Powercode OSPF Tutorial

The purpose of this document is to provide a guide to the correct method of integrating Powercode into an OSPF network.

For the purpose of this document, I will be using the Mikrotik 450G for configuration examples but this document is applicable to any OSPF capable router.

Routing Protocol Overview

For those of you already familiar with routing protocols, you can skip this section.

What is a routing protocol?

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes.

Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network. This way, routers gain knowledge of the topology of the network.

What is OSPF?

Open Shortest Path First (OSPF) is an adaptive routing protocol for IP networks. It uses a link state routing algorithm and falls into the group of interior routing protocols, operating within a single autonomous system.

The basic concept of link-state routing is that every node constructs a map of the connectivity to the network, in the form of a graph, showing which nodes are connected to which other nodes. Each node then independently calculates the next best logical path from it to every possible destination in the network. The collection of best paths will then form the node's routing table.

What does this mean to you?

This means that you can add a new subnet to any OSPF enabled router in the network and **every other router in the entire network** will know three things:

1. That this subnet exists on the network

2. The best route to this subnet on the network

3. All other routes to this subnet on the network

This also means that, as long as there is another path to this subnet available on the network, you can have a transport failure with minimal service interruption to the customers served by that subnet and without any additional work on your part.

If you read the previous Powercode routed network tutorial you may have thought 'static routes are great but what happens when you have more than a couple of routers in your network?'

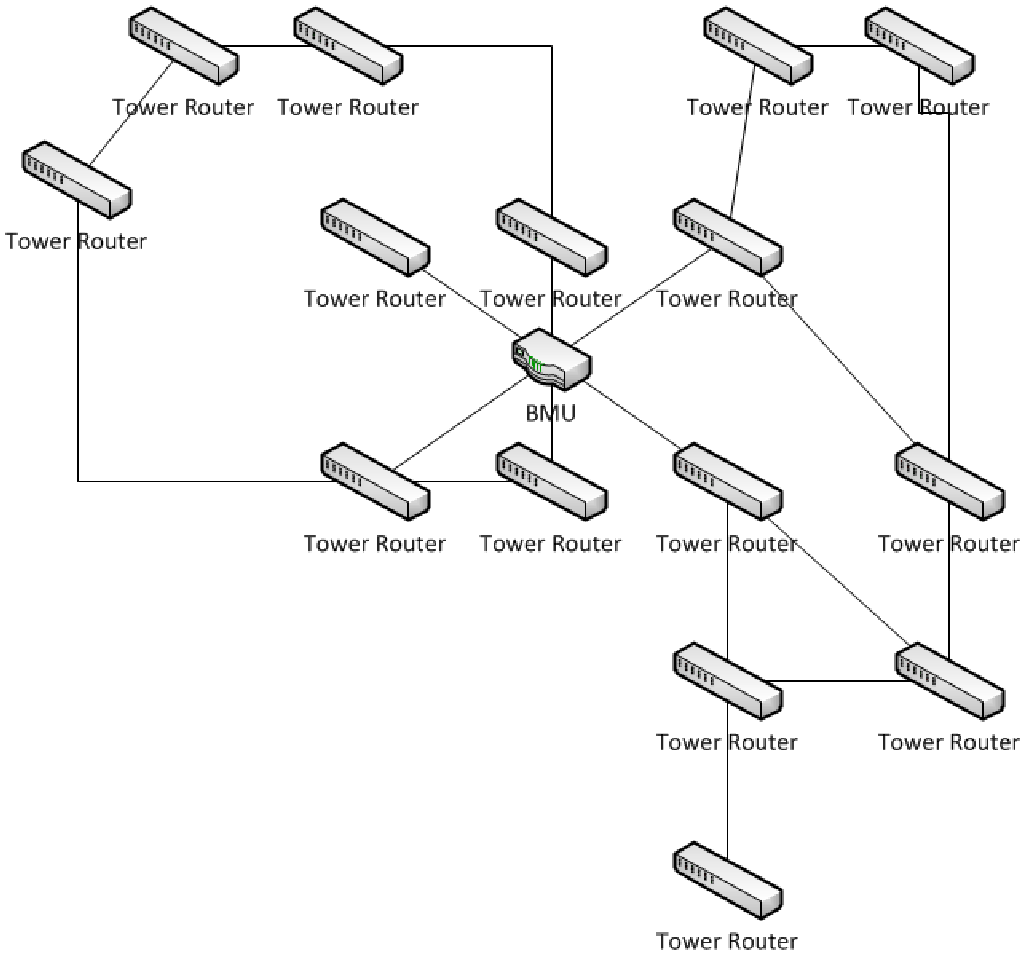
The answer is a routing protocol and the one I will focus on in this document is OSPF.

Why pick OSPF?

There are a couple of major reasons to select OSPF over other routing protocols – availability in a wide range of routers and ease of configuration.

For a basic configuration, OSPF is one of the easier protocols to configure and as it is an open standard, most routers support it.

So, all that being said, let's take a look at a good OSPF candidate network.



This type of network is a prime candidate to be a routed network. If this network was Layer 2, you would have a potential nightmare on your hands with spanning tree, ARP traffic and other Layer 2 issues.

On the other hand, if you moved to a routed network and tried to configure this network using just static routes, you would have an even larger challenge on your hands.

Our solution to this conundrum is to implement a routing protocol and our choice will be OSPF.

How will OSPF determine the path to take in this network?

OSPF uses **path cost** as its basic routing metric. In practice, most routers will look at the **interface speed** to determine the local cost on the router. For example, a 10Mbps link may have a cost of 10 and a 100Mbps link may have a cost of 1.

Bear in mind that this is interface speed, not transport speed. If you have a backhaul that can only pass 5Mbps but the physical interface on it is a 100Mbps interface, the router will calculate this as a 100Mbps interface for path cost calculation.

In practice, you can generally assume that OSPF will calculate the best path to take by hop count, assuming all interface speeds are equal. You can manipulate this calculation by applying a fixed cost to a particular interface. We will address this specifically in a later section but it is important to be aware of the method by which a router will determine the direction to send a packet.

Considerations before migrating from Layer 2 to Layer 3

Before moving to any routed network, a few things should be considered.

1. Customers will be able to see all your hops on a traceroute. This means you will probably want to configure all links between routers with public IP addresses.
2. You will no longer be able to send out network wide broadcasts and you will no longer be able to see the MAC address of a customer that is behind a remote router.
3. You can no longer route large subnets across your entire network – each router will need to have a unique subnet for customers, equipment management, etc.

This is a good thing, from a network design perspective – it stops people being able to do ARP poisoning across your whole network, it cuts down on ARP traffic and more. However, it does make some things more difficult. For example, you will no longer be able to use ‘Match MAC & IP’ in Powercode unless you have a BMU at each tower, as the BMU will no longer be able to see the MAC of the customer.

What routers should I use?

Whatever you want! OSPF is not a proprietary protocol. As long as the router you use supports standard OSPF, it will work.

We have tested OSPF on the BMU MAXX with Mikrotik, Imagestream and Cisco.

The Mikrotik 450G will handle most smaller towers at a low cost (~$200) or you can go with a $250,000 Cisco 7600 – it’s up to you!

The biggest obstacle will probably be the learning curve if you are not already familiar with the concepts we’re discussing but a basic, routed OSPF setup is not terribly difficult to configure and learn.

Powercode Considerations

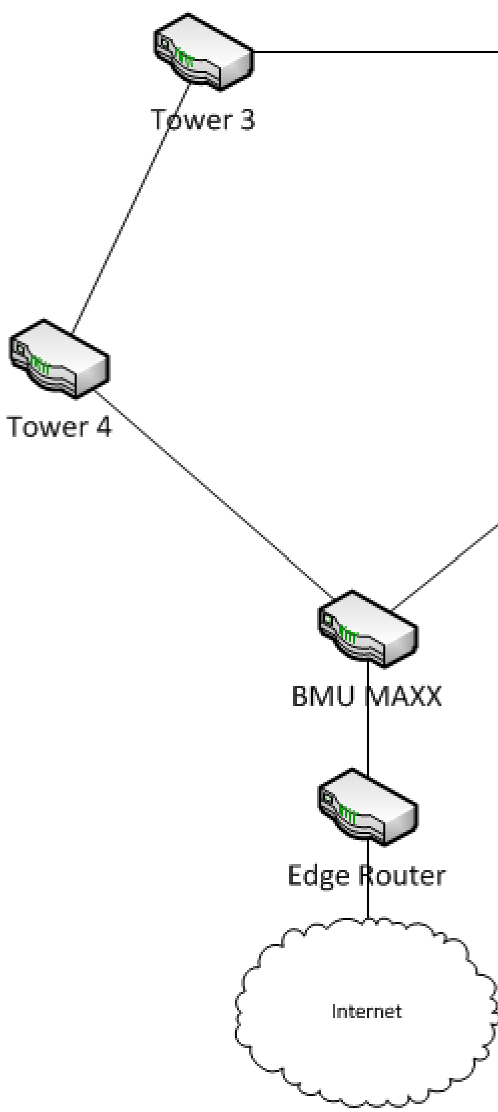
One additional step for Powercode is that you will need to add every router interface to **Infrastructure**. This means your customer facing interfaces, network uplink interfaces, management interfaces – everything!

You will also need to set all the remote routers to **DHCP relay** to the BMU. We'll look at this in a second.

All subnets that you are doing DHCP relay for in the BMU need to be added to a **Shared Network**.

Let's take a look at a real configuration step by step for a simple, small ring. This kind of configuration can scale to a much larger setup without any changes.

Here is our example network.



The first thing we need to determine is an IP addressing scheme that we want to use on this network. For the purpose of this tutorial, we will use private IP addresses for everything but, as mentioned earlier, I would strongly suggest using public IP addresses for the links between the routers.

First, let's determine customer IP space that we want to use at each tower.

Tower 1 Customer Space	192.168.1.0/24
Tower 2 Customer Space	192.168.2.0/24
Tower 3 Customer Space	192.168.3.0/24
Tower 4 Customer Space	192.168.4.0/24

Now let's add some space that we want to use to manage equipment at the tower. This space could be used to assign to CPE, tower equipment, a UPS or whatever other gear you have.

Tower 1 Equipment Management	172.16.0.0/24
Tower 2 Equipment Management	172.16.1.0/24
Tower 3 Equipment Management	172.16.2.0/24
Tower 4 Equipment Management	172.16.3.0/24

Now we need space for uplinks between the routers. Each interface on the router that faces another router will need an IP address on it.

Tower 1 to Tower 2	10.0.0.0/30
Tower 2 to Tower 3	10.0.0.4/30
Tower 3 to Tower 4	10.0.0.8/30
Tower 4 to BMU	10.0.0.12/30
BMU to Tower 1	10.0.0.16/30

Finally, we need to create a management IP for each tower router. We need a management IP on these routers because you don't want to rely on an interface address to access the router in case it goes down. For example, if you try to telnet into the Tower 1 router on the 10.0.0.0/30 subnet and that interface is down, you won't be able to access the router. By adding a management address on a virtual interface, we can ensure we can get into the router through any active interface regardless of the status of the other interfaces.

I'll cover the configuration of this management interface later in the document. For now, just be aware we want to configure one. Since this is a virtual interface, we can use a /32 subnet.

Tower 1 Management	192.168.255.1/32
Tower 2 Management	192.168.255.2/32
Tower 3 Management	192.168.255.3/32
Tower 4 Management	192.168.255.4/32

Now that all the subnets for these routers have been determined, configuration can begin.

I will step through the configuration of the Tower 1 router in this document. Let's determine the subnets we need for this router.

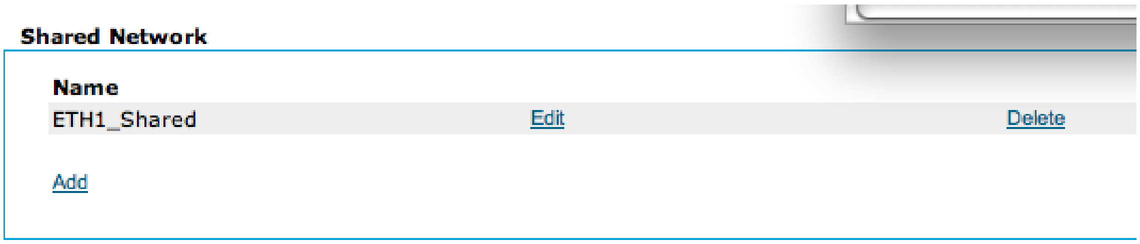
Tower 1 Customers	192.168.1.0/24
Tower 1 Equipment	172.16.0.0/24
Tower 1 to Tower 2	10.0.0.0/30
Tower 1 to BMU	10.0.0.16/30
Tower 1 Management	192.168.255.1/32

First, I will show the Powercode configuration that is needed for this router. We will only need to add subnets to the Powercode BMU that will be used to address equipment managed in Powercode. This means we need to add Tower 1 Customers and Tower 1 Equipment subnets to Powercode.

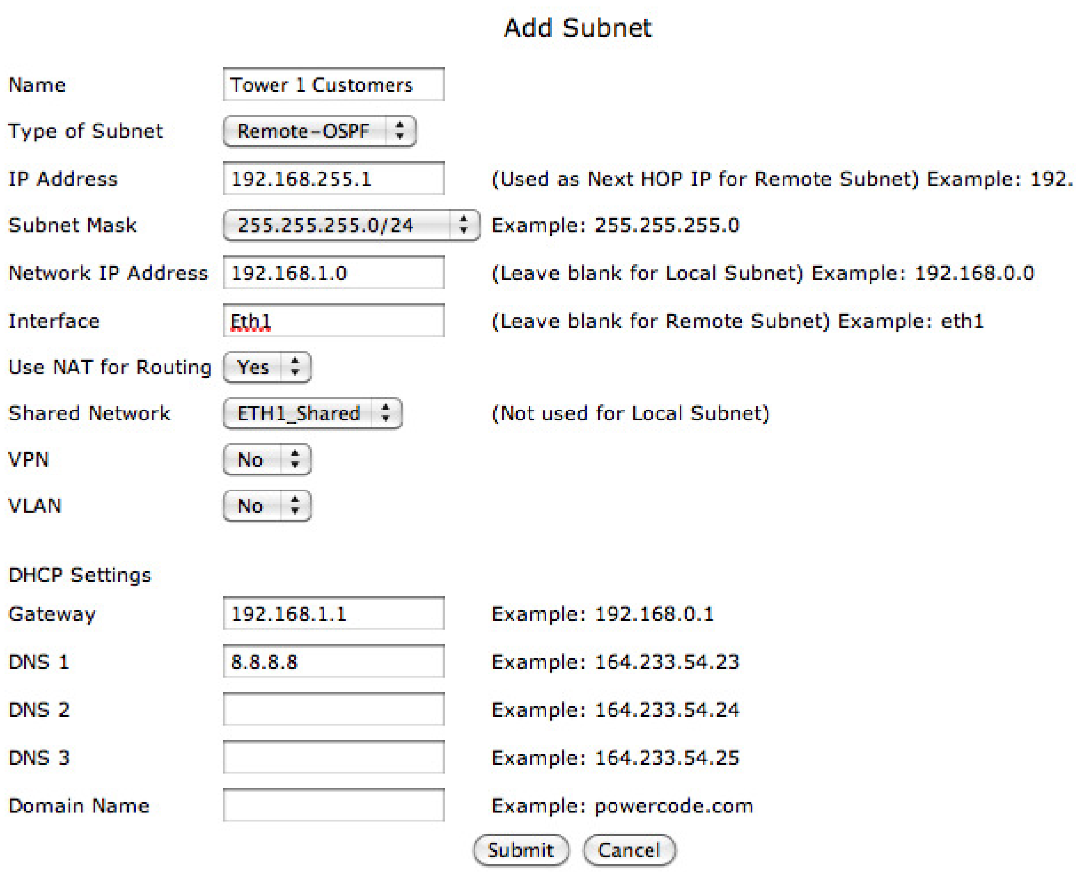
We want to bring the whole network back into a single port on the BMU. Eth 1 will be the port we select but you can use any port you like.

Before we configure any of the subnets, we need to create a shared interface in Powercode. The shared interface allows us to assign multiple DHCP subnets to an interface when we are using DHCP relay. If you don't assign the subnets to the shared interface, you will have problems with DHCP relay from your tower routers.

You only need one shared interface per physical interface. Under the BMU, click **Add** under **Shared Network** and create a shared interface named **ETH1_Shared.**



Now let's create our subnets.



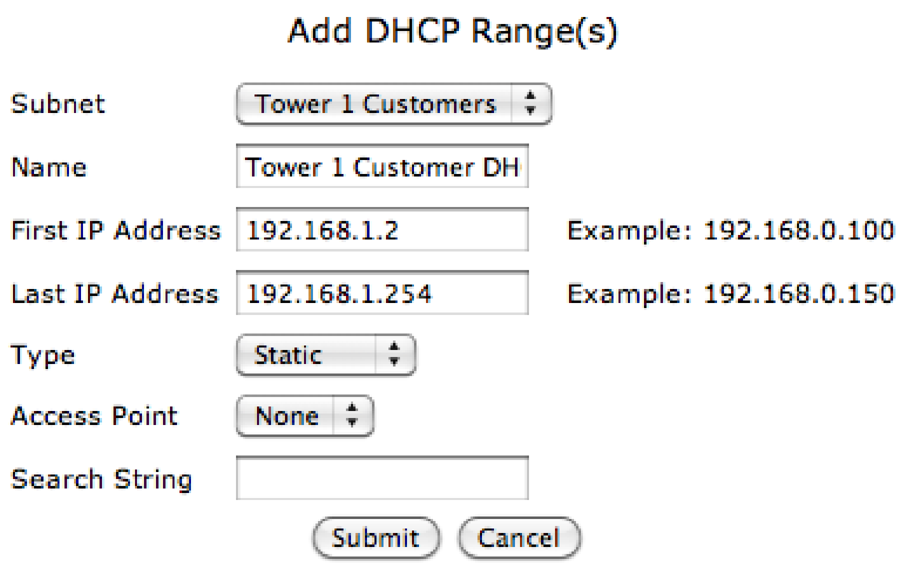
There are three things we need to do here that are slightly different than creating a Local Subnet.

1. Set the Type of Subnet to Remote-OSPF. This means the subnet will not be created locally on the BMU but will be made available for DHCP and equipment addressing.

2. The IP Address field should be set to the next hop address for this subnet. This is not really important for type Remote-OSPF as we are not creating static routes – I would recommend entering the management IP of the router here for tracking purposes.
3. Set the Shared Network to the network we previously created – ETH1_Shared.

Make sure you select **Use NAT for Routing** and set to **Yes** if this is a private address you are giving to a customer.

Once you are done creating the subnets, we need to create DHCP ranges for any IPs that will be given out. In our example, we only really need DHCP for the customer range but you may want to use DHCP for your tower equipment as well.



Rebuild your BMU once all the subnets and DHCP ranges are added.

Once you have completed the subnet setup in Powercode there is one final step to be completed. All router interfaces need to be added to **Infrastructure.** This includes uplinks between routers, interfaces customers connect to, interfaces that equipment is connected to – everything.

So, for Tower 1, we would need to add:

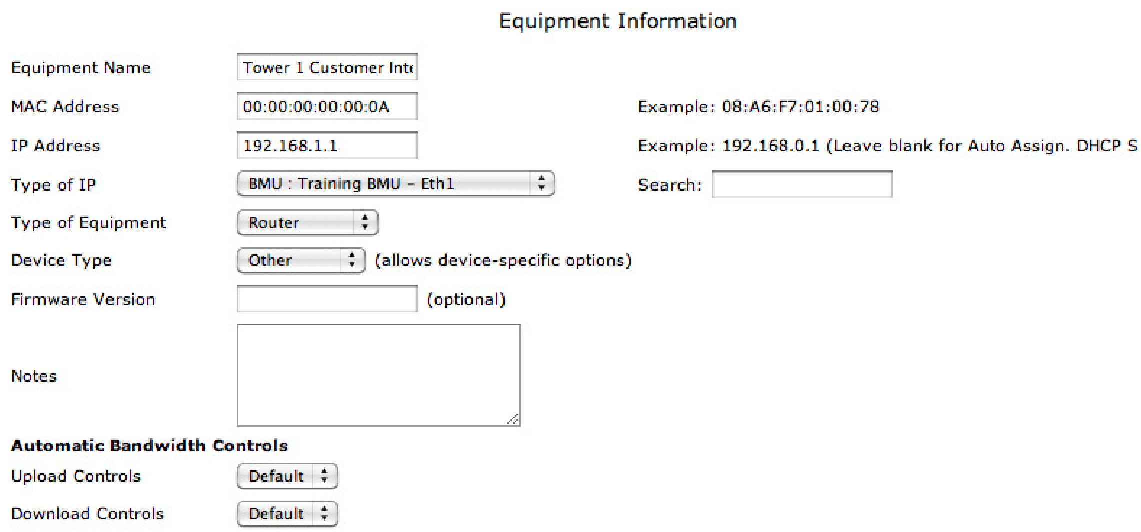
The IP address that connects from Tower 1 to the customers (192.168.1.1)

The IP address that connects from Tower 1 to the equipment (172.16.0.1)

The IP address from Tower 1 to Tower 2 (10.0.0.1)

The IP address from Tower 1 to the BMU (10.0.0.17)

The management address on Tower 1 (192.168.255.1)



Enter a descriptive name for the interface in the **Equipment Name** field. Enter the MAC address as 00:00:00:00:00:0A – this is a global matching MAC address. Since we won't see the MAC address for these packets on the BMU (as MAC addresses are not transmitted across a Layer3 network) we need to use the global match MAC.

For **Type of IP**, select the interface this router is connected to.

Once you have added all the interfaces to **Infrastructure** you are done with the Powercode configuration.

BMU Configuration

In the BMU web interface, go to **Routing** and then **OSPF Configuration**.

You need to configure a few options in here prior to configuring the rest of the network.

The **Router ID** is a unique identifier for the router that is used to identify it through the network to other OSPF routers. Generally, I use the management address of the router as the Router ID. For your BMU, I would use your WAN IP.

Route Redistribution is used to redistribute routes from other protocols or tables back into OSPF. Since the BMU currently only supports OSPF, we don't have any other protocols to redistribute from. However, we do want to advertise a default route into our OSPF network so check **Default** under **Route Redistribution**.

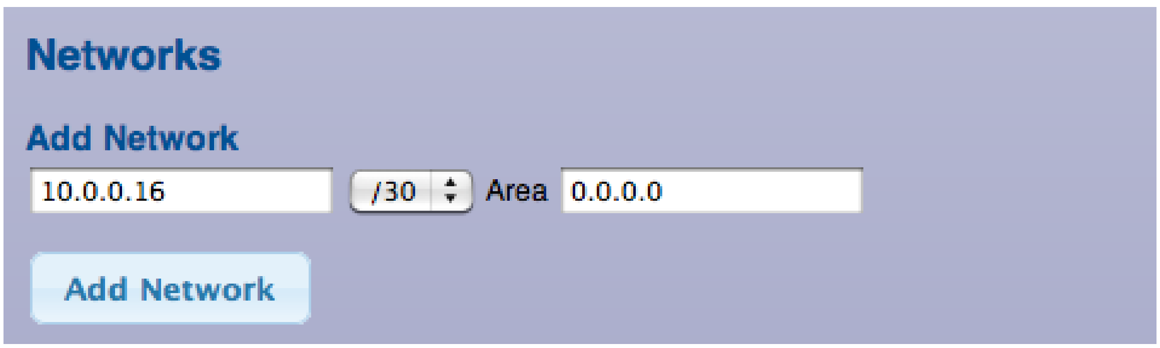
We also need to set our network facing interface to an **Active** interface. The BMU defaults to setting all OSPF interfaces to **Passive**. This means that these interfaces are not allowed to form OSPF peering sessions with other routers. Open the **Eth 1** interface and uncheck the **Passive** checkbox. Now click **Update OSPF Configuration**.

The final thing we need to do is enter the networks we want to advertise into OSPF. By default, the BMU will not advertise any networks into OSPF unless you have set route redistribution for a specific network or you have entered it into the network advertisement section.

The only subnets we need to advertise from the BMU are:

1. A default route.
2. The Tower 1 to BMU subnet.
3. The Tower 4 to BMU subnet.

We are already advertising the default route by selecting **Default** under **Route Redistribution**. Let's add our Tower 1 to BMU subnet (10.0.0.16/30)

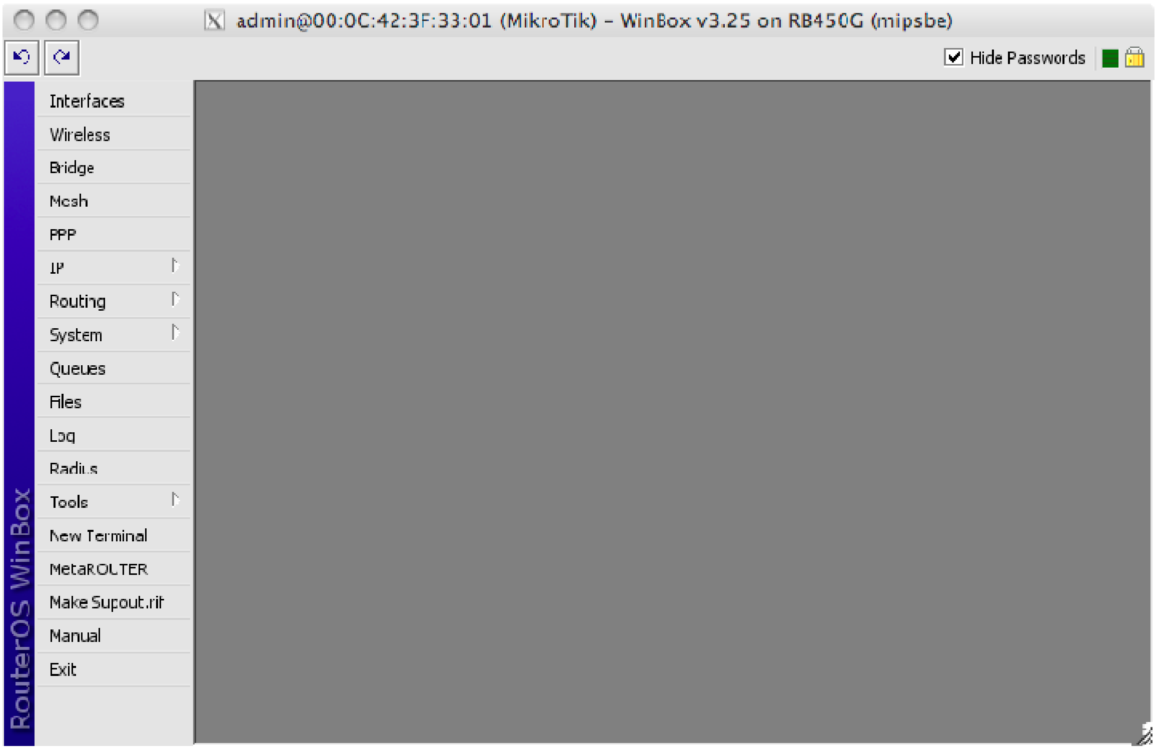


The **Area** input field allows you to select the OSPF area you want to advertise into. Your main OSPF area is 0.0.0.0. Multiple OSPF areas is outside the scope of this document – for this tutorial, we will be putting every router into the backbone area. Leave the area at 0.0.0.0 and click **Add Network**.

We're now done with the BMU configuration – let's move onto the Tower 1 router.

I'm using a Mikrotik 450G for this configuration example but you can use any OSPF capable router.

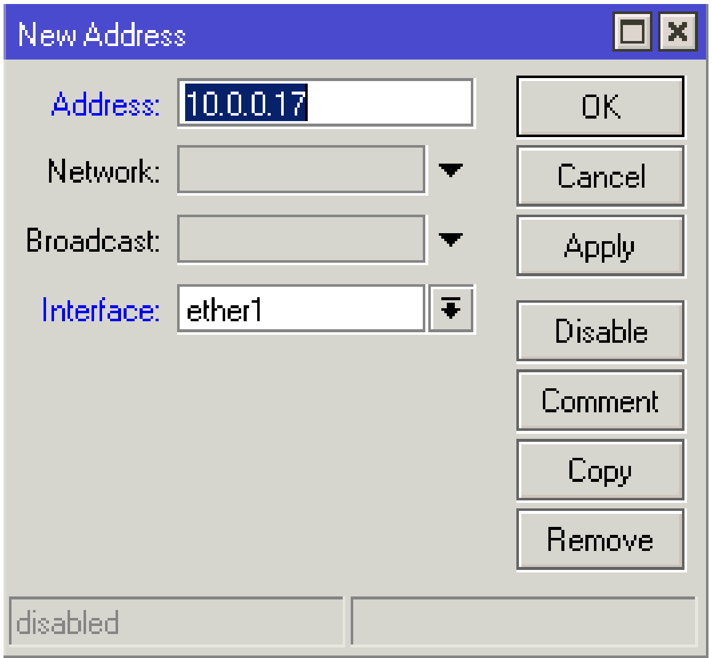
Router Configuration



Here we are logged into Winbox. Let's configure our IPs.

Click on **IP** and then **Addresses**. We need to determine the interfaces we are going to configure our IPs onto so let's configure as follows:

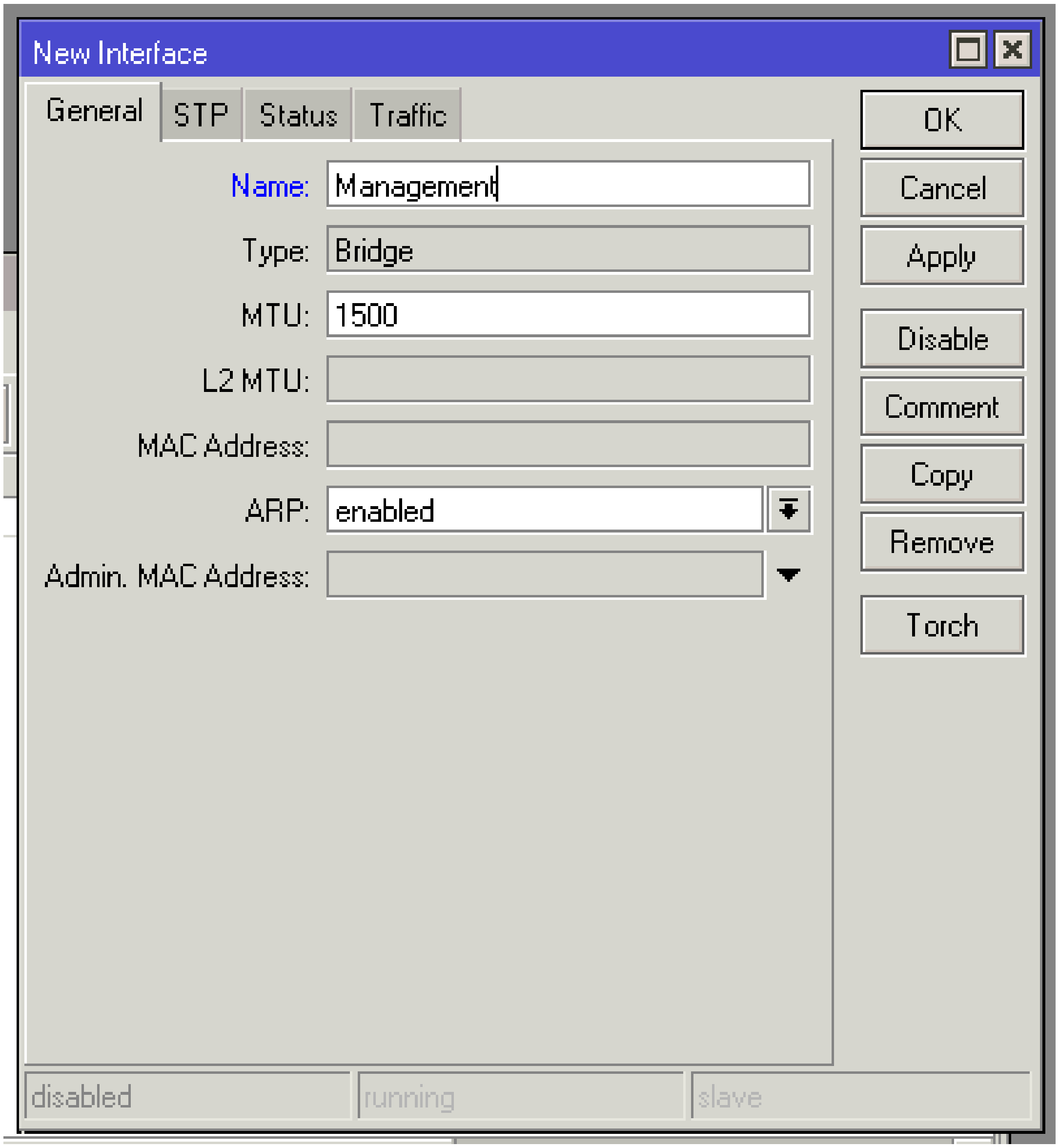
Ether 1	Tower 1 to BMU
Ether 2	Tower 1 to Tower 2
Ether 5	Customer DHCP and Equipment Mgmt



Go through and add all your subnets to the router.

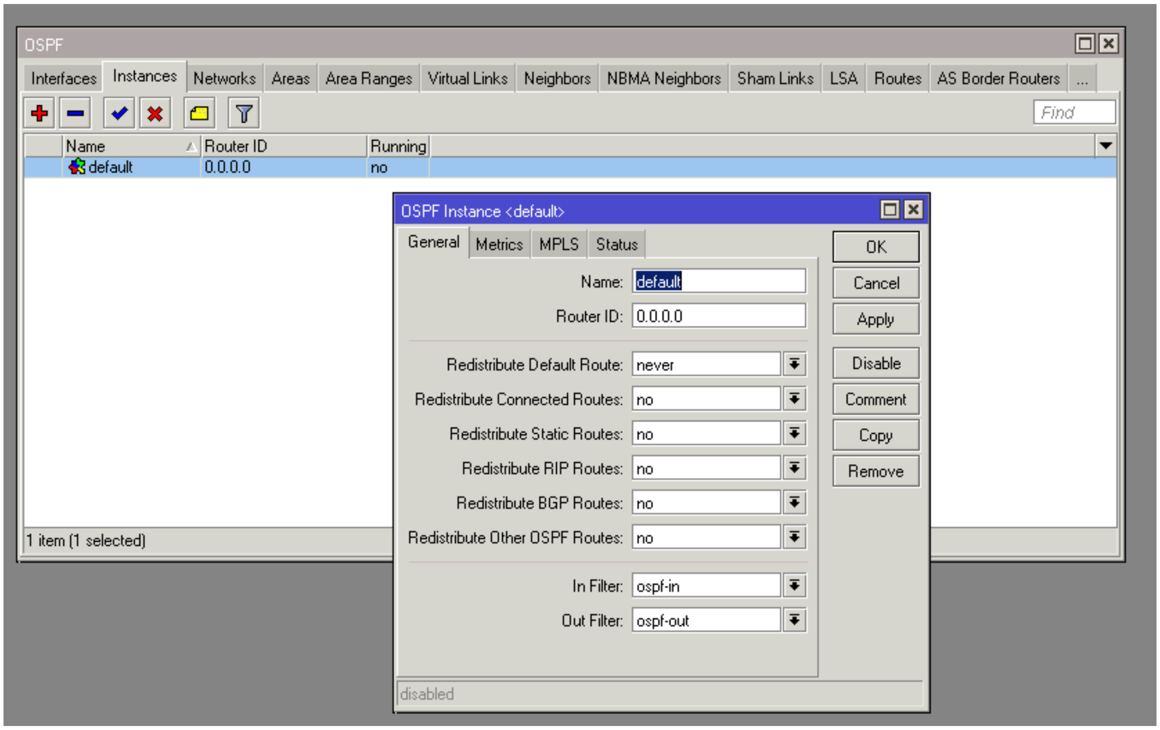
We also need to add the management address to a virtual interface so let's create that now.

Click on **Bridge** and then click on **+**.



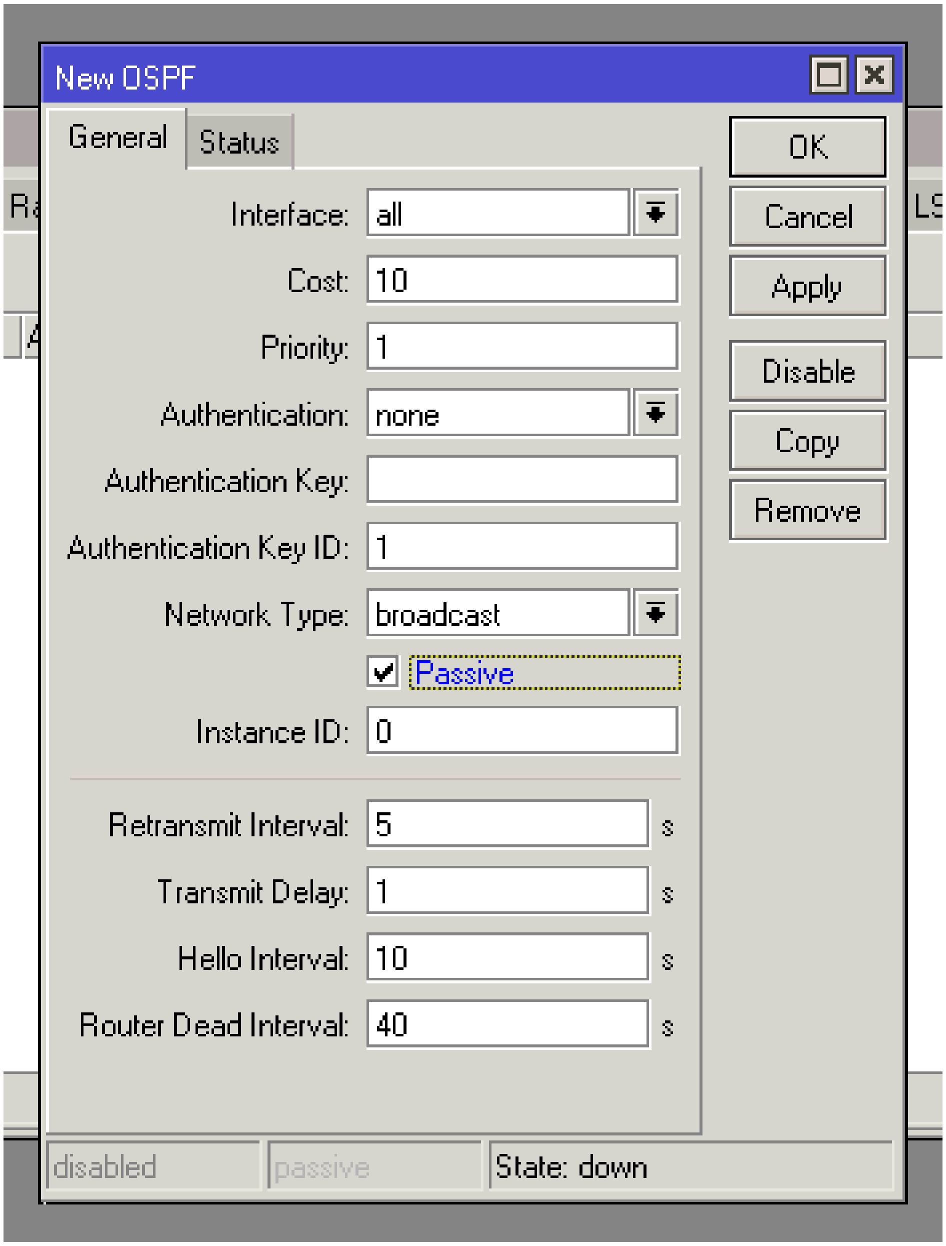
Create a bridge interface named **Management**. Now go back to the **IP Addresses** section and add our management IP to the **Management** interface.

Now let's configure OSPF. Click on **Routing** and then **OSPF**.

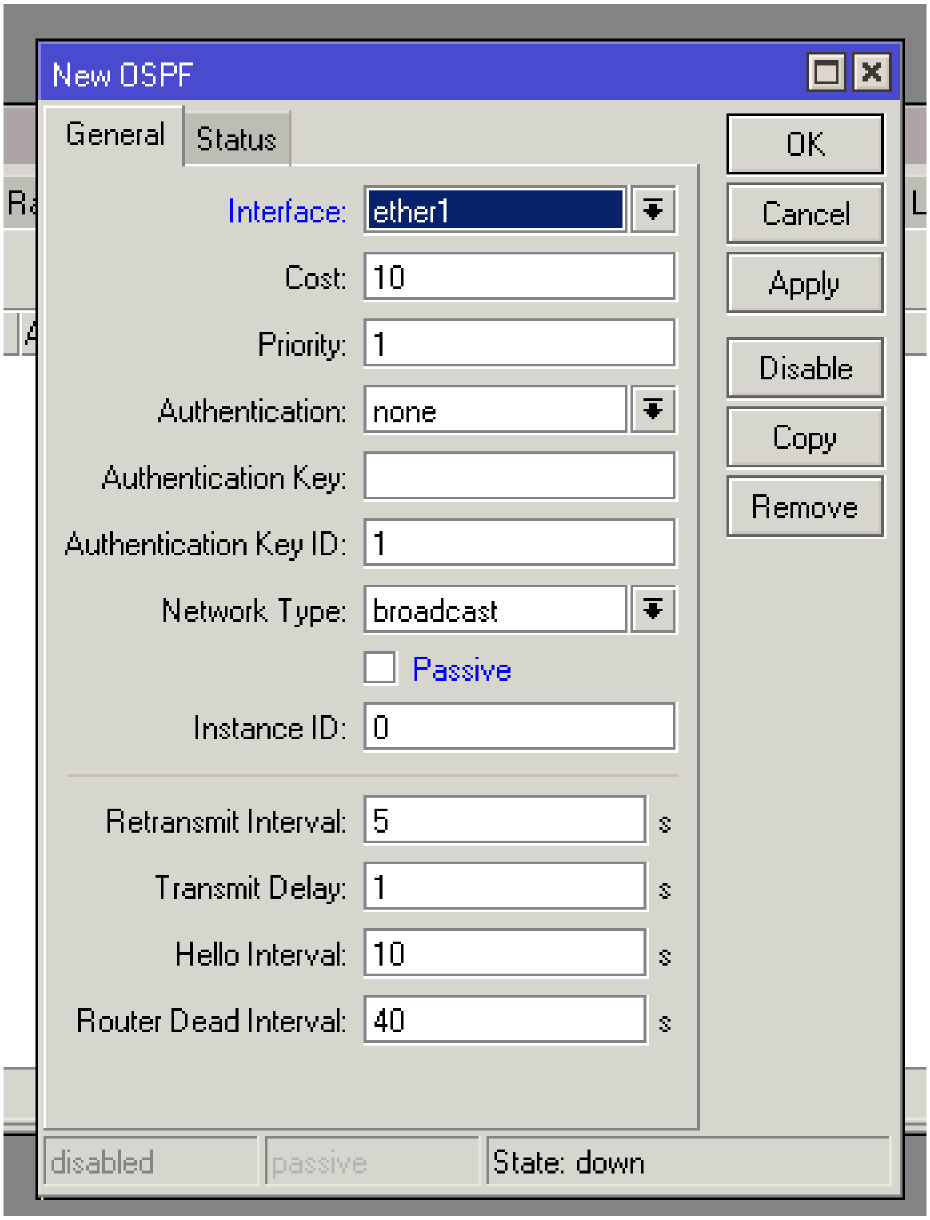


Click on the **Instances** tab to configure your OSPF instance. All you really need to do in this section is change your Router ID – I recommend setting it to the management address. For the purposes of our configuration, everything else can be left to the defaults.

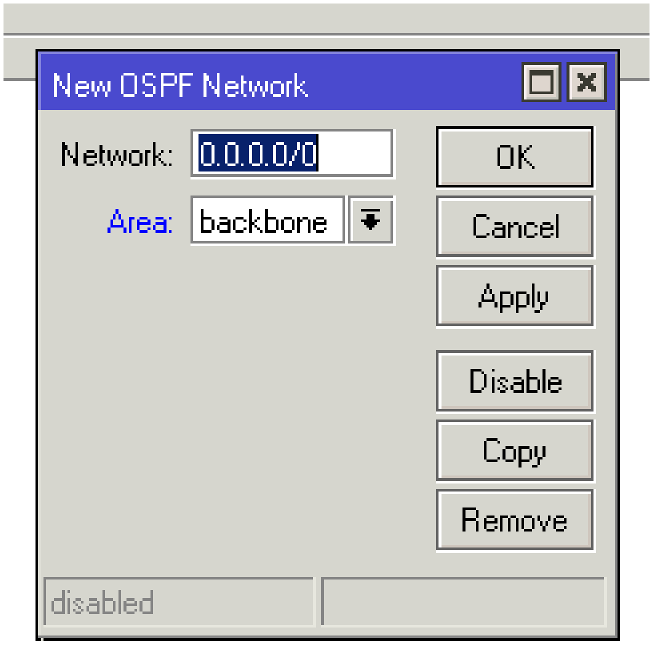
Now click on the **Interfaces** tab. The Mikrotik default is to have all interfaces active for OSPF. To match my recommended configuration, let's set all the interfaces to passive by default. Click the **+** and set the **Interface** to **All** and then check the **Passive** box.



Now we need to explicitly set to active all the interfaces we will actually be running OSPF on. Go ahead and add both Ether 1 and Ether 2 as active OSPF interfaces. Leave all the other options at their default settings.



Now we need to add the networks that we will be advertising from this router. Click on the **Networks** tab and click the **+**.



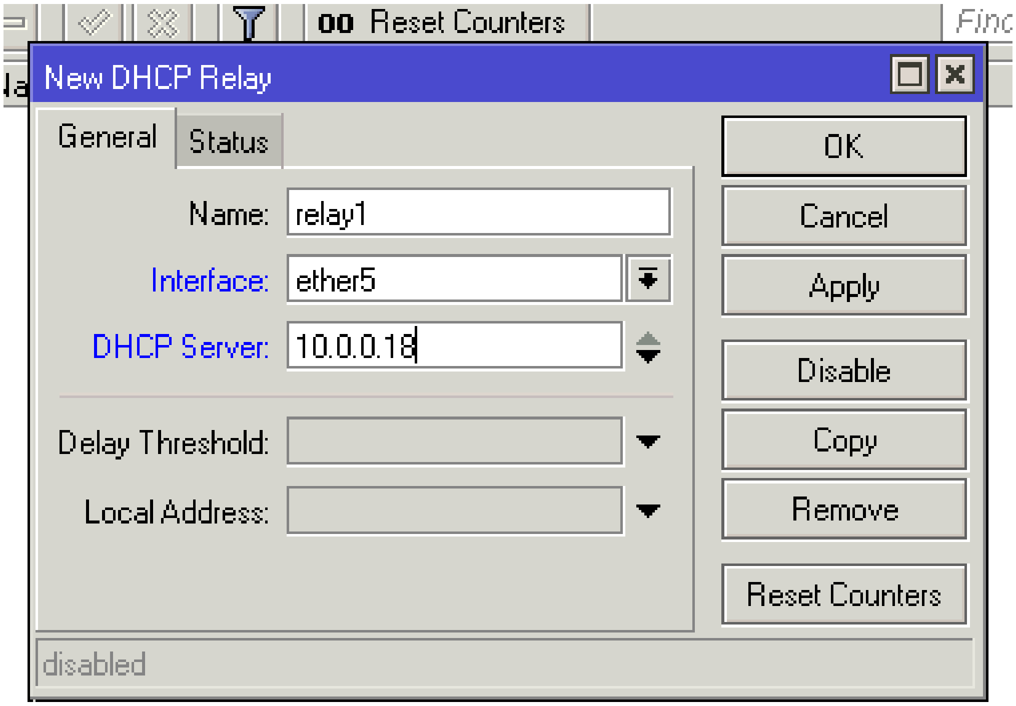
Enter every subnet that exists on the router. If you fail to enter a subnet, it will not be advertised into the network and other routers will not know the correct path to take to reach an IP in that subnet.

Now connect this router to your BMU. You can verify if the OSPF adjacency is formed by clicking on the **Neighbors** tab under **Routing->OSPF** on the Mikrotik or clicking on **OSPF Neighbors** under **Routing** on the BMU.

You can also verify if the routes are being advertised correctly by checking the routing table. To do this on the BMU, click on **Routing** and then **Routing Table**.

Once everything is setup and functioning, the final step we need to take is to setup **DHCP Relay**. To set this up, click on **IP** and then **DHCP Relay**.

Click on the **+** and then enter the appropriate information. Select the interface that you need to run DHCP on and then enter the IP of the BMU.



Now plug your laptop into Ether 5, enter the MAC address of your laptop into Powercode and assign an IP from the appropriate subnet.

You should then be able to pull an appropriate IP address via DHCP from the BMU and get online.