UUG Routing Lab

For this lab, we're building a network with dynamic routing. These routers are small Linux-powered devices made by MikroTik. To start, we'll build two separate networks and then link them into a larger network.

These routers come preconfigured like most home routers with one Internet/WAN port, several internal/LAN ports, wireless connected to the internal side, address translation (NAT) to rewrite internal IP addresses to the outside address, and firewall rules to filter out malicious traffic. Most of that has been deleted so we can build a more enterprise-like network.

Pages within the Mikrotik web interface have been underlined and steps you should write down have a 📋symbol

Part 1 - Booting up

Once you've chosen a router and powered it up, connect to its wireless network. All of the routers can be managed by browsing http://192.168.88.1. The username and password are both **admin**. Take a moment to explore the MikroTik web interface, and they also have an SSH interface with a similar structure.

📋 Go to IP -> Addresses and find the address for your loopback “lo” interface.
📋 Draw your router with its loopback address on the whiteboard.

Part 2a - Connect to a neighbor and decide IP addresses

Now you’ll establish your first connection to a neighbor. Find who’s closest, get an ethernet cable, and plug in both sides. Go to the Interfaces page and confirm the router is connected. Also go to the IP -> Neighbors page to see who the router has discovered. This uses the Link Local Discovery Protocol (LLDP) to advertise information among directly connected devices.

We’re going to steal JMU’s IP addresses within the 134.126.x.x range. Remember that IP addresses are four octets from 0 to 255. To make a subnet choose a random number for the third octet. This number is shared with the router on the other side. Then you will choose a separate IP address for each router within that subnet and use that as the 4th octet.

📋 Write the port number you’ve chosen, which router name is connected, and the IP address each of you has chosen on your worksheet.
📋 Write the IP addresses you’ve chosen on the whiteboard diagram.

Part 2b - Configuring your IP address

Navigate to IP -> Addresses. Select New, add the IP address you chose with the /24 subnet mask at the end. Make sure to choose the right etherX interface for the new address, then hit OK to save. Now go to the Tools -> Ping screen and try to ping the IP address of your neighbor.

Part 2c - Configuring your other neighbors

Repeat the steps above to connect another neighbor, choose a subnet, and an IP address for both sides.

📋 Write the new port and IP addresses on your worksheet, then go write them on the whiteboard

You should be able to ping either router that you are directly connected to, but not a router that is two connections away. You can use the IP -> Routes page to show that you only have information about directly connected networks.

Everyone should now be connected to two neighbors and have formed a loop.

Part 3a - OSPF Identity

OSPF requires a 32 bit integer to uniquely identify each connected router. Because we're working with networks, that number gets formatted as an IP address. OSPF will choose an existing IP if we don't specify which to use, and that can get chaotic as we add and remove connections.

Select Routing -> Router ID
Select New
Make note of the name "id-1"
Select Dynamic ID: only loopback
Select from VRF: main
Select OK to save

Part 3b - OSPF Instance

Now we'll tell the router to start the OSPF process.

Select Routing -> OSPF (Instances)
Version: 2
Router ID: "id-1", created above
Select OK to save

Part 3c - OSPF area

OSPF keeps track of every linked cable in the topology and must send that to all participating routers. As your network grows, this can become a major CPU burden. Because many larger networks have a hierarchy, or boundaries between different groups, OSPF uses “areas” to segment the information it must track. For our tiny network, we’ll put everything in the default area.

Select Routing -> OSPF (Areas)
Select New
Leave defaults
Select OK to save

Part 3d - OSPF Interface template

To use OSPF, you must define what properties are used on each connection. Sometimes you have router ports facing users/devices and they should not participate in OSPF. Sometimes a router is connected to two different areas and you must select which ports are on each side. You can either configure ports manually, or create a template that is applied to matching ports.

Select Routing -> OSPF (Interface Templates)
Select New
Interfaces: all
Select OK to save

Part 4 - testing the network

Use the Routing -> OSPF (Neighbors) and IP -> Routes pages to inspect the network topology. Use Tools -> Ping and Tools -> Traceroute to test connectivity across the network and see which paths have been chosen. Unplug the cable the network chose and see it re-route.

Part 5a - Mega network

Repeat parts 2 and 3 above to connect both smaller networks. 📋Make sure to update your worksheet and the whiteboard as you add connections.

Part 5b - Damage detection and avoidance

Repeat part 4 to test connections end-to-end across the network.

IPv6 bonus round

IPv6 addresses are 128 bits and written as 8 groups of 4 hex characters, separated by colons. For simplicity, any leading zeros within a block can be omitted, and the longest group of consecutive zeroes can be written as just "::"

JMU's IPv6 block is written short-hand as 2620:54:0::/48, which features both the leading zero omission and the consecutive zero block. The full address then becomes 2620:0054:0000:0000:0000:0000:0000:0000/48. When expanded, the components are:

Globally assigned subnet:	**2620:0054:0000**:0000:0000:0000:0000:0000
JMU assigned subnet:	2620:0054:0000:**0000**:0000:0000:0000:0000
Device address:	2620:0054:0000:0000:**0000:0000:0000:0000**

Part 6a - assign loopback address

Much like IPv4, OSPF works better with a loopback address assigned that's outside any particular link. The IPv4 loopback addresses were preconfigured, but you'll need to add yours.

A1 - 2620:54:0::1/128	B1 - 2620:54:0::5/128
A2 - 2620:54:0::2/128	B2 - 2620:54:0::6/128
A3 - 2620:54:0::3/128	B3 - 2620:54:0::7/128
A4 - 2620:54:0::4/128	B4 - 2620:54:0::8/128
C - 2620:54:0::9/128	

Navigate to IPv6 -> Addresses, then select New. Type your address in the Address box, uncheck Advertise (otherwise you'll get an error), and hit OK to save.

In IPv6, Advertise is like DHCP (though DHCPv6 also exists), and is used to auto-configure addresses. We will be manually assigning addresses to our routers, so un-check this option.

Part 6b - assign link addresses

Each connected link will also need an address assigned. Remember from earlier that we are allowed to assign any address within this space: 2620:0054:0000:**0000**:0000:0000:0000:0000. For simplicity, we'll use ::1 on one end of the link and ::2 on the other, for example then, you might have 2620:54:0:6767::1/64 and 2620:54:0:6767::2/64.

On each of your connected links, choose a four-digit subnet with the other team and decide who will be ::1 and who will be ::2. Add the address like part 6a, including un-checking Advertise. Use Tools -> Ping to test your connection.

📋Write your subnets on your sheet and the whiteboard

Part 7 - OSPF for IPv6

IPv6 requires OSPF version 3, so we will need to create an almost duplicate configuration to IPv4 that we did in part 3. Mikrotik allows you to reuse the identity across both versions, so we'll recycle "id-1" unless you gave it a different name.

Part 7a - OSPFv3 Instance

Navigate to Routing -> OSPF (Instances) and select New. Use the following parameters:

- Version: 3
- Router ID: id-1

Take note of the instance name that was chosen, and hit OK to save.

Part 7b - OSPFv3 Area

Navigate to Routing -> OSPF (Areas) and select New. Use the following parameters:

- Instance: use the instance name you just created above.

Take note of the area name that was chosen, and hit OK to save.

Part 7c - OSPFv3 Interface template

Navigate to Routing -> OSPF (Interface Templates) and select New. Use the following parameters:

- Interfaces: all
- Area: use the name you created above

Hit OK to save.

Part 8 - Testing IPv6

At this point, Routing -> OSPF (Neighbors) should start to populate with IPv6 information. IPv6 -> Routes will also start to show paths across the network.

Use Tools -> Ping and Tools -> Traceroute to test connections across the network.

Network Notes

What is the name of your router? _____

What is your loopback IP? _____

Port	Router name	Your IP	Neighbor IP

IPv6 Notes

Port	Router name	IPv6 Subnet	Your IP	Neighbor IP