MPLS exploration lab

Assignment MPLS lab: Lab03-MPLS quiz on Canvas

Lab date: February 21, 2020

Due date: 23:59PM, February 24, 2020 CET

Author: Marijke Kaat
Email: marijke.kaat@surfnet.nl
University of Amsterdam

Introduction

The goal of this assignment is to let you familiarize with the basics of MPLS configuration on Juniper routers and get an idea of how to build and operate an MPLS network.

- A simple network was built for you with MPLS technologies and protocols to explore and answer questions on specific details of the configurations, the status of processes and/or protocols, etc.. You do not have to configure anything on the routers, you can use show commands(*) to gather information or perform pings, traceroutes, etc.. to learn and check things.

- The lab is set up on Juniper router **Chico** in the SNE LAB. An environment is built consisting of 7 “logical routers” that are interconnected in a certain topology. Imagine this is an MPLS backbone, with some customer networks connected to it (which are not actually connected). A certain set-up is chosen and it is up to you to figure out how it was done and answer some questions about it in the **Lab03-MPLS quiz on Canvas**.

- Everyone can log in to ***all*** the logical routers and use e.g. show commands to figure out what the situation is in the network. See the next page for the username/password combinations for each router.

- You do not need to log in at all routers at the same time, just one at the time, as we are with many people the system might get slow.

- **Do not try to change** any passwords or (parts of) the configurations, that will ruin the lab set-up for you and your fellow students!

(*) - see page 7 with list of useful commands

usernames & passwords

You will be logging in using ssh to 10.0.1.22 (Chico) to each separate logical router (called logical-system in JunOS).

The usernames and passwords are shown below, so for router r1 you use:

`ssh r1@10.0.1.22` to login to router r1
etc..

Router Name	username	password
r1	r1	studr1
r2	r2	studr2
r3	r3	studr3
r4	r4	studr4
r5	r5	studr5
r6	r6	studr6
r7	r7	studr7

Task 1 - Discover the Topology

The fist task is to figure out some details of the network topology. This means discovering how the routers are connected, which interfaces are used, which protocols, etc..
Gather the needed information to get a clear picture of the set-up of the network, e.g. addresses, prefixes, interfaces, routing protocol and everything you need to know to get a good view of the network.

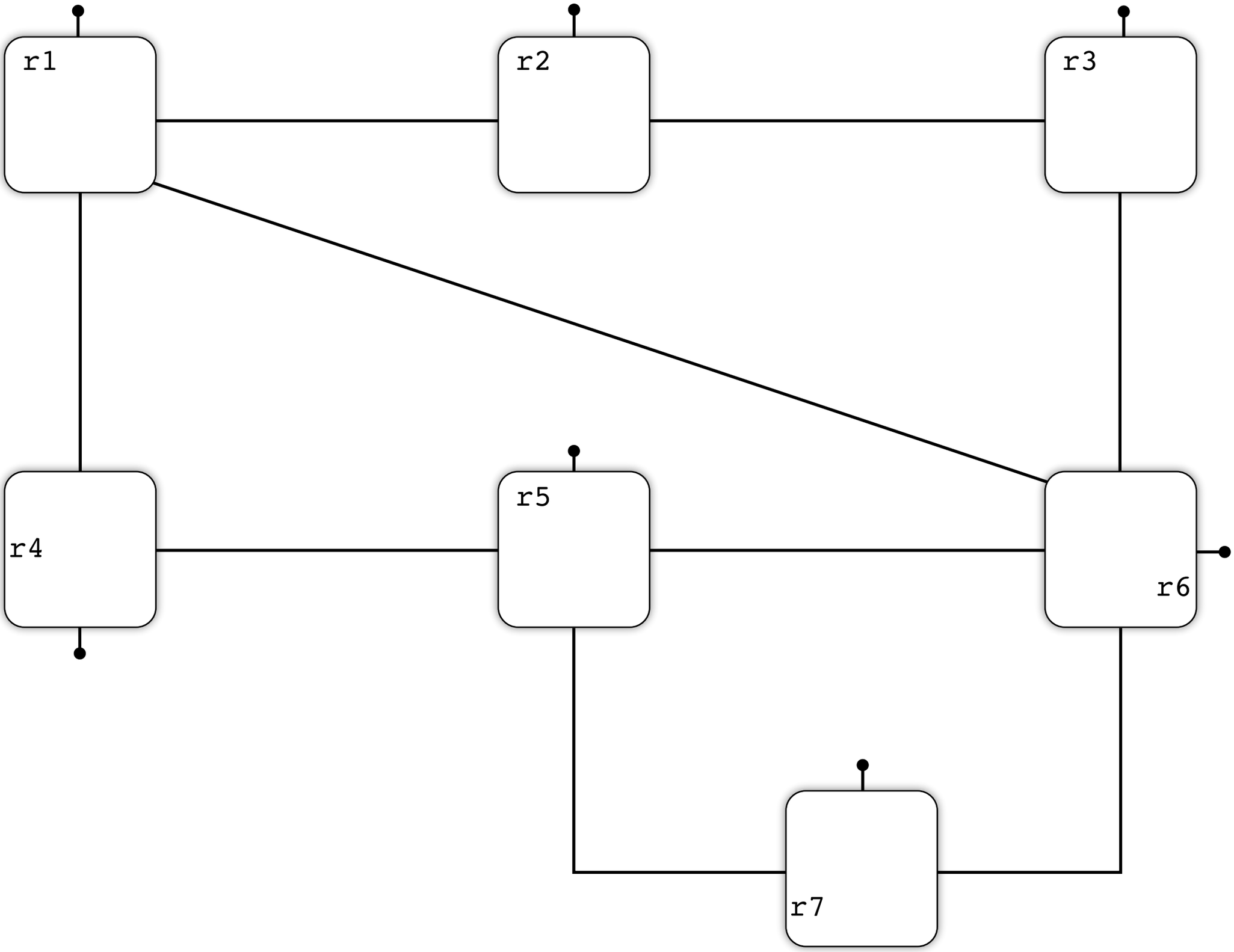
The following information might be useful:

- The routers in the lab topology are all logical routers on one physical system. The GE (Gigabit Ethernet) interfaces are connected with physical fibers to form the topology. Together they form a small MPLS backbone.
- You can log-in to one of the logical routers (e.g. “r1”) and see only that router’s interfaces, configuration etc..
- Each logical router also has its own loopback interface. The host router (Chico) has loopback interface lo0.0, the logical systems have loopbacks lo0.X where X is the number given to each router.

Log in to the separate routers to look at the configurations, the interfaces, the addresses configured, protocols running, etc.etc. and answer the questions in the MPLS-quiz (tagged with Task 1).

You can use the basic topology picture as reference (see page 5) and to fill in the details.
You can also collect output from the routers (show commands etc.) to help you answer the questions.

Lab topology February 21 2020



Task 2 - Explore the network

Your next task is to figure out how MPLS and all other related protocols are configured and which LSPs (Label Switched Paths) are set up on the lab topology.

For MPLS to run on the routers one has to configure MPLS and enable an MPLS instance on the router. One or more label signaling protocols need to be running, unless LSPs are configured manually. You also need a routing protocol (IGP) to exchange prefix reachability information between the routers.

Look around on the routers, and check the configurations, the (status of the) interfaces, the protocols running, the different databases and tables (routing, link-state, forwarding, label etc.etc.). Look at details of the configurations for the different protocols that are enabled so you understand how MPLS on juniper routers is configured and works.

You can use the commands shown on page 7, or find other commands or options to the commands by typing “?’ on the command line. At the paging following the commands you’ll find some more information about routing tables specific for Juniper routers.

Answer the questions tagged “Task 2” in the Lab03-MPLS on canvas.
To be able to answer the questions you will have to login to all routers, not necessarily all at the same time. Before you start the answering these questions make sure you have explored the network properly and know your way around the routers, try the commands and evaluate their output.

Useful juniper commands

- show configuration (| display set)

- show interfaces (terse)

- show route (extensive)
- show route protocol <protocol>
- show route table inet.3
- show route table mpls.0

- show isis brief | detail | extensive
- show isis interface
- show isis neighbors
- show isis database

- show mpls lsp (detail | extensive)
- show mpls lsp ingress | egress |transit
- show mpls interface (detail)

- show ldp interface (detail)
- show ldp neighbor (extensive)
- show ldp session (detail)
- show ldp database (detail)

- show ldp route (extensive)
- show ldp path (extensive)

- show rsvp interface (detail)
- show rsvp neighbor (detail)
- show rsvp session (detail)

- ping mpls ….
- traceroute mpls …
- traceroute mpls …

- show route forwarding-table destination <prefix>
- show route <prefix> active-path
- show route forwarding-table family mpls / inet [table] …

Additional info - Routing table

The Junos OS maintains two databases for routing information:

- Routing table — Contains all the routing information learned by all routing protocols. (Some vendors refer to this kind of table as a routing information base [RIB].)
- Forwarding table — Contains the routes actually used to forward packets. (Some vendors refer to this kind of table as a forwarding information base [FIB].)

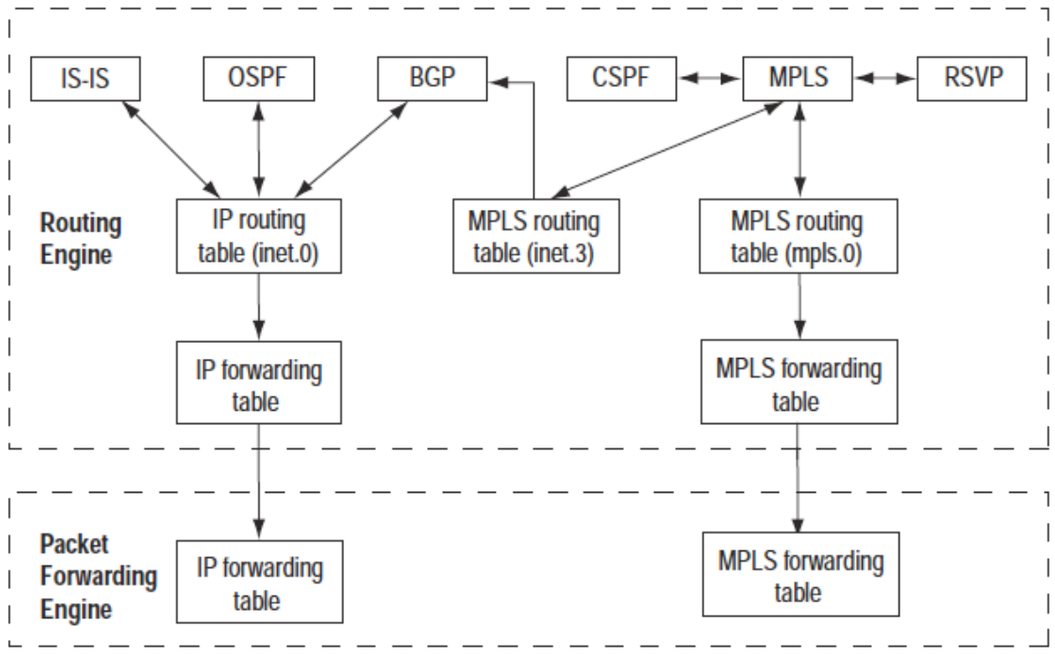
In fact there is more than 1 routing table on a Junos device. And a routing table is NOT the same as a forwarding table.

Understanding Junos OS Routing Tables

Junos OS automatically creates and maintains several routing tables. Each routing table is used for a specific purpose. In addition to these automatically created routing tables, you can create your own routing tables.

Each routing table populates a portion of the forwarding table. Thus, the forwarding table is partitioned based on routing tables. This allows for specific forwarding behaviour for each routing table. For example, for VPNs, each VPN-based routing table has its own VPN-specific partition in the forwarding table.

It is common for the routing software to maintain unicast routes and multicast routes in different routing tables. You also might have policy considerations that would lead you to create separate routing tables to manage the propagation of routing information.



Additional info - Routing table

Creating routing tables is optional. If you do not create any, Junos OS uses its default routing tables, which are as follows:

- inet.0—For IP version 4 (IPv4) unicast routes. This table stores interface local and direct routes, static routes, and dynamically learned routes.
- inet.1—For the IPv4 multicast forwarding cache. This table stores the IPv4 (S,G) group entries that are dynamically created as a result of join state information.
- inet.2—For subsequent address family indicator (SAFI) 2 routes, when multiprotocol BGP (MBGP) is enabled. This table stores unicast routes that are used for multicast reverse-path-forwarding (RPF) lookup. The routes in this table can be used by the Distance Vector Multicast Routing Protocol (DVMRP), which requires a specific RPF table. In contrast, Protocol Independent Multicast (PIM) does not need this table because it can perform RPF checks against the inet.0 table. You can import routes from inet.0 into inet.2 using routing information base (RIB) groups, or install routes directly into inet.2 from a multicast routing protocol.
- inet.3—For IPv4 MPLS. This table stores the egress address of an MPLS label-swiched path (LSP), the LSP name, and the outgoing interface name. This routing table is used only when the local device is the ingress node to an LSP.
- inet6.0—For IP version 6 (IPv6) unicast routes. This table stores interface local and direct routes, static routes, and dynamically learned routes.

MPLS and Routing Tables

The IGPs and BGP store their routing information in the inet.0 routing table, the main IP routing table. If traffic-engineering BGP is configured, thereby allowing only BGP to use MPLS paths for forwarding traffic, MPLS path information is stored in a separate routing table, inet.3. Only BGP accesses the inet.3 routing table. BGP uses both inet.0 and inet.3 to resolve next-hop addresses. If traffic-engineering bgp-igp is configured, thereby allowing the IGPs to use MPLS paths for forwarding traffic, MPLS path information is stored in the inet.0 routing table.

More info on Routing Information Bases (RIB):
https://www.juniper.net/documentation/en_US/release-independent/solutions/information-products/pathway-pages/rg-understanding-tn.pdf

Additional info - Route Preference Values (Administrative Distance)

The Junos OS routing protocol process assigns a default preference value (also known as an *administrative distance*) to each route that the routing table receives. The default value depends on the source of the route. The preference value is a value from 0 through 4,294,967,295 ($2^{32} - 1$), with a lower value indicating a more preferred route.

How Route Is Learned	Default Preference	Statement to Modify Default Preference
Directly connected network	0	–
System routes	4	–
Static and Static LSPs	5	static
Static LSPs	6	–
RSVP-signaled LSPs	7	RSVP preference as described in the MPLS Applications Feature Guide
LDP-signaled LSPs	9	LDP preference, as described in the MPLS Applications Feature Guide
OSPF internal route	10	OSPF preference
IS-IS Level 1 internal route	15	IS-IS preference
IS-IS Level 2 internal route	18	IS-IS preference
RIP	100	RIP preference
RIPng	100	RIPng preference
Aggregate	130	aggregate
OSPF AS external routes	150	OSPF external-preference
IS-IS Level 1 external route	160	IS-IS external-preference
IS-IS Level 2 external route	165	IS-IS external-preference
BGP	170	BGP preference, export, import

https://www.juniper.net/documentation/en_US/junos/topics/reference/general/routing-protocols-default-route-preference-values.html