

Praktikum RouterLab SS 2008 Work Sheet 2: VLAN, Routing Information Protocol (RIP)

The purpose of this work sheet is twofold: First, we will learn how to configure Virtual LANs (VLANs), that allow to set up logical layer-2 networks upon a physical topology. Second, the Routing Information Protocol (RIP) as an example for a dynamic routing protocol is introduced. The goal is to understand the advantages and disadvantages of the distance vector approach.

Important Notes:

- May 12th (Pfingstmontag) is a public holiday. Therefore, groups with time slots on Monday are allowed to reserve devices in the Berlin cloud for this work sheet. The regular time slots will be reserved as usual. If it is ok for you to work on May 12th, please keep to your regular time slots. If not, reserve timeslots in the Berlin cloud via the *labtool*. Please be fair, and don't reserve more time than you actually need!!! In any case, you should not use different clouds for solving the problems of this work sheet. Throughout this work sheet we will always list the devices in the sequence "Ham-Cloud/Muc-Cloud/Ber-Cloud".
- For each work sheet we have references to relevant literature on the website. Please check!

Table 1: Assignment of devices to groups

Group	Ham-Cloud	Muc-Cloud	Ber-Cloud
Router	ham-rc1, ham-rj1, ham-rj2	muc-rc1, muc-rj1, muc-rj2	ber-rc1, ber-rj1, ber-rj2
Switches	ham-sc1, ham-sc2	muc-sc1, muc-sc2	ber-sc1, ber-sc2
IP range	10.1.0.0/16	10.2.0.0/16	10.3.0.0/16
VLAN IDs	Each team can use up to 9 VLAN IDs, where last 2 digits reflect team ID <i>Example: Team 09 has VLANs 109, 209, ..., 909</i>		

Question 1: (50 Points) *Virtual LANs (VLANs)*

Virtual LANs (VLANs) have the same attributes as a physical LAN, but they allow for end stations to be grouped together into logical LANs. This question motivates possible applications of VLANs and gives an introduction into the 802.1Q standard.

- (a) The first step is to enable IP connectivity between adjacent routers in a similar manner as in the previous work sheet! For this purpose, please have a look at Figure 1. It shows adjacencies between routers as thick dashed lines. Your configuration must satisfy the following conditions:
- If two routers are interconnected with an arc ("logical LAN"), then the interfaces of these two routers must be able to ping each other.
 - Each "arc" will be configured as a "logical LAN" later on. Therefore, assign IP addresses in a way such that there is no (!) overlap in IP address range for all pairs of "logical LANs" shown in Figure 1. The IP address ranges used for different "logical LANs" must be disjoint.
 - You are not allowed to modify the setup of *loadgen102/loadgen104/loadgen106* throughout this work sheet if not mentioned otherwise! These two machines are used as software routers.

- It is possible to assign multiple IP addresses to a router interface. For now, assign two IP addresses to `ge-0/0/0` of `ham-rj2/muc-rj2/ber-rj2`!

Draw a topology map that shows your IP address assignment (see Figure 1)! Configure IP addresses accordingly and check if ping works!

Note: As our switches also run Cisco IOS, the configuration of switches is similar to Cisco routers. Note that switches are shared resources. Therefore, state such as VLAN IDs is not deleted when a new reservation starts. For this purpose you may have to use the following statement in the appropriate *interface configuration mode*:

```
no switchport mode trunk
switchport trunk allowed vlan none
```

- (b) Assume that `ham-sc2/muc-sc2/ber-sc2` is replaced by an Ethernet hub. Which routers would see Ethernet frames that are sent from `ham-rc1/muc-rc1/ber-rc1` to `ham-rj2/muc-rj2/ber-rj2`?
- (c) Our goal is to have a separate VLAN (802.1Q standard) for each “logical LAN” shown in Figure 1. Please have a look at the following sources! You’ll find pointers to these sources on the RouterLab website.
- http://en.wikipedia.org/wiki/Virtual_LAN
 - VLANCisco: p12-1 to p12-3, p12-8 to p12-9, p12-10, p12-14 to p12-18
 - ... there is a lot of material in the web!

Answer the following questions:

1. What are possible motivations for using VLAN? Pick two reasons and explain them briefly (2-4 sentences)!
2. What is the difference between *Port-based VLANs* and *VLAN Trunks*?
3. Which mechanism is used to distinguish between Ethernet frames of different VLANs (VLAN Trunks)?

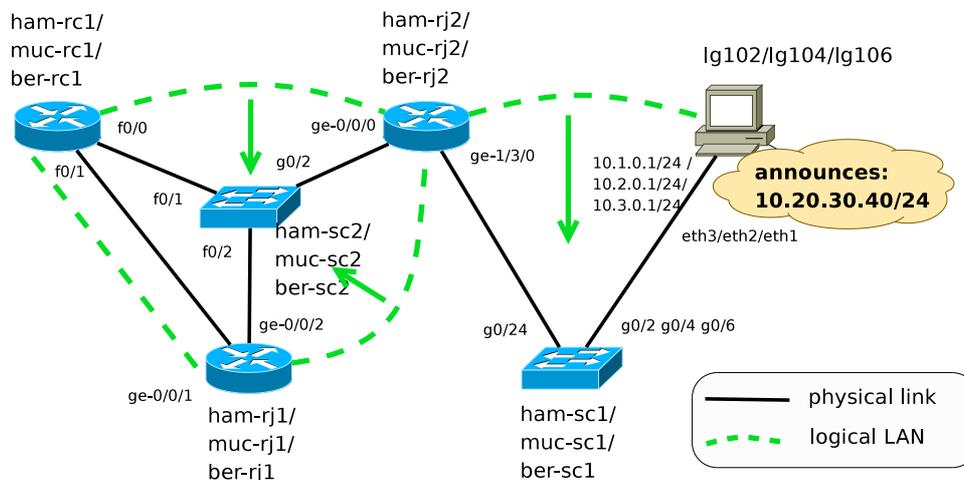


Figure 1: Topology: Mapping of VLANs to physical links.

- (d) Configure a separate VLAN for each “logical LAN” in Figure 1 except for the direct link between `ham-rj1/muc-rj1/ber-rj1` and `ham-rc1/muc-rc1/ber-rc1`, and add the used VLAN IDs to your topology map! Make sure that adjacent router can ping each other! Your setup must satisfy the following conditions:
- Only use VLAN IDs of in the range $x00 - x99$ where x is your team number!
 - Do not use interfaces other than those specified in Figure 1. However, you are allowed to configure subinterfaces for your physical interfaces.
 - Do not change the configuration of the *loadgen*!
 - If possible, use **access mode** (port-based VLAN) and not tagged VLAN (e.g., on *sc1*)!

Some hints:

- Figure out which mode (`switchport mode <access|trunk>`) to use for the switches!
- For the routers: Figure out where you need *subinterfaces* (Ciscos) or new *units* (Juniper)! If possible, avoid configuring subinterfaces or extra units
- List of switch commands you will need:

```
(config)vlan <vlan-id>
(config-if)switchport mode <trunk|access>
(config-if)switchport access <vlan id>
(config-if)switchport trunk allowed vlan add/remove <vlan id>
```
- Cisco router: Create subinterface e.g., `f0/1.<id>`!

```
(config-subif)encapsulation dot1Q <vlan-id>
```
- Juniper router: Create a unit and enable `vlan-tagging`:

```
ge-x/x/x {
  vlan-tagging;
  unit <id> {
    vlan-id <vlan-id>;
    family inet
  }
}
```

...

For more information on how to configure VLANs on switches on routers, please check the Cisco and Juniper documentations.

Use `ping` to check if all adjacent routers are mutually reachable!

Question 2: (50 Points) *Routing Information Protocol (RIP)*

In the previous work sheet, we configured static routes to send packets over multiple hops towards a certain destination. This question introduces the Routing Information Protocol (RIP), a dynamic routing protocol that relies on the distance-vector approach.

- What is the difference between dynamic routing protocols and static routing protocols? What are the advantages of dynamic compared to static routing? Find at least three examples of dynamic routing protocols!
- RIP belongs to the class of distance-vector routing protocols. For more information on RIP, please have a look at RFC 2453 (see link on RouterLab).

Read Section 3.4 of RFC 2453 and answer the following questions!

- Which entities exchange routing information (updates)?
 - What routing information does each entity generally keep in its routing database?
 - Does a RIP routing update contain all routes or only a partial set of routes that a RIP neighbor uses?
 - When are update messages sent?
 - How do routing entities detect that a neighbor is not reachable any more?
- Take the configuration of Question 1 (including configured VLANs and IP addresses) and configure RIP to compute routes towards prefix `10.20.30/24` that is originated at the *loadgen*! All routers in the network of Figure 1 should have a route towards `10.20.30/24`. For this purpose, enable RIP n all interfaces of the four “logical network”s. The *loadgen* is already pre-configured (IP address see Figure 1).

Beforehand, please log on to your *loadgen* and use the following command to ensure that no firewall entries are currently configured on the *loadgen*:

```
/sbin/iptables -F
```

The following documents explain how to configure RIP for Cisco and Juniper (see website):

- CiscoRIP
- JunosRIP (check for minimum RIP configuration)

Which route is selected by `ham-rc1/muc-rc1/ber-rc1`? (`show ip route`). What is the metric associated with the selected route?

- (d) Understand the “Count-to-Infinity” problem of distance-vector protocols by reading Section 3.4.1 and Section 3.4.2 of RFC 2453!

Explain the two mechanisms that RIP uses to prevent instabilities due to “Count-to-Infinity” (4-6 sentences)!

Is it theoretically possible that the “count-to-infinity” problem occurs for our prefix 10.20.30/24 if link ham-rj2/muc-rj2/ber-rj2 to the *loadgen* fails? If no, explain why! If yes, give an example!

- (e) Now we will check what happens if the link from ham-rj2/muc-rj2/ber-rj2 to the *loadgen* is disturbed.

For this purpose activate a debug session on ham-rc1/muc-rc1/ber-rc1:

```
logging console debugging
term monitor
debug ip rip1
```

Simulate packet loss between ham-rj2/muc-rj2/ber-rj2 and the *loadgen*! For this purpose, you are allowed to log on to the *loadgen*. Use the following statement to deny all outgoing packets on the appropriate interface *eth3/eth2/eth1*:

```
/sbin/iptables -A OUTPUT -o <eth3|eth2|eth1> -j DROP
```

How much time elapses approximately until ham-rc1 (muc-rc1) deletes the route to prefix 10.20.30/24 from its routing table? (Note: This can take a while)

Explain what you see in the debug output (4-6 sentences). Can you see the impact of RIP mechanisms that are supposed to prevent instabilities due to “count-to-infinity”?

Don’t forget to undo the *iptables* command, when you’re done:

```
/sbin/iptables -F
```

- (f) “Count-to-Infinity” is one disadvantage of distance vector protocols. Can you think of another one (hint: big networks)?

What is a possible advantage of distance vector protocols?

Submission details: read the FAQ on

http://www.net.t-labs.tu-berlin.de/teaching/ss08/RL_labcourse/

Submit the following:

- Topology map from Question 1
- All configuration inputs on routers, switches and loadgens (no trials, only the final ones)
- The outputs of all commands such as ping, tcpdump, etc.
- The completed evaluation form (extra sheet)

Due Date: Friday, May 16th, 2008, 08:00 am

¹switch off debugging with `no debug ip rip`