

## Lab 12: VPRN

Or: (1) MP-BGP on PE; (2) VPRN service; (3) BGP for PE-CE routing

### What you will do:

1. Verify availability of VPRN support infrastructure: IP addressing, IGP, LDP
2. Configure and verify a full-mesh of MP-BGP peerings between PE routers
3. Configure and verify an edge-to-edge VPRN service, which traverses core (P) routers
4. Configure and verify BGP as the Customer-Provider routing protocol
5. Use "show" and oam commands to verify the complete status of the VPRN

### Things that you will need to know or learn:

1. CLI commands for configuring all required infrastructure, up to the level of LDP
2. CLI commands for configuring MP-BGP for the VPN-IPv4 family of addresses
3. CLI command for configuring a VPRN service
4. CLI commands for configuring BGP as the CE-PE routing protocol
5. CLI commands for showing, ping, and tracing across the VPRN service

### What you need to submit and when:

1. There is no pre-lab for Lab 11.
2. Complete the in-lab part of the exercise (see below), **before** the end of your lab period.
3. Post-lab: extra practice by repeating this lab using OSPF as the CE-PE VPRN protocol.

### Required Equipment:

- USB memory stick to save results for post-lab questions
- Hard-cover lab notebook, for reference during SBA at the end of the course.
- PC with internet access, a browser, Java, and terminal program (Provided in T108)

### In-Lab Marks:

- 1 mark: Demo of MP-BGP established with the diagonal pod (no routes needed in PE BGP table)  
1 mark: Demo of fully configured VPRN service, showing the service & SAP Up/Up  
1 mark: Demo of successful oam vprn-ping and oam vprn-trace

The in-lab is worth 1/2 of the overall lab mark; the post-lab is worth 1/2 of the overall lab mark.

10% of your final mark is for labs done during the course of the semester.

### References and Resources:

- SA Module 5 on L3 VPN services
- SA Lab guide, lab 9
- EDU Lab: remote-access lab facility hosted at the Nokia Kanata campus

## Addressing & Login Table

	Edu Lab 1	Edu Lab 2
R1	192.168.206.164	192.168.206.196
R2	192.168.206.165	192.168.206.197
R3	192.168.206.166	192.168.206.198
R4	192.168.206.167	192.168.206.199
R5	192.168.206.168	192.168.206.200
R6	192.168.206.169	192.168.206.201
R7	192.168.206.170	192.168.206.202
R8	192.168.206.171	192.168.206.203
R9	192.168.206.172	192.168.206.204
R10	192.168.206.173	192.168.206.205
R11	192.168.206.174	192.168.206.206
R12	192.168.206.175	192.168.206.207

Edu Lab 1 Login	Passwd	Edu Lab 2 Login	Passwd
aca001-328		aca002-318	
aca001-329		aca002-319	
aca001-330		aca002-320	
aca001-331		aca002-321	
aca001-332		aca002-322	
aca001-333		aca002-323	
aca001-334		aca002-324	
aca001-335		aca002-325	

See Blackboard for a list of passwords; write **yours** in the space above.

<https://learningserviceslabs.nokia.com/>

## Topology Diagram

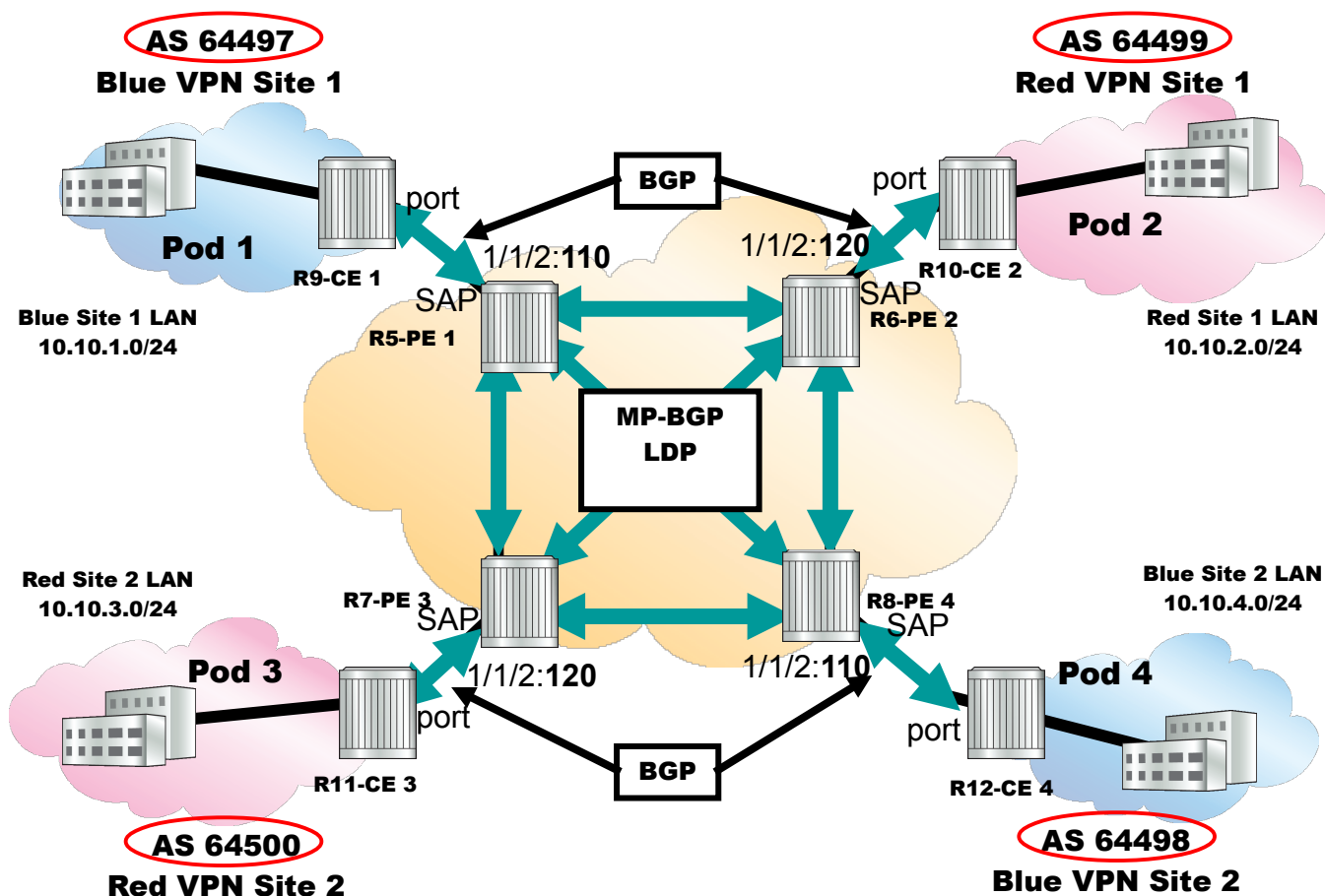


Image source: Nokia SA Lab Guide

## Command Reference (see SA Lab 9 for additional commands)

### no shutdown

# Don't forget this!! Everywhere!

```
configure • service • bgp • group {grp-name} • family vpn-ipv4 # in MP-BGP
configure • service • vprn {svc-#} • route-distinguisher {ASN-4}:{#} # in VPRN service
configure • service • vprn {svc-#} • vrf-target target:{ASN-4}:{#} # in VPRN service
configure • service • vprn {svc-#} • auto-bind-tunnel • resolution any # in VPRN service
configure • service • vprn {svc-#} • auto-bind {gre | ldp | rsvp-te | mpls} # SR OS ver <13
configure • router • policy-statement <name> entry {#} from protocol bgp-vpn #in PE->CE BGP
configure • router • policy-statement <name> entry {#} from protocol direct #in CE->PE BGP

show • router [svc-#] • status # Show running proto's; VPRN!
show • router [svc-#] • route-table # Show route table; VPRN!
show • router [svc-#] • bgp • summary # Show BGP summary; VPRN!
show • router [svc-#] • bgp • neighbor # Show neighbor details; VPRN!
show • router [svc-#] • bgp • routes # Show BGP RIB-in; VPRN
show • router • bgp • routes vpn-ipv4 # Show RIB-in, MP-BGP
show • service • id {svc-#} • base # Show service: Up/Up, SAP, etc
oam • vprn-ping [svc-#] source {src-IP} destination {dst-IP} # Top-level service ping
oam • vprn-trace [svc-#] source {src-IP} destination {dst-IP} # Top-level service trace
```

---

### Task 0: Verify and re-build configuration to support Services

Although SA Lab 9 doesn't explicitly describe it, you'll need to verify the three critical infrastructure support items for services (in general) and VPRN's in particular. You'll need to verify/configure:

- interfaces, with IPv4 addresses
- a single-area OSPF domain throughout the inner-ring (P routers) and middle-ring (PE)
- LDP configuration throughout the inner-ring (P routers) and middle-ring (PE routers)

Ensure (ie. Prove!) that everything is working properly:

- How many routes should be in the provider core routing table? (Hint: 18)
- How many OSPF neighbors should each router have? (Hint: either 4 (P) or 1 (PE))
- What active LDP bindings must exist? (Hint: at least 8 for the system interfaces)

### Task 1: Configure a full-mesh of MP-BGP sessions for PE routers

SA Lab 9 goes through the complete three-part process for creating a VPRN service, which extends edge-to-edge diagonally across the service provider network. Part 1 is the MP-BGP configuration which has **exactly** one special feature: "family **vpn-ipv4**" route exchange.

Follow the instructions for "Configuring MP-BGP as the PE-PE protocol" on p. 94-96 of the lab guide. Refer also to SA Module 5, p. 60-61 if you need extra help.

**CHECK POINT #1:** Demo of MP-BGP established with the diagonal pod, and no routes in the PE BGP table.

## Task 2: Configure VPRN service

The SA lab guide spells out a few requirements and parameters for the VPRN service:

- the CE-PE link uses Dot1Q encapsulation (where QQQ = either 110 or 120):  
the CE side uses "port 1/1/2:QQQ" and the PE side uses "sap 1/1/2:QQQ"
- the Dot1Q encapsulation, Route Distinguisher (RD), and Route Target (RT) **all** incorporate the service ID (Ya gotta love consistency!)
- a VRPN is a L3 service, so don't forget to create an **interface** with a SAP embedded within

Follow the instructions for "Enabling the VPRN Service on the PE" on p. 96-98 of the lab guide. Refer also to SA Module 5, slides 67, 69, 78 if you need extra help.

**CHECK POINT #2:** Demo of fully configured VPRN service, showing the service & SAP Up/Up. Prove that service labels have been allocated via MP-BGP.

## Task 3: Complete the PE and CE BGP configuration

The SA lab guide provides ASN numbers for both the PE and CE BGP configurations. Be sure to match up the ASN numbers on both sides of the link!

Follow the BGP configuration instructions on p. 99-104 of the lab guide. Refer also to SA Module 5, slides 72-74 and 78 if you need extra help.

- Don't forget to configure a Router ID, if you haven't already done so.
- Note in particular the export policy for the PE BGP configuration: from protocol **bgp-vpn**

**CHECK POINT #3:** Demo of successful *oam vprn-ping* and *oam vprn-trace* across the service. You'll need to be sure to use source and destination IP addresses that are in the VRPN service's routing table!

## Task 4: Save your configs

As always, save the configs for your P, PE, and CE routers on the EDU ftp server:

use **edu1 / dEEtgx2Y** or **edu2 / dEEtgx2Y** for each 1/2 of the class; **Rxx = R01, R02, ...**

**save:** `admin save ftp://{acct}:{pswd}@192.168.181.81/Rxx/ande0001-L12.cfg`

**check:** `file dir ftp://{acct}:{pswd}@192.168.181.81/Rxx/`

**restore:** `exec ftp://{acct}:{pswd}@192.168.181.81/Rxx/ande0001-L12.cfg`

To repeat this lab using MySRLab, use the routers according to the following topology:  
R3(CE) — R1(PE) – R5(P) – R6(P) – R2(PE) — R4(CE)