

**ASSIGNMENT #3**  
**VLANs AND ROUTING**  
12/5/'16

Report Due: 23/05/'16  
Date of Exam: 24/05/'16

**Assignment Target:**

This assignment is designed to introduce the students to the DD-WRT open-source wireless router platform, which will be used in following assignments and familiarize them with VLANs, IPv4 hierarchical addressing & routing, and the building of routing tables.

---

**Goals:**

1. Clarify the notions of network segment, broadcast domain.
  2. Become familiar with the usage of VLANs & VLAN tagging.
  3. Learn to read & produce routing tables for known topologies.
  4. Build the network of Fig.2 using supernetting.
  5. Become accustomed to building advanced routing tables taking advantage of CIDR and maximal matching.
  6. Develop patience to handle open-source-driven devices.
- 

**Tasks:**

0. Perform a h/w Reset on all provided Linksys WRT54GL devices:
    - a. Do it while pressing the "Reset" button for 10sec while the device is plugged in.
    - b. Once the "Power" led stabilizes, connect a PC on one of the four numbered ports (ignore the "internet" port) and verify pinging 192.168.1.1 that the device has booted.
    - c. Use a browser to connect to the devices' web interface setup.
    - d. Whenever the device wakes up from a hardware reset you need provide a new administrative username & password. Use "root" and "hy435" respectively.
  1. Confirm that the four numbered ports act as a switch under the default settings. Attempt to explain why this is happening, by going to the Setup→VLANs tab.
  2. Upload the provided configuration files on two routers.
- 

**CAUTION:**

The files provided are named configR1.bin and configR2.bin. DO NOT upload the same file on both routers provided. Each router will hence be designated as R1 or R2 based on the uploaded file.

---

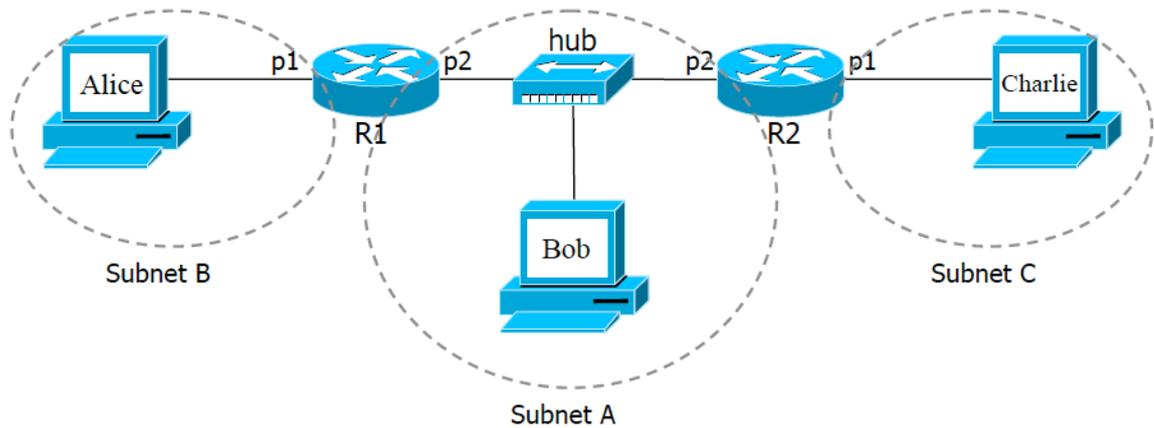
Do so by going to the Administration→Backup tab.

The provided configuration files set up the port/VLAN/IP assignments summarized in Table 1.

**Table 1:** The assignment port setup on routers R1 and R2.

port #	VLAN #	802.1Q tags	IP on R1	IP on R2
Internet	ignore	ignore	ignore	ignore
1	0	no	192.168.1.1/24	192.168.2.1/24
2	2	no	10.10.20.1/24	10.10.20.2/24
3	0,3,4	yes	N/A	N/A
4	4	no	N/A	N/A

1. As VLANs have been configured the switched ports on each router are not all on the same LAN. Verify this by connecting a pair of PCs having same subnet IPs on R1 and attempting to ping each other. What is the role of VLAN tagging in the link between ports 1 & 3?
2. Hook up R1 and R2 using only port 3.
  - a. Verify that port 1 on R1 (p1R1) communicates with port 1 on R2 (p1R2), same for ports 4, using the same PCs/IPs from the previous task.
  - b. Report a sniffer screen dump to verify that tagged frames indeed traverse the (p3R1)-(p3R2) link, by inserting a hubbed sniffer between two tagged ports of the routers. If inserting the hub results in loss of connectivity, explain why this happens\*. In such a case provide the sniffer dump by connecting the sniffing device directly to one of the output ports (e.g. p3R1).
  - c. Use the SLM2008 gigabit switch with the proper settings (describe the setup in your report) in order to sniff properly the tagged frames.
  - d. Do a simple VLAN configuration on 4 ports of the SLM2008 switch (two ports that belong only to one VLAN and two that accept only tagged frames), using the same VLAN IDs as of R1, R2. Insert the switch in-between the (p3R1)-(p3R2) link and check that it behaves as expected. Are all the VLANs transferred properly through the switch?  
*\*hint: How does 802.1Q tagging modify the Ethernet frame? (You are expected to report this.)*
3. Hook up R1 and R2 using only port 2. From now on you will have to exert caution on the IP addresses used on the PCs, since you will be examining IP routing. The network topology to be emulated is the one of figure 1.



**Figure 1:** The first network topology.

Typically on a router IP addresses are assigned on its network interfaces. When you examine the Setup→Networking and Setup→Advanced routing tabs you will see that DD-WRT assigns IP addresses also on VLANs.

This is far from standard practice; still we will have to live with it. Under the provided setup files using Table 1 the port-VLAN-IP mapping is unique for ports 1 and 2 on the routers and its correspondence to Figure 1 should be clear.

- a. Assign IP addresses, subnet masks and gateways to Alice, Bob & Charlie, report and justify them. Verify you have IP connectivity by pinging each other.
  - b. Examine the routing tables on R1 and R2 and describe how the first packet from Alice will reach Charlie.
- \*hint: Use sniffers wherever you feel like it.*
- c. Describe how the first packet from Bob will reach Alice and how Charlie. Comment on the difference. Can you help Bob be more efficient?
4. Install the configR3.bin and configR4.bin to the second WRT54Gs pair provided, as you did in the Task 2.  
Port 1 on R3 & R4 is your "management port". You can connect a pc on it and access either router on IP: 10.10.10.1/24.
  5. Re-install configR1.bin and configR2.bin in the first set of WRT54GLs.
  6. Assume that the network in Fig.2 is the class-B 192.168.0.0 network. Perform the following changes:
    - a. Since R1 & R2 are preconfigured to support on their p1 ports the subnets 192.168.1.0/24 and 192.168.2.0/24 respectively, redefine the IP addresses of their p2's such that subnet C is the minimum possible supernet of subnets A & B: do not waste subnet space. To install the new IP addresses you need go to the Setup→Networking tabs, and at "Port Setup" change the IP addresses at the "Network Configuration VLAN2".

---

**CAUTION:**

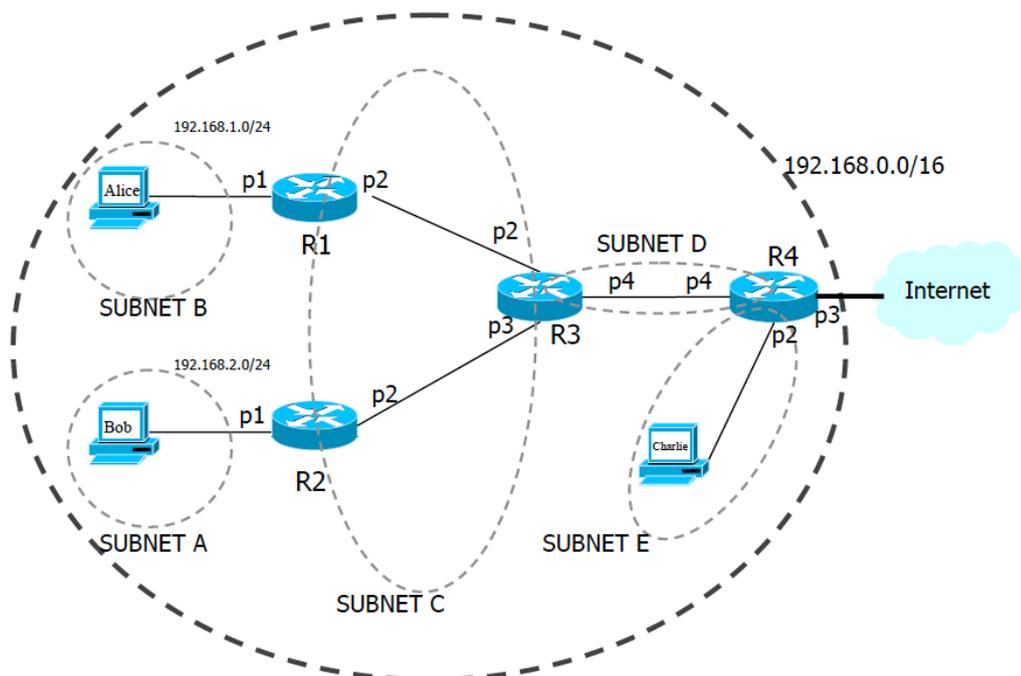
Whenever changes are saved & applied you **MUST** perform a power reset on the router to play on the safe side.

---

- b. Perform the respective IP change to ports p2 & p3 of R3 in order to establish the connectivity of Fig.2 in Subnet C.
  - c. Update the routing table in R1 & R2:  
You have to go to the tab Setup→Advanced Routing and at "Static Routing" find rule "IPsub1" and alter it appropriately w.r.t. the changes in 2.a & 2.b.
  - d. Create the routing rules in the R3 routing table, to support the forwarding to subnets A and B.
- 
- CAUTION:**  
Remember that in DD-WRT instead of "ports" the routing table lists VLANs. This means that you have to examine the mapping of the ports to VLANs and act accordingly.
- 
- e. Verify the validity of your changes so far by having Alice ping Bob.
  - f. Enable Subnet D by setting the IP's and routing table entries on p4 of R3 and p4 of R4, again in a minimal fashion.
  - g. Enable Subnet E on p2 of R4 assuming that it will never have more than 1 host.
  - h. Assume p3 of R4 connects to the Internet. Use a PC with IP 147.52.0.2/24. Setup port 3 accordingly and update the routing table of R4 to support these final changes.
  - i. Verify that the "Internet" PC can ping any of the 3 hosts in your infrastructure.

**Big Bad Bonus task:**

Assume that the R1–R3 connection is faulty. To avoid the loss of subnet B we should establish a secondary path. (The solution you should provide also takes care of a potentially faulty R2-R3 link and subnet A). Do so by connecting p4 on R1 to p4 on R2 and perform the required modifications on the Routers' setup.



**Figure 2:** The second network topology - a small hierarchical network accessing the Internet.