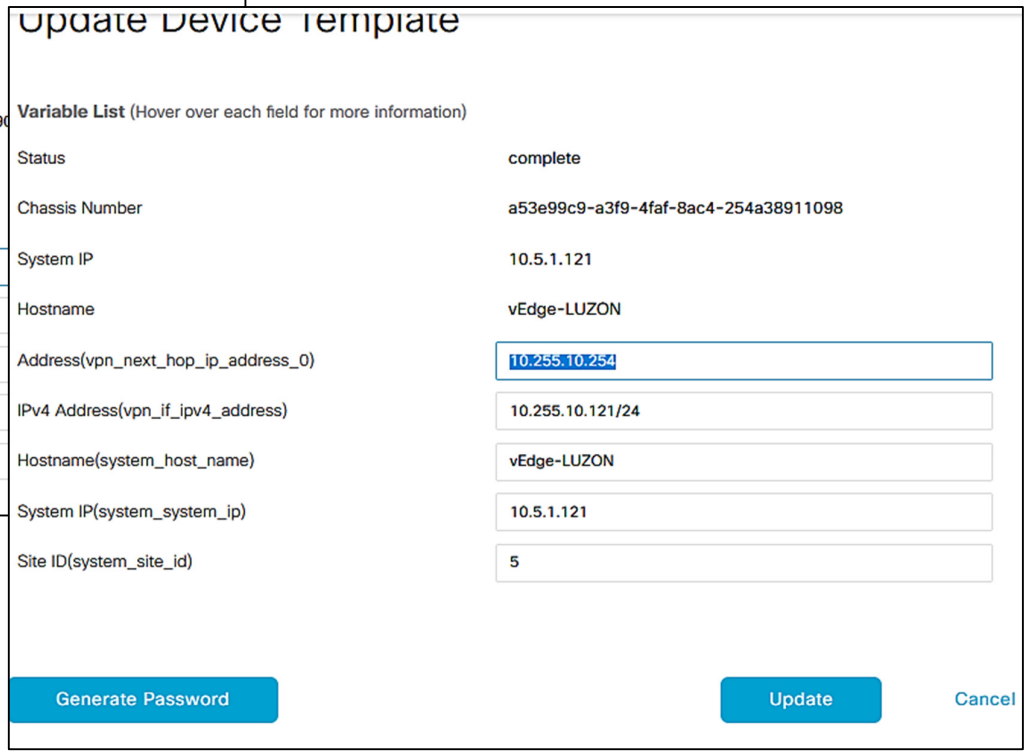


Prepared by: GGener

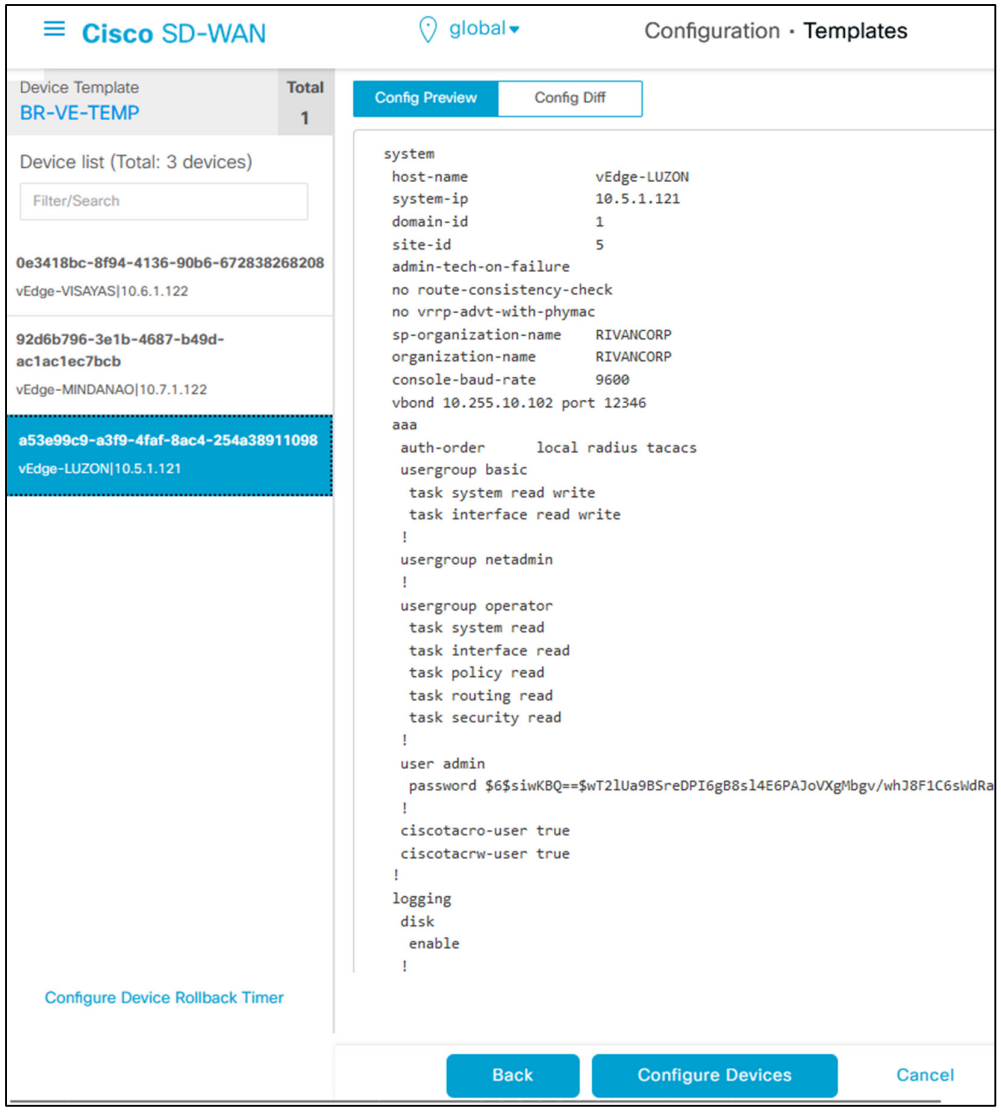
(for final edit) **... UPDATE (edit) Device Template** each Rivan vEdges (Luzon, Visayas, Mindanao) ... > Address (next hop): ***10.255.10.254***

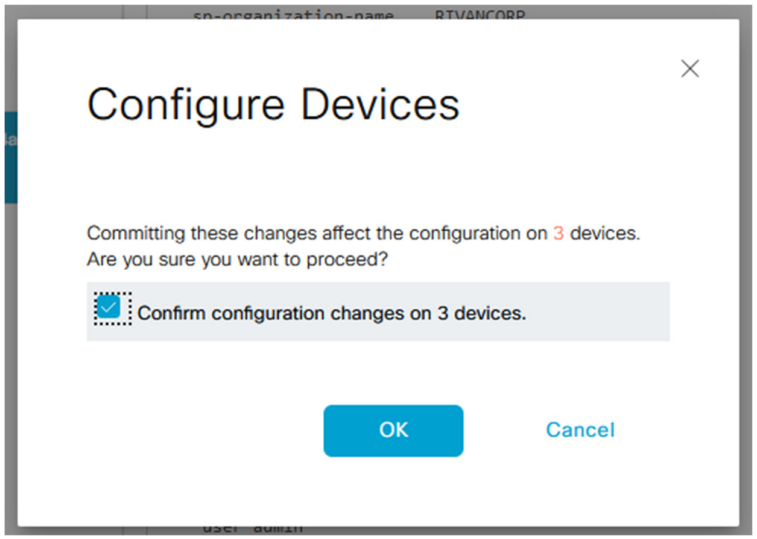


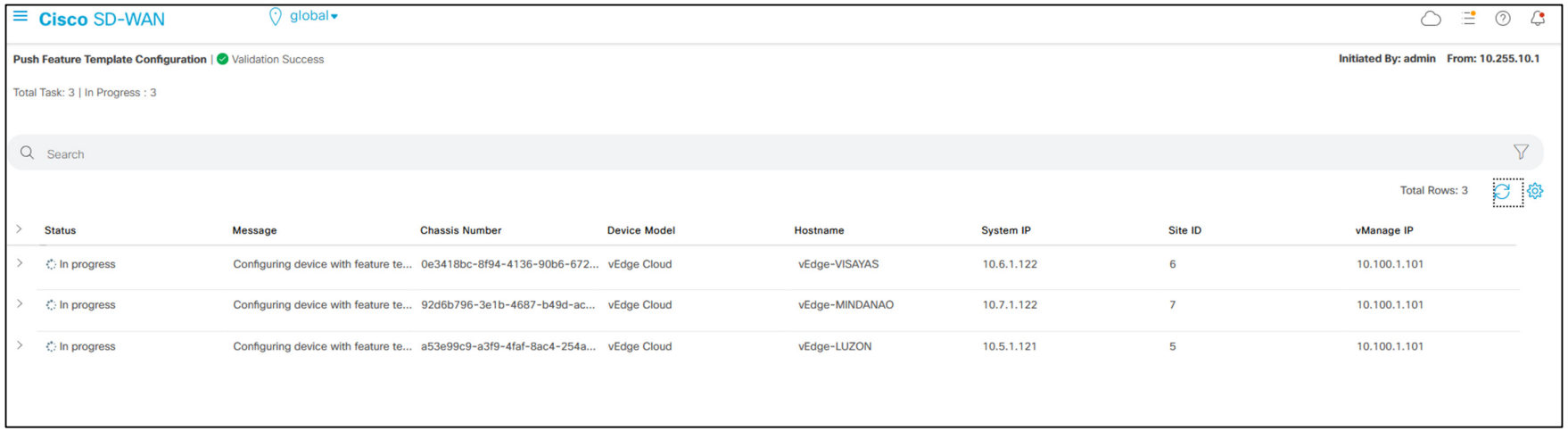




Next > CONFIGURE DEVICES > Confirm Configuration… > OK …. (and cross-fingers or pray!)







Total Rows: 3

Status	Message	Chassis Number	Device Model	Hostname	System IP	Site ID	vManage IP
Success	Done - Push Feature Template C...	0e3418bc-8f94-4136-90b6-672...	vEdge Cloud	vEdge-VISAYAS	10.6.1.122	6	10.100.1.101
Success	Done - Push Feature Template C...	92d6b796-3e1b-4687-b49d-ac...	vEdge Cloud	vEdge-MINDANAO	10.7.1.122	7	10.100.1.101
Success	Done - Push Feature Template C...	a53e99c9-a3f9-4faf-8ac4-254a...	vEdge Cloud	vEdge-LUZON	10.5.1.121	5	10.100.1.101

If you have 3 SUCCESS, GOOD JOB (^_^) … if failed… re-check the each created templates via Feature Templates.

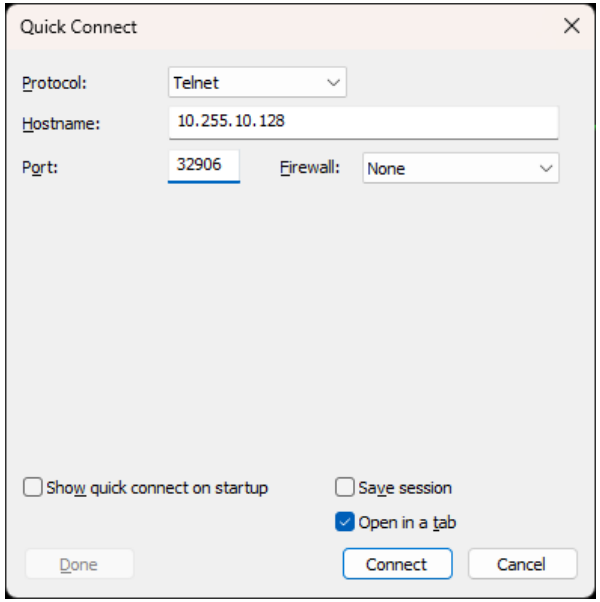
WAIT… there's more!!! (we're just halfway through)… while pushing config status, add these initial pre-config scripts for ***Luzon, Visayas, and Mindanao***

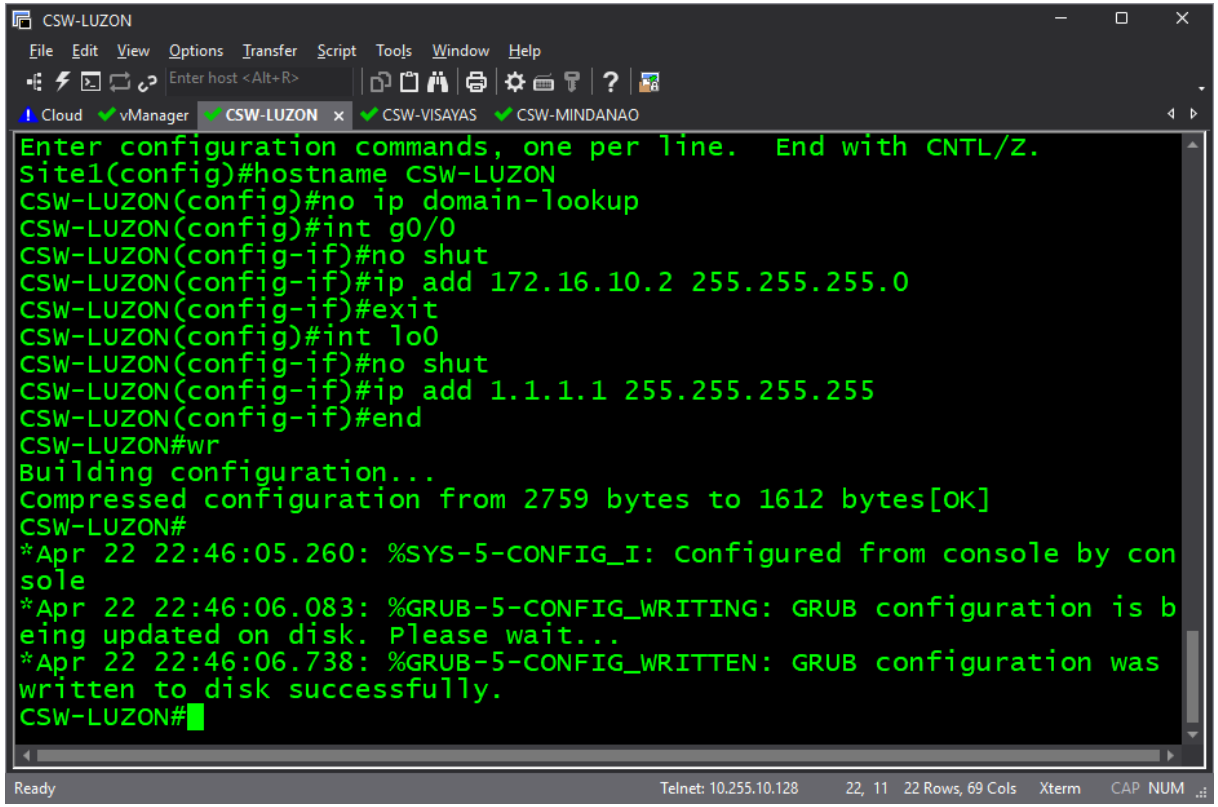
```
!for Telnet 10.255.10.xxx : 32906
!*LUZON*
en
conf t
hostname CSW-LUZON
no ip domain-lookup
int g0/0
no shut
ip add 172.16.10.2 255.255.255.0
exit
int lo0
no shut
ip add 1.1.1.1 255.255.255.255
end
wr
```

```
!for Telnet 10.255.10.xxx : 32907
!*Visayas*
en
conf t
hostname CSW-VISAYAS
no ip domain-lookup
int g0/0
no shut
ip add 172.16.20.2 255.255.255.0
exit
int lo0
no shut
ip add 2.2.2.2 255.255.255.255
end
wr
```

```
!for Telnet 10.255.10.xxx : 32908
!*Mindanao*
en
conf t
hostname CSW-MINDANAO
no ip domain-lookup
int g0/0
no shut
ip add 172.16.30.2 255.255.255.0
exit
int lo0
no shut
ip add 3.3.3.3 255.255.255.255
end
wr
```

(telnet 10.255.10.xxx : 32906, 32907, 32908), verify that *Luzon, Visayas, and Mindanao* in the topology are running and properly configured before proceeding.


Quick Connect
Protocol:
Telnet
Hostname:
10.255.10.128
Port:
32906
Firewall:
None
Show quick connect on startup
Save session
Open in a tab
Done
Connect
Cancel


CSW-LUZON
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
Cloud vManager CSW-LUZON CSW-VISAYAS CSW-MINDANAO
Enter configuration commands, one per line. End with CNTL/Z.
Site1(config)#hostname CSW-LUZON
CSW-LUZON(config)#no ip domain-lookup
CSW-LUZON(config)#int g0/0
CSW-LUZON(config-if)#no shut
CSW-LUZON(config-if)#ip add 172.16.10.2 255.255.255.0
CSW-LUZON(config-if)#exit
CSW-LUZON(config)#int lo0
CSW-LUZON(config-if)#no shut
CSW-LUZON(config-if)#ip add 1.1.1.1 255.255.255.255
CSW-LUZON(config-if)#end
CSW-LUZON#wr
Building configuration...
Compressed configuration from 2759 bytes to 1612 bytes[OK]
CSW-LUZON#
*Apr 22 22:46:05.260: %SYS-5-CONFIG_I: Configured from console by con
sole
*Apr 22 22:46:06.083: %GRUB-5-CONFIG_WRITING: GRUB configuration is b
eing updated on disk. Please wait...
*Apr 22 22:46:06.738: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was
written to disk successfully.
CSW-LUZON#
Ready
Telnet: 10.255.10.128
22, 11 22 Rows, 69 Cols Xterm
CAP NUM

Additionally after the initial config scripts: Configure Initial OSPF Scripts to remote SITES, add the following commands via CLI …

!CSW-LUZON

en

conf t

router ospf 1

network 172.16.10.0 0.0.0.255 area 0

network 1.1.1.1 0.0.0.0 area 0

end

wr

!

.

!CSW-VISAYAS

en

conf t

router ospf 1

network 172.16.20.0 0.0.0.255 area 0

network 2.2.2.2 0.0.0.0 area 0

end

wr

!

.

!CSW-MINDANAO

en

conf t

router ospf 1

network 172.16.30.0 0.0.0.255 area 0

network 3.3.3.3 0.0.0.0 area 0

end

wr

!

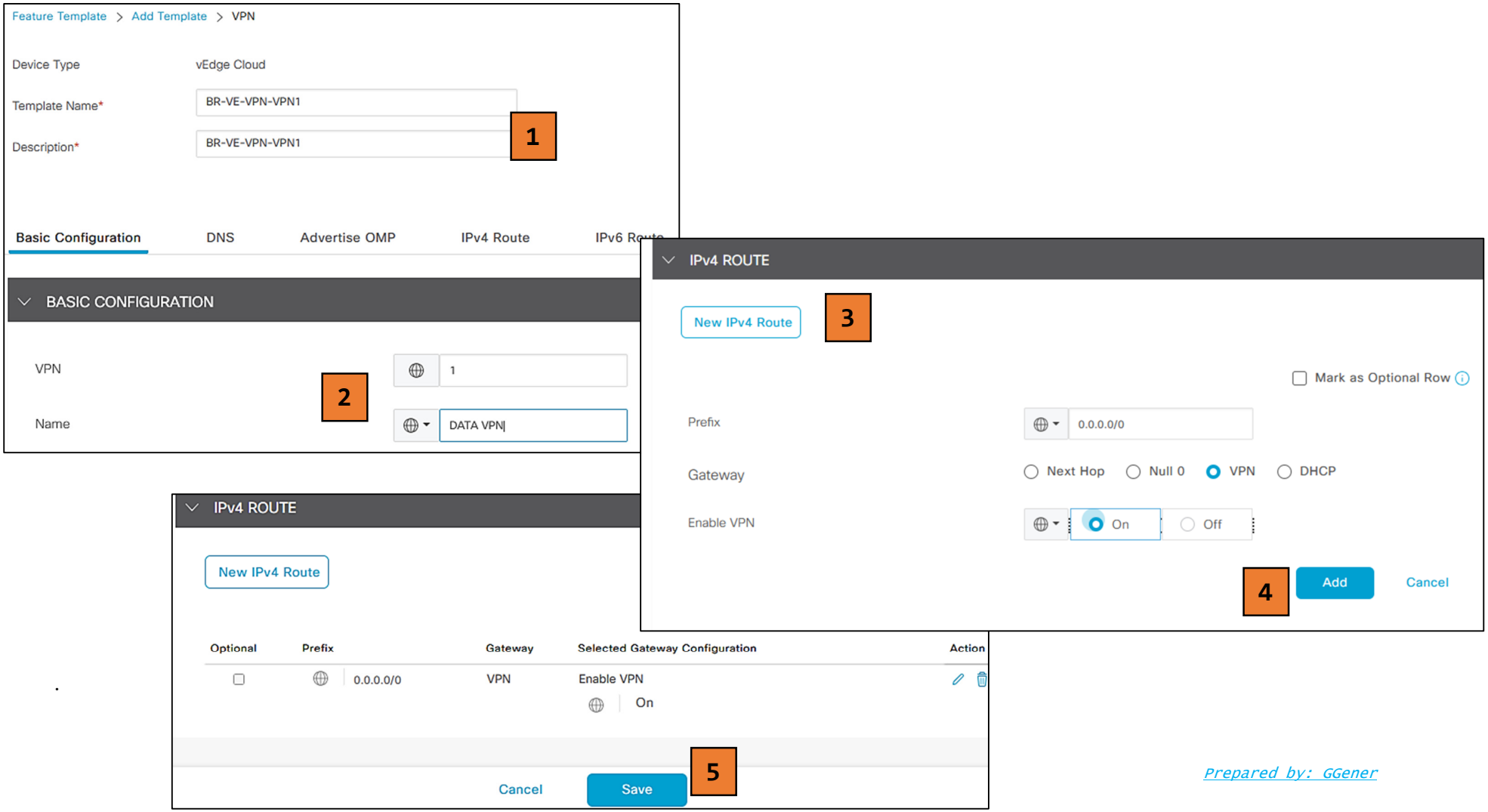
.

```
CSW-LUZON#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
CSW-LUZON(config)#no router ospf 1
CSW-LUZON(config)#router ospf 1
CSW-LUZON(config-router)#network 172.16.10.0 0.0.0.255 area 0
CSW-LUZON(config-router)#network 1.1.1.1 0.0.0.0 area 0
CSW-LUZON(config-router)#end
CSW-LUZON#wr
Building configuration...
Compressed configuration from 2845 bytes to 1671 bytes[OK]
CSW-LUZON#!
```

Cloud | vManager | CSW-LUZON | CSW-VISAYAS | CSW-MINDANAO

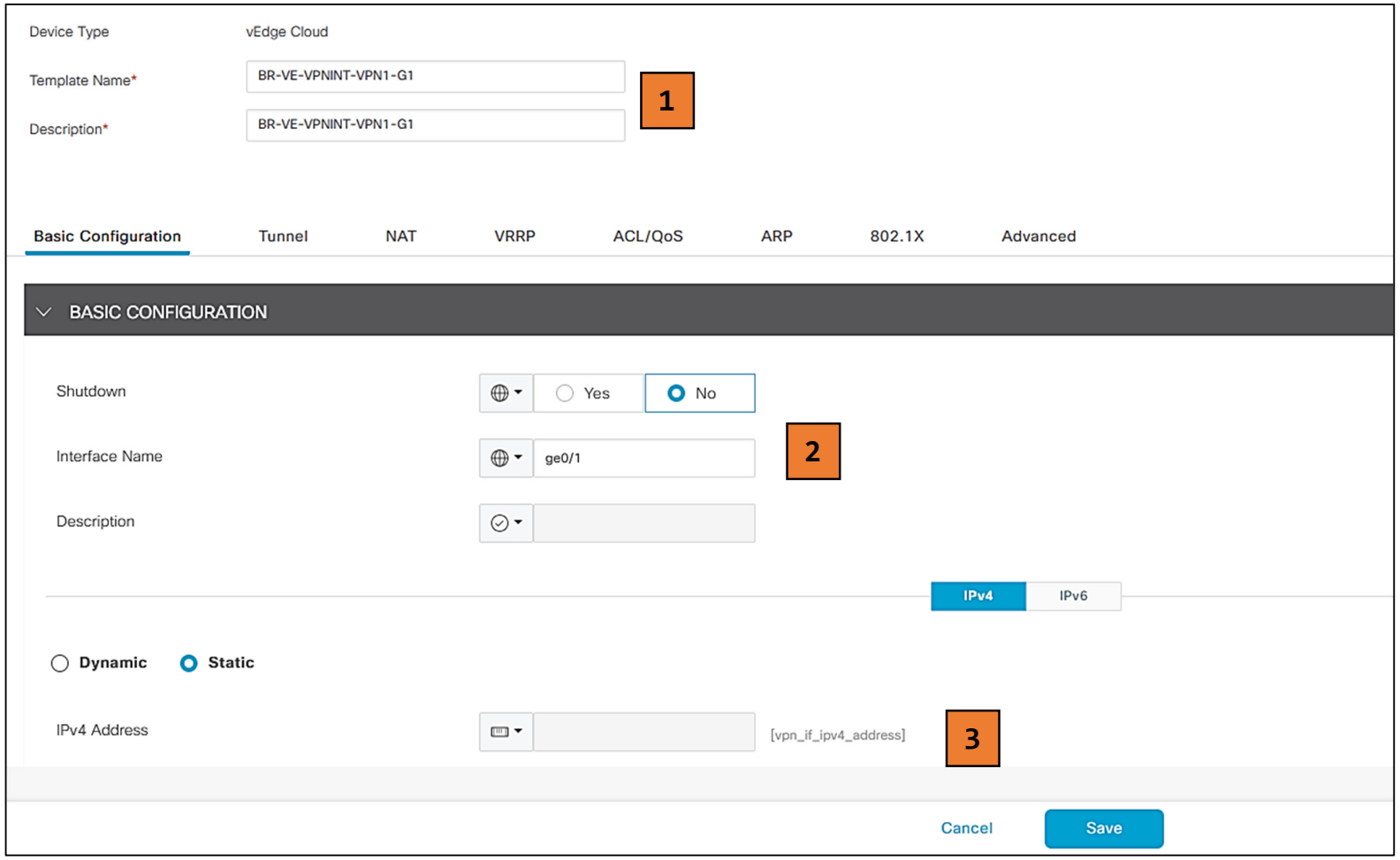
```
CSW-VISAYAS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
CSW-VISAYAS(config)#router ospf 1
CSW-VISAYAS(config-router)#network 172.16.20.0 0.0.0.255 area 0
CSW-VISAYAS(config-router)#network 2.2.2.2 0.0.0.0 area 0
CSW-VISAYAS(config-router)#end
CSW-VISAYAS#wr
Building configuration...
Compressed configuration from 2847 bytes to 1670 bytes[OK]
```

Reminder: VPN512 for MGMT, VPN0 for Connectivity… ***new VPN1 for Data Plane (or a.k.a. Service VPN)***…. ***@ vManage for OSPF Template Data Connectivity:*** Configuration > Templates > Feature Templates : Add Template > vEdge Cloud > VPN :
1. Template Name/Description: **BR-VE-VPN-VPN1** >>> 2. VPN: **1** >>> Name: **DATA VPN** (or SERVICE VPN)
>>> 3. New IPv4 Route : Global **0.0.0.0/0** >>> Enable VPN: Global **ON** >>>> 4. ADD >>> 5. **SAVE**

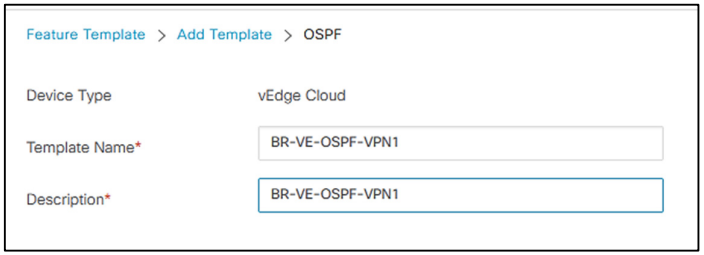


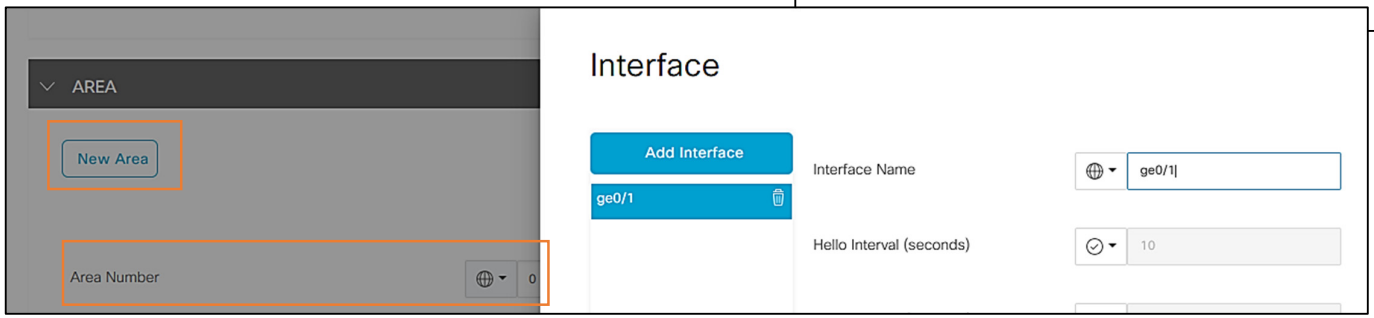
(for the DATA/SERVICE VPN Connectivity… Add Template > vEdge Cloud > VPN Interface Ethernet)

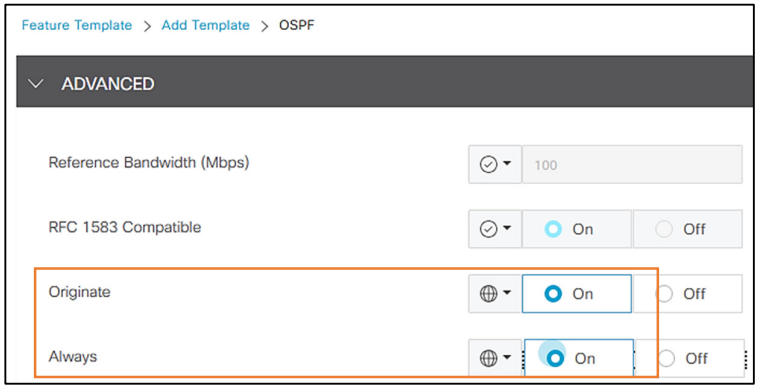
Template Name: BR-VE-VPNINT-VPN1-G1 >> Shutdown : Global NO >> Interface: ge0/1 >> IPv4 Address: Device Specific >>> SAVE



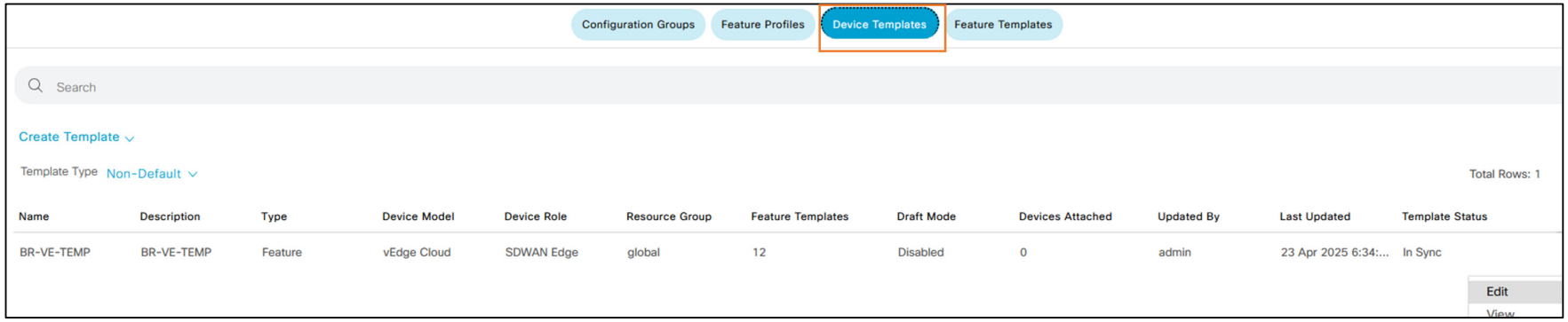
(for OSPF Data/Service Routing Template)… Add Template > vEdge Cloud > OSPF: Template Name: **BR-VE-OSPF-VPN1** : New Redistribute >> Protocol: Global OMP (Overlay Management Protocol) > ADD >> New Area > Area Number Global: 0 > Add Interface > Interface Name: ge0/1 > ADD (2 times) >> Advance > Originate: Global ON and Always: (Global) ON >> SAVE



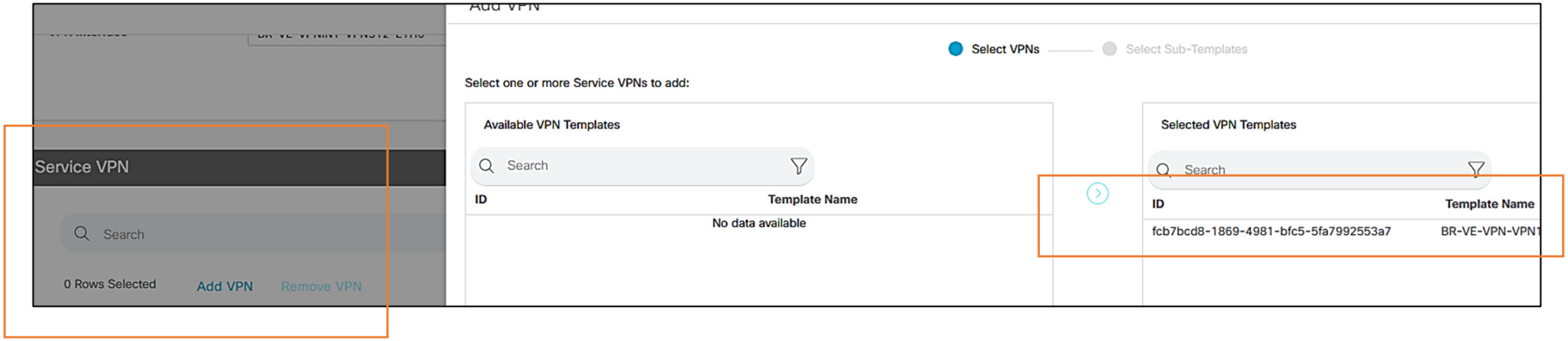




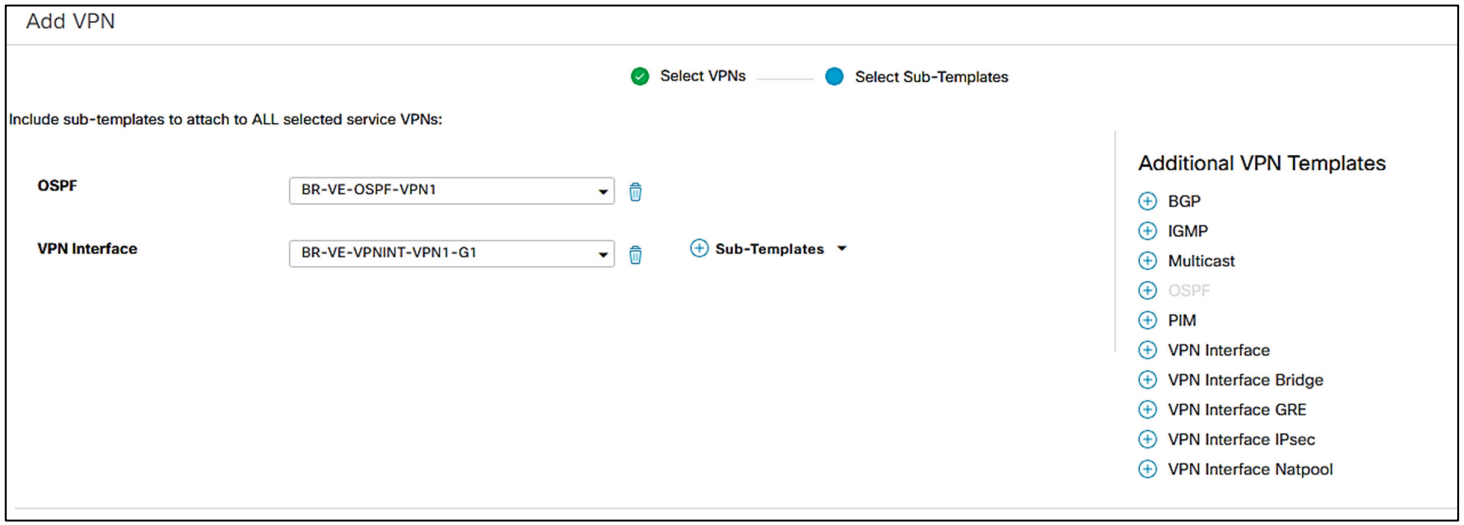
for the connectivity of OSPF Template):… Device Templates : BR-VE-TEMP... > Edit

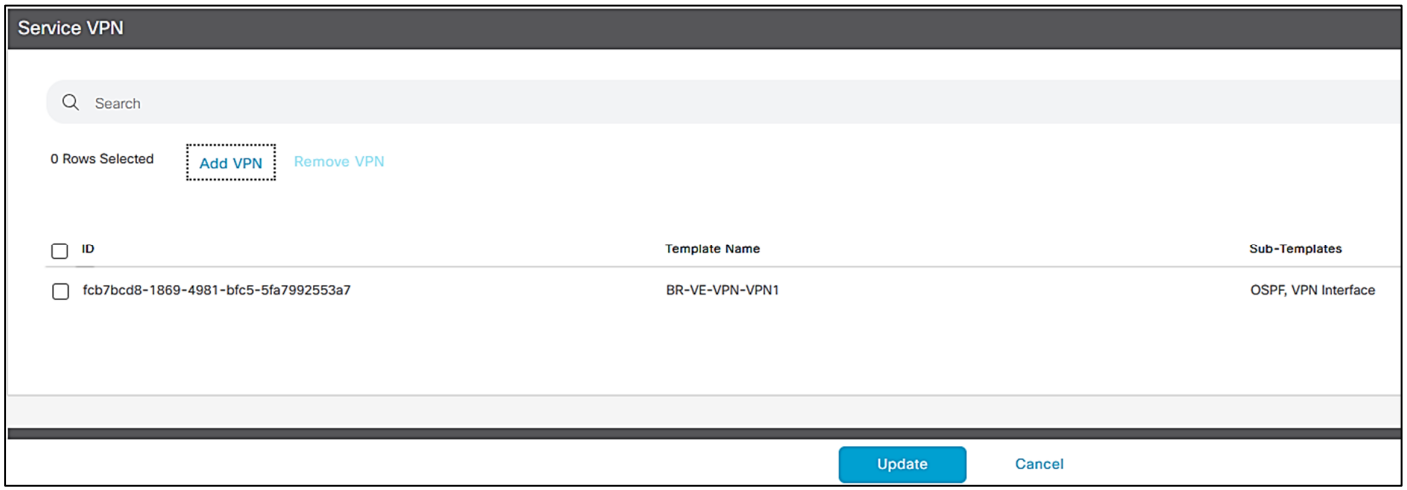


(scroll) Service VPN > Add VPN > select BR-VE-VPN1 > (add to the right >) > **NEXT**



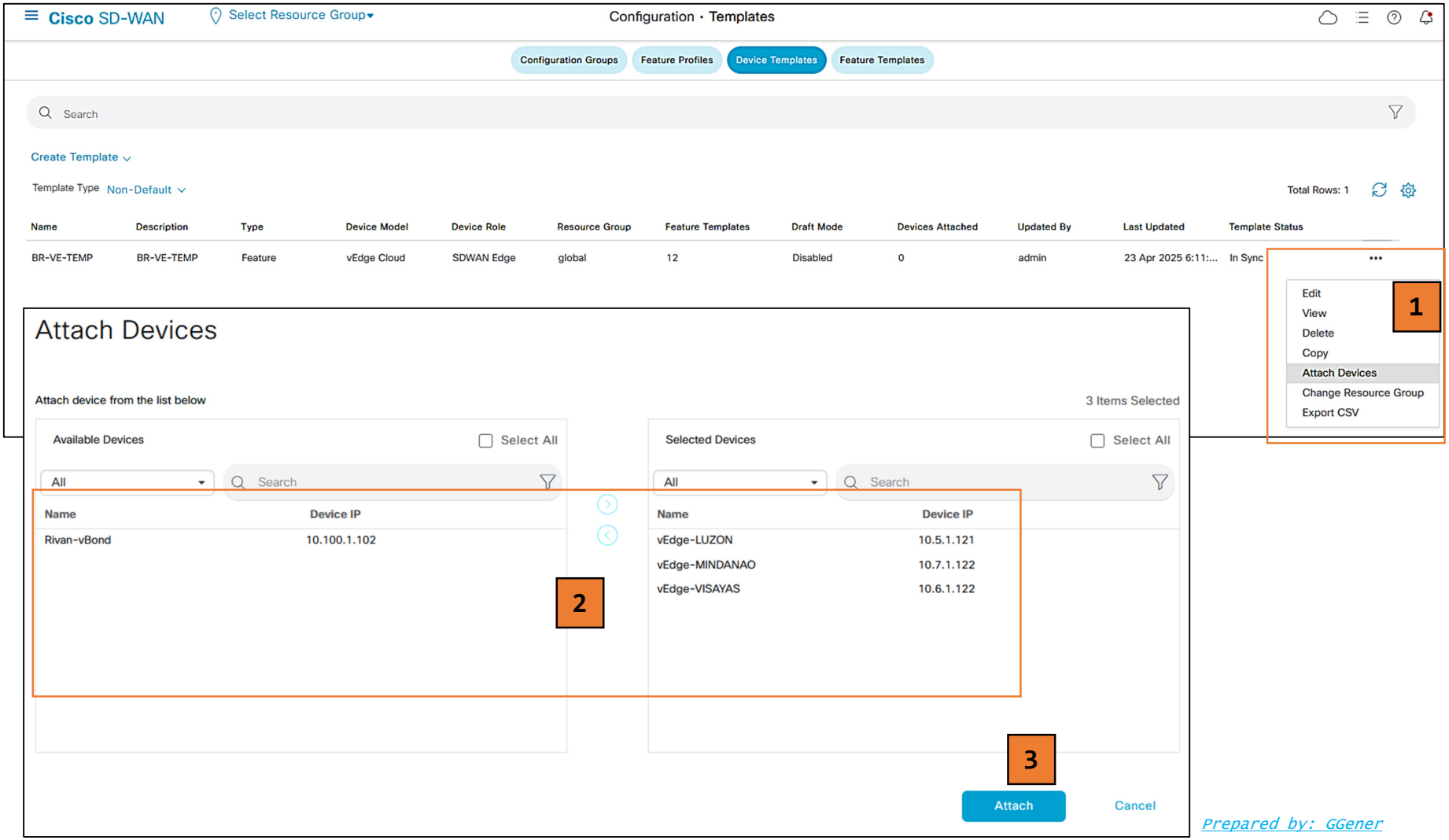
> OSPF+ > BR-VE-OSPF-VPN1 : VPN Interface+ > VPN Int: BR-VE-VPNINT-VPN1-G1 > >> **ADD** >> **UPDATE**



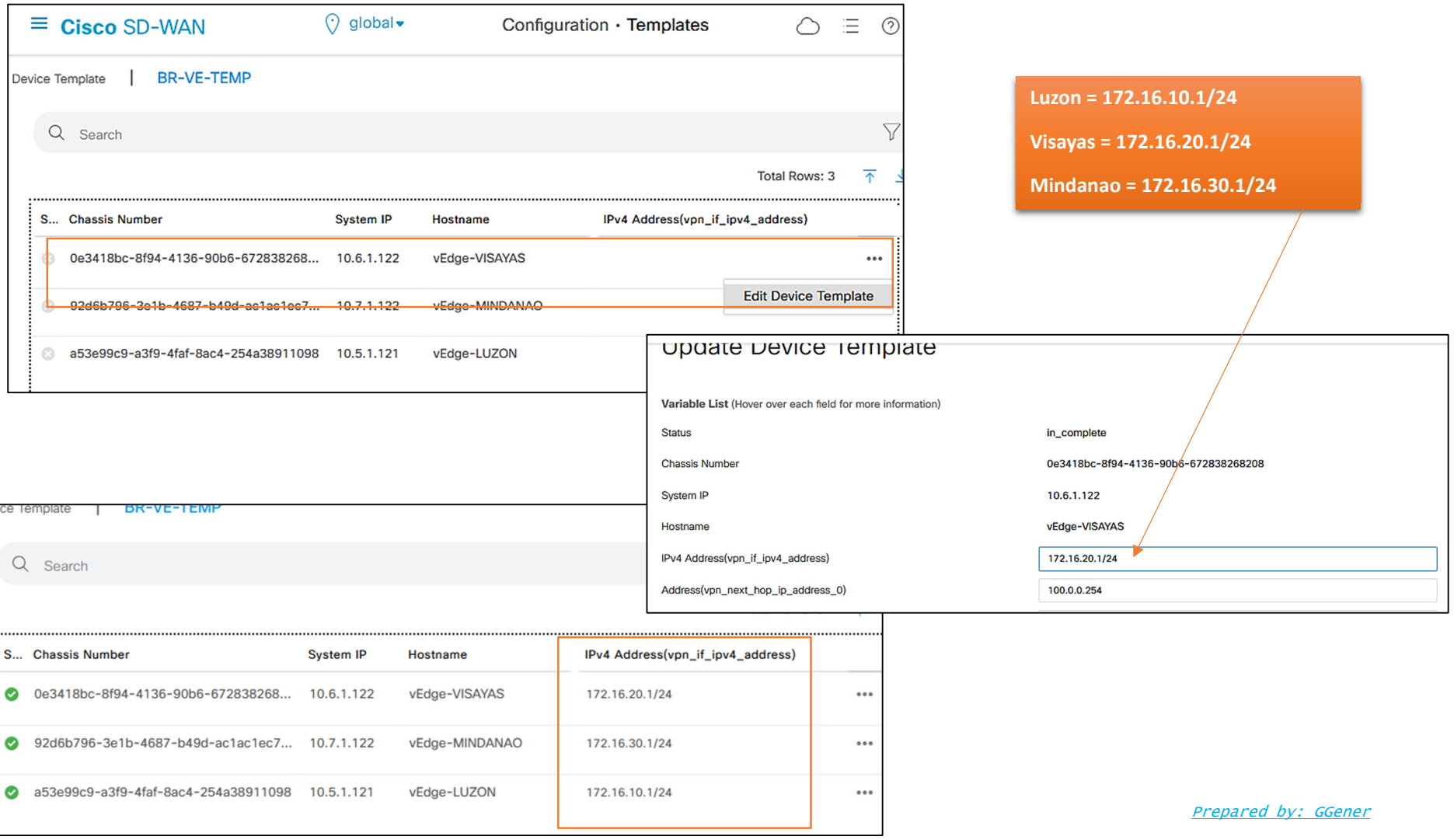


vEdges Final Phase Deployment *(do the procedure below if BR-VE-TEMP needs to re-attach again)*

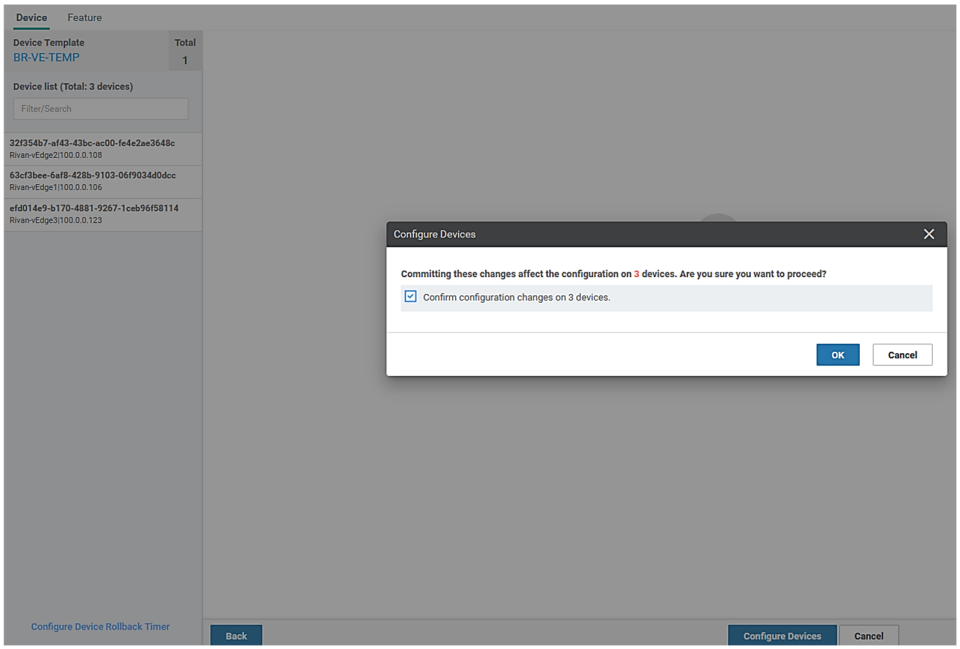
1. click ••• (BR-VE-TEMP) > Attach Devices >> 2. Select the vEdges of LUZON-VISAYAS-MINDANAO >> 3. Attach

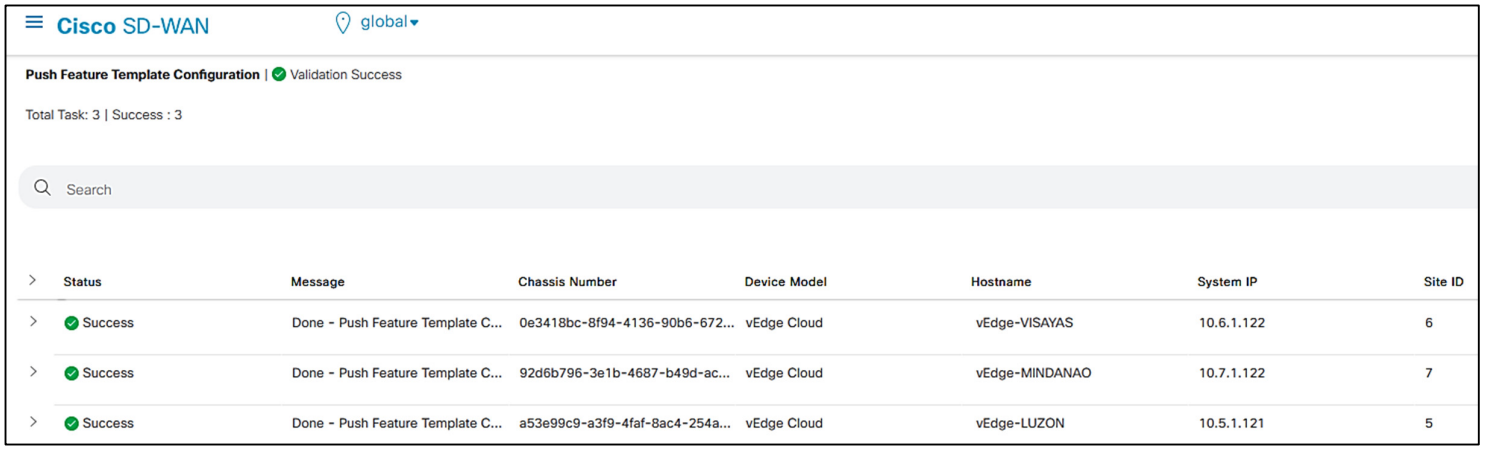


1. click ••• (each vEdges) > vpn_if_ipv4_address: ***172.16.x0.1/24*** (where x == according to sites Luzon, Visayas, or Mindanao)) ,
and **Update,** also do to the other vEdges. *!!! :!(it can be checked on Luzon, Visayas, Mindanao devices via CLI sh ip int br @ eth0 to verify the ip)*

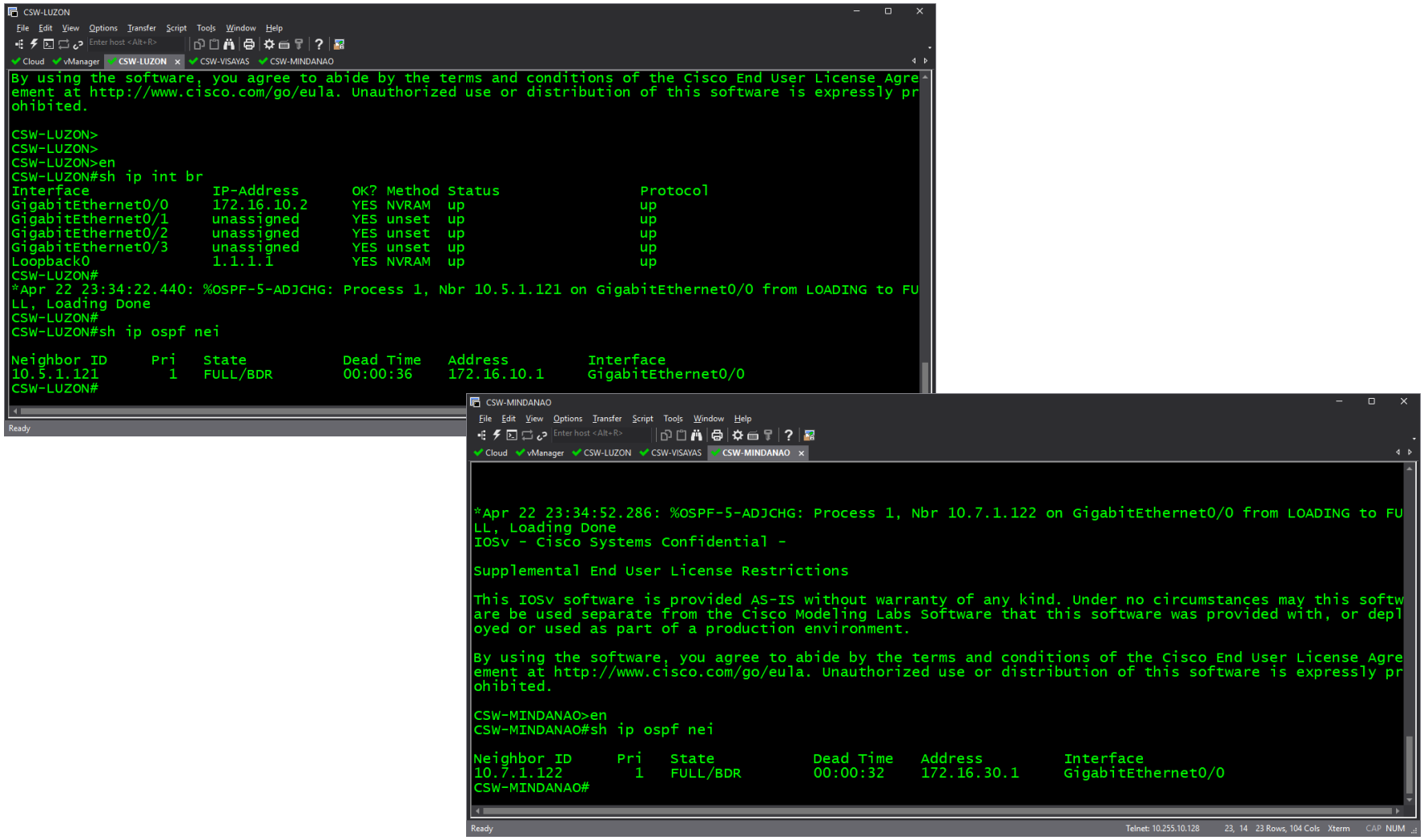


Next > CONFIGURE DEVICES > (and cross-fingers again!)

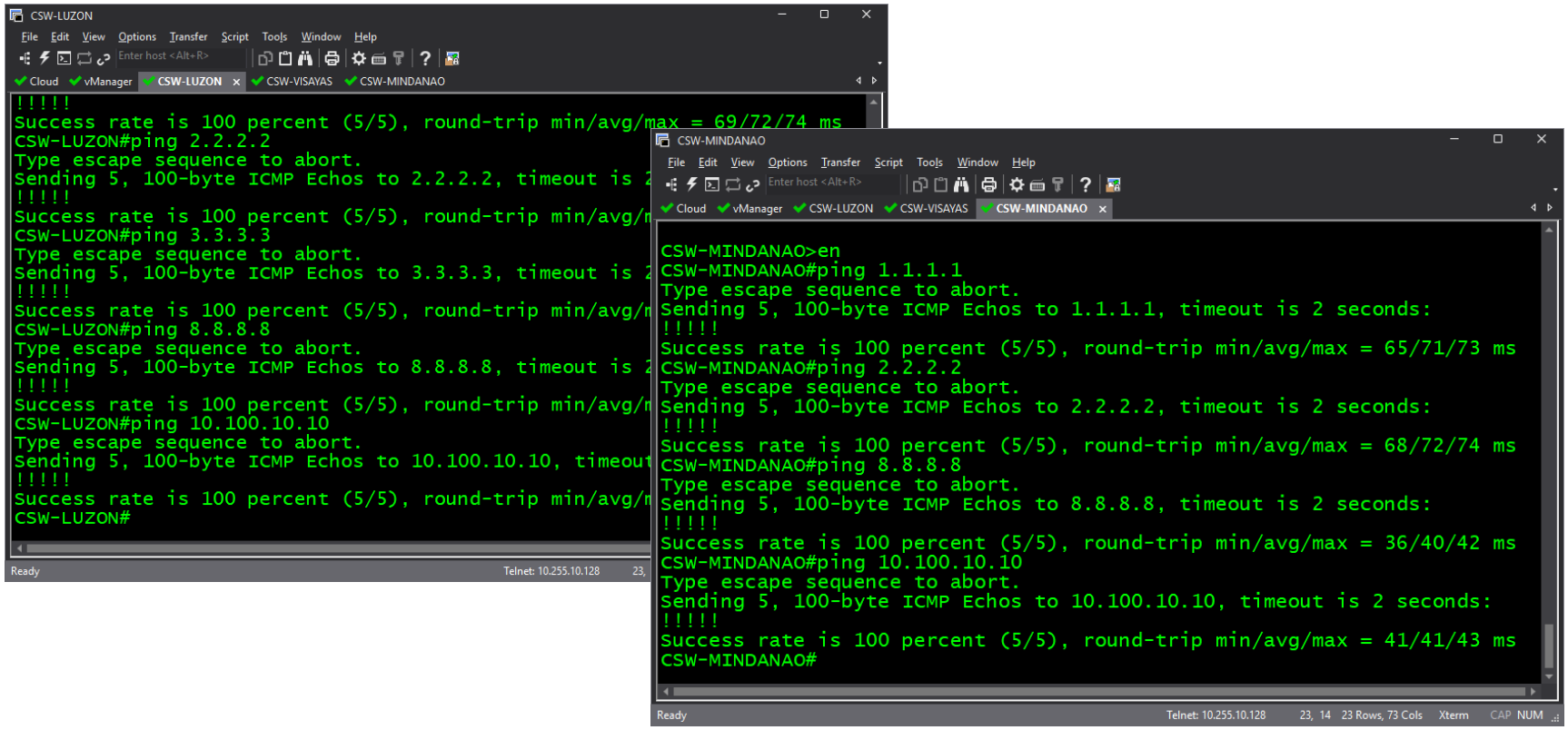




(while in progress of saving, you may monitor the CLi of Sites Luzon, Visayas, and Mindanao for OSPF Neighboring)
(thru cli, you can confirm via sh ip ospf nei... it should be in FULL/BDR)



ping 8.8.8.8 and each site's loopback addresses for checking, if you have 3 SUCCESS, GOOD JOB (^_^) … if failed… re-check the OSPF Templates up to Final Specifications of each sites IP Addresses. *(refer to page 40).*



#CONGRATULATIONS

#SDWAN.Success (^_^)
#GGWP \m/

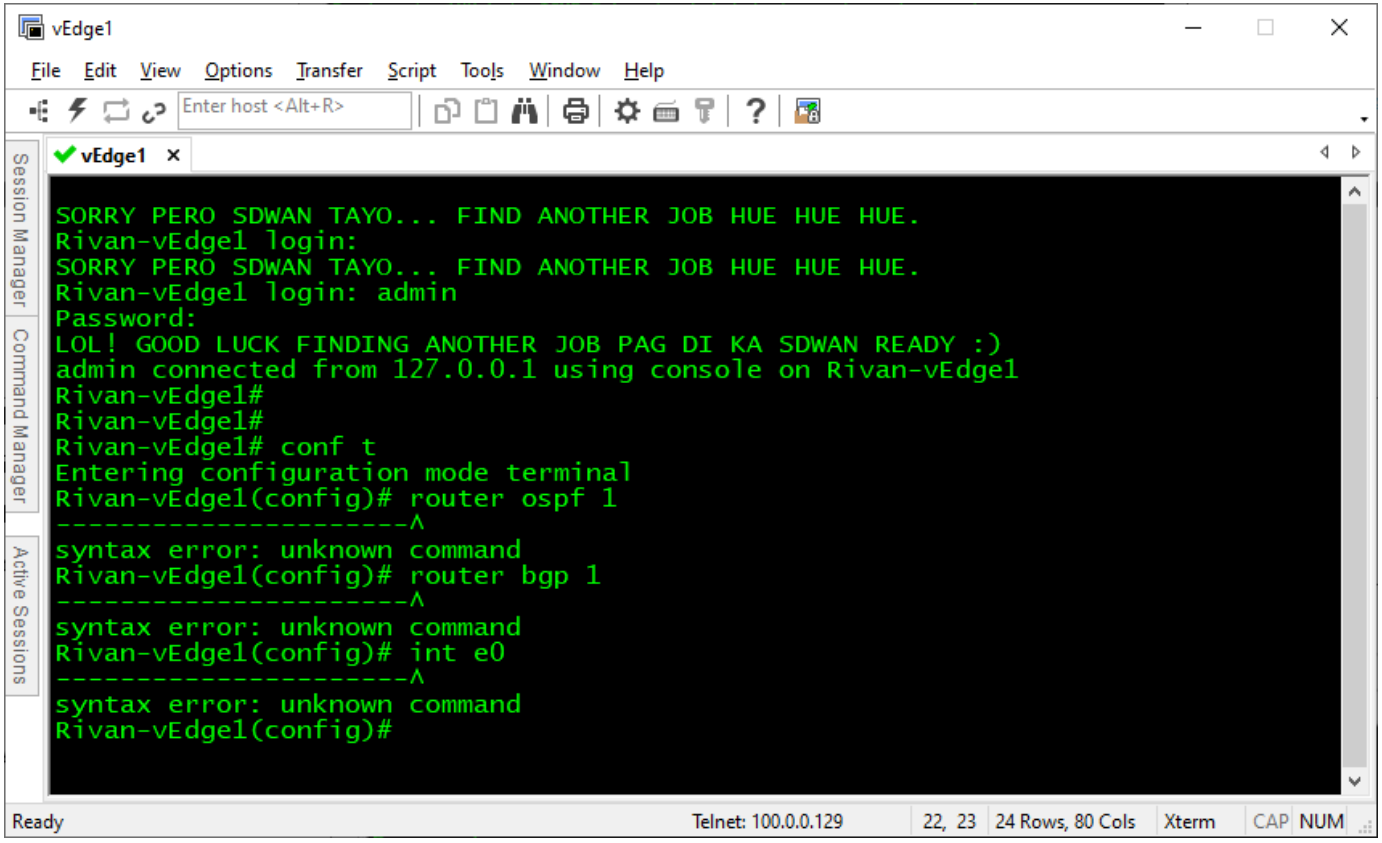
Prepared by: GGener

BONUS CHECKING !!!

if everything works… access the vEdges, the welcome message will display as defined in the VE-BANNER Template.

Login: admin / C1sc0123

There is still *configure terminal* but most common commands are not valid due to the management from SDWAN vManage.



#SDWAN-Works :)

#GloryToTeamRivan