Lab 12 PostLab: VPRN
Or: (1) MP-BGP on PE; (2) VRPN service; (3) BGP for PE-CE routing

What you will do:
1. Redo SA Lab 9 on MySRLab
2. Confirm proper operation of the VPRN
3. Use additional commands to examine the VPRN operation
4. Save configs and enter your answers for each task on Blackboard

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. Complete the "Lab 12 Post-lab" exercise on Blackboard with answers from your work, before your next lab period.

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:

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's Kanata campus

Topology Diagram

This is the MySRLab network topology that is used for this lab. It is similar to the top half of the Edu topology from the weekly in-lab. **NOTE**: that **only some** links are configured and activated!
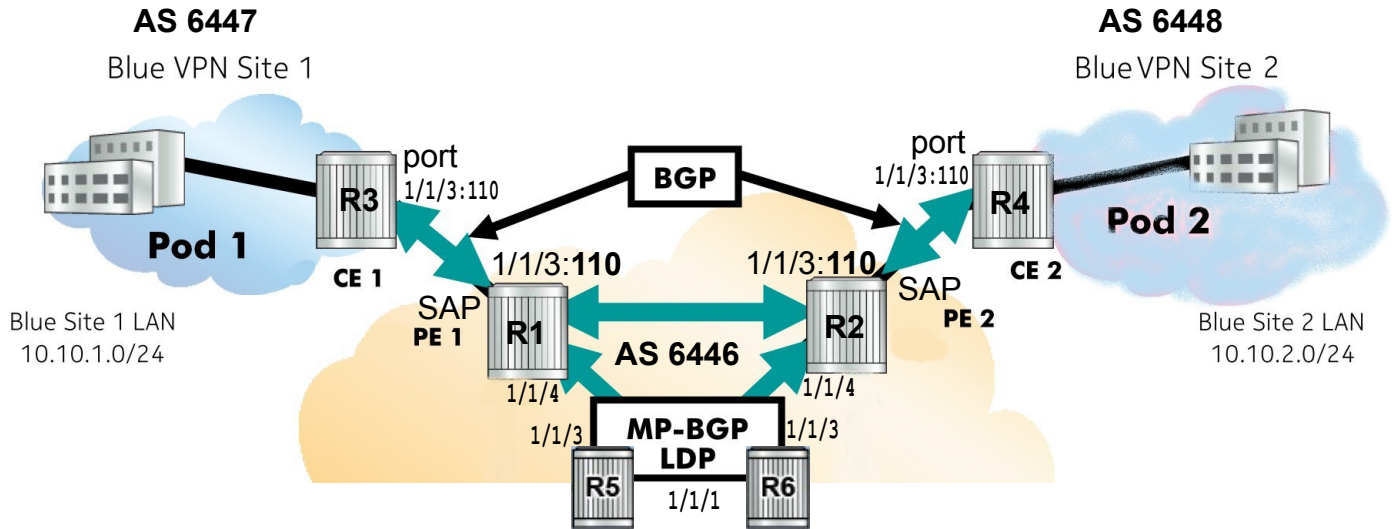
Drawing adapted from: Nokia SA Lab Guide

Addressing Table for MySRLab Practice Labs

ALL routers are IPv4 addresses in the range **192.168.X.Y** with **X.Y** as given in the table below.

	PL3	PL4	PL5	PL6	PL7	PL8
R1	188.4	188.36	188.68	188.100	188.132	188.164
R2	188.5	188.37	188.69	188.101	188.133	188.165
R3	188.6	188.38	188.70	188.102	188.134	188.166
R4	188.7	188.39	188.71	188.103	188.135	188.167
R5	188.8	188.40	188.72	188.104	188.136	188.168
R6	188.9	188.41	188.73	188.105	188.137	188.169
PC1	188.10	188.42	188.74	188.106	188.138	188.170

The Ixia tester PC is accessed via the Remote Desktop Protocol (RDP), with clients available for Windows (built-in as "mstsc.exe"), Linux (rdesktop), and OSX (http://cord.sourceforge.net/)

Practice Lab	User ID	Password
PL3		
PL4	See pages 4-5 of the	
PL5	*MySRLab Technical Primer* and page 8 of the *MySRLab Getting Started Guide* (available on Blackboard) for connectivity & login details.	
PL6		
PL7		
PL8		

Command Reference (see SA Lab 9 for additional commands)

<mark>no shutdown</mark>   # Don't forget this!! Everywhere!

configure • service • bgp • group {grp-name} • family **vpn-ipv4**   # in MP-BGP
configure • service • vrpn {svc-#} • route-distinguisher {ASN-4}:{#}   # in VPRN service
configure • service • vrpn {svc-#} • vrf-target target**:**{ASN-4}:{#}   # in VPRN service
configure • service • vrpn {svc-#} • auto-bind-tunnel • resolution any   # in VPRN service
configure • service • vrpn {svc-#} • auto-bind {gre | ldp | rsvp-te | mpls}   # SR OS ver 10
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 [**svc-#**] • bgp • routes   # Show 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/or re-build configuration to support Services

Verify that you have 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: 7 routes)
– How many OSPF neighbors should each router have? (Hint: either 2 (P) or 1 (PE))
– What active LDP bindings must exist? (Hint: at least 4, one for each system interface)

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

In this post-lab, there are only 2 PE routers, so "full-mesh" in this case means one MP-BGP session between the pair of 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**" address transport.

Follow the instructions for "Configuring MP-BPG 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.

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 Q = 110):
  the CE side uses "port 1/1/3:110" and the PE side uses "**sap** 1/1/3:110"
- 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 an embedded SAP

Follow the instructions for "Enabling the VPRN Service on the PE" on p. 96-98 of the lab guide, with the exception that you should use _auto-bind-tunnel resolution any_ for transport.
Refer also to SA Module 5, slides 67, 69, 78 if you need extra help. Inspect the operation of the VPRN once the configuration is complete.

Step 1.   Confirm that the VPRN service, the associated interface and it's SAP are all fully Up/Up. If not, troubleshoot from bottom to top: PE port, mode, encapsulation, VPRN interface, VPRN service; ensure that everything is "no shut"
Step 2.   Confirm the CE interface is Up/Up; troubleshoot as above if needed.
Step 3.   From each PE, use an ordinary _ping_ from VPRN to CE :
   ping router 110 10.10.x.1 {where x = 1 for left side, or x = 2 for right side)
Step 4.   Get "_base_" information about the VPRN service; capture & save the output
Step 5.   Issue a show command to display any associated SDPs; capture & save the output:
   show service id 110 sdp
Step 6.   Show any associated LDP service bindings; capture & save the output:
   show router ldp bindings service
Step 7.   Grab a copy of the BGP routing table from the PE:
   show router bgp routes

Questions to answer:
- What is the TTL from the ping? Does that make sense?
- What is the VPRN _type_ shown in the base info for the service?
- What is shown for the resolution for the Auto Bind Tunnel?
- For the VPRN base info, what is shown for "SDP Bind Count"?
- From "show service id 110 sdp", how many SDPs are bound to the VPRN service?
- How many routes are in the BGP RIB?

Task 3: Complete the PE and CE BGP configuration

The topology diagram 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**

Inspect the operation of the VPRN once the configuration is complete.

Step 1. Ping from CE -> CE, using the far-end CE system interface as the target. (It should be successful! If not, troubleshoot.) Note the TTL decrement.

Step 2. On either PE, examine VPN routes available in MP-BGP; capture & save the output:
```
show router bgp routes vpn-ipv4
```
Can you identify the 96-bit VPN-IPv4 routes?

Step 3. On the same PE router, show the VRF routes; capture & save the output:
```
show router 110 bgp routes
```
What kind of routes are these: "normal" or VPN?
```
show router 110 bgp routes vpn-ipv4
```
Any 96-bit VPN-type routes in the VRF?

Step 4. On the _other_ PE, examine the labels in use; capture & save the output:
```
show router mpls-labels label 32 524287 in-use
```
You'll need to correlate the label usage between the PEs.

Questions to answer:
- What is the TTL decrement when pinging from CE to CE? Does this make sense?
- Step 2: In the VPN-IPv4 routes, is the RouteDistinguisher "_type_" field shown?
- Step 2: In the VPN-IPv4 routes, is there a label shown for each route?
- Are there any VPN-type routes in the VRF BGP RIB? Does this make sense?
- Step 4: In the list of labels, is there a match to the label(s) shown in step 2?
- Step 4: Who/what is the "owner" for the label?
- Step 4: Now think about it carefully: is the label(s) shown in step 2 a service label or a transport label?

Task 4: OSPF for PE and CE routing

This task should actually be very quick & easy: replace all BGP routing between CE and PE with OSPF, all in area 0. You'll still need the export policy on the PE side, but otherwise it's just listing the interfaces within OSPF. Here's a challenge: can you get it working in less than 10 mins?

Task 5: Save your configs

As always, **save your final configs** so that you can refer to them later for practice and study.

save: admin save ftp://{mySRLabAlphaLogin}:{assignedPswd}@mysrlab/STD/**Rx**/Lab12.cfg
verify: file dir ftp://{mySRLabAlphaLogin}:{assignedPswd}@mysrlab/STD/**Rx**/