Lab
MPLS with Traffic Engineering

Last Update 2011.06.01

1.0.0

Source

- This lab was developed by ibarrere
- That is the only name listed on the site
- It is found in a blog post from May 2009 on the http://www.networking-forum.com web site at
  - http://www.networking-forum.com/blog/?p=145
- This looks like a very useful site

MPLS in a Lab Environment

- As it is difficult to create a real MPLS network in a lab environment and since simulation programs do not offer a MPLS cloud as they do for Frame Relay, this lab will use an emulation program
- In this case GNS3 running Dynagen which is controlling the Dynamips emulator
- How to use GNS3 is covered in detail in another presentation on this web site

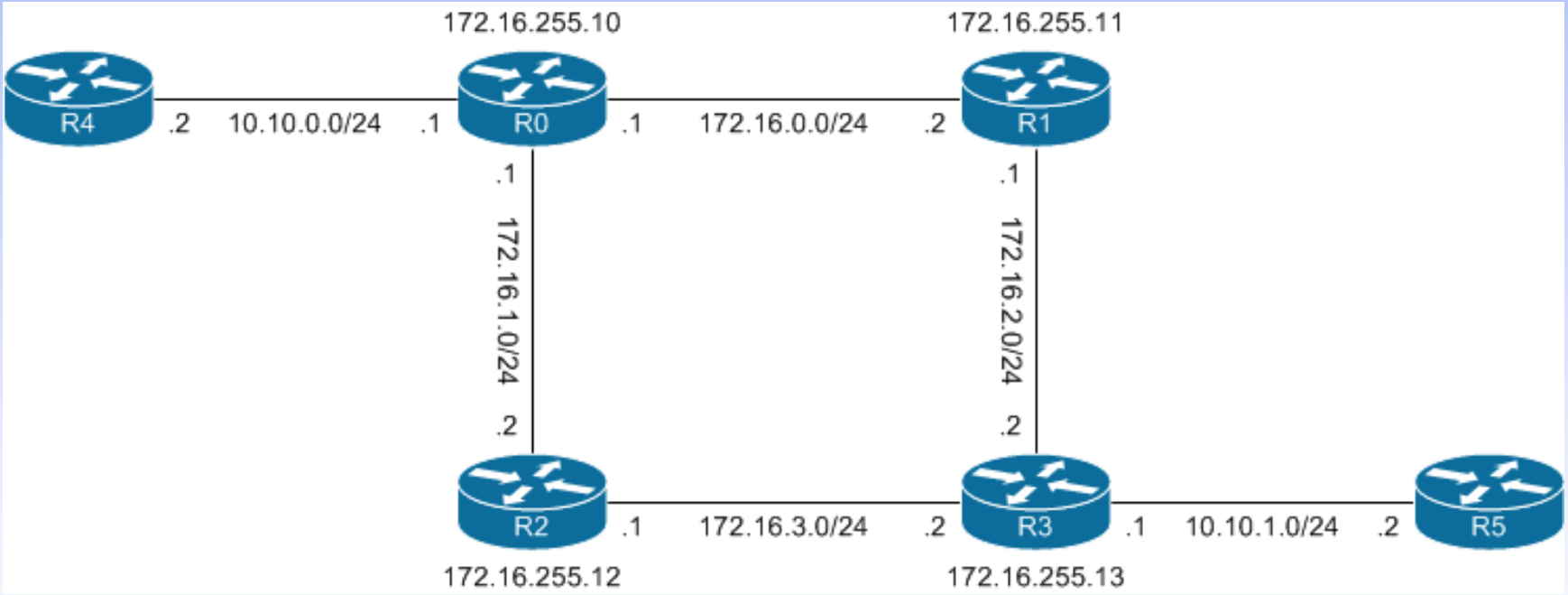
Lab Network

- Here is the lab network as setup in GNS3
- To create the topology either
  - Download and open this file in GNS3
    - MPLS With Traffic Engineering Lab.net
  - or
  - Lay the routers out as the diagram that follows shows

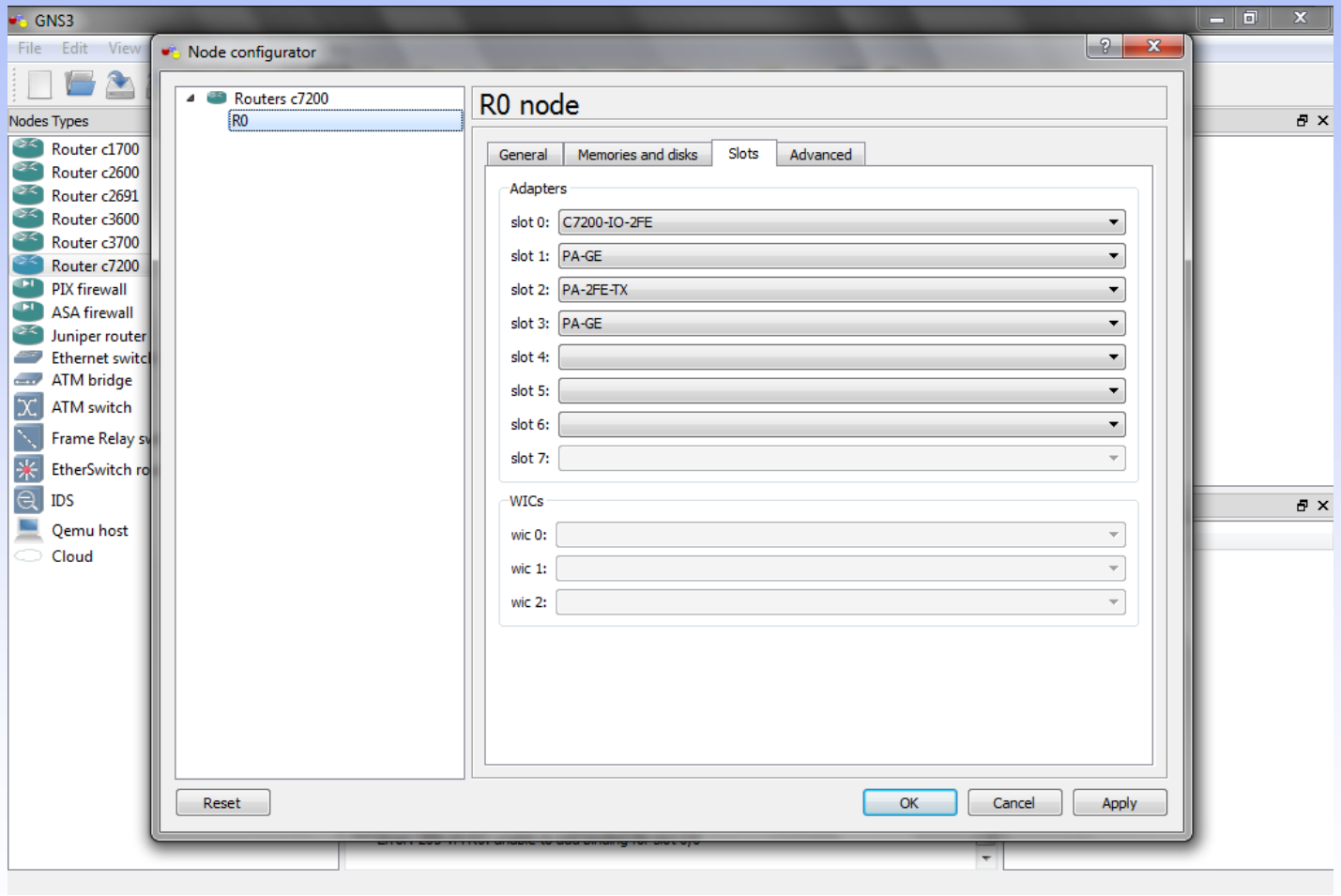
Lab Network

- When the routers are placed be sure the labels match as well
- Next the modules to be added to the routers, which are all 7200 models
- Then the connections between the routers are made
- To simplify the setup the modules are all the same even though some of them are not actually needed in all the routers

Lab Network



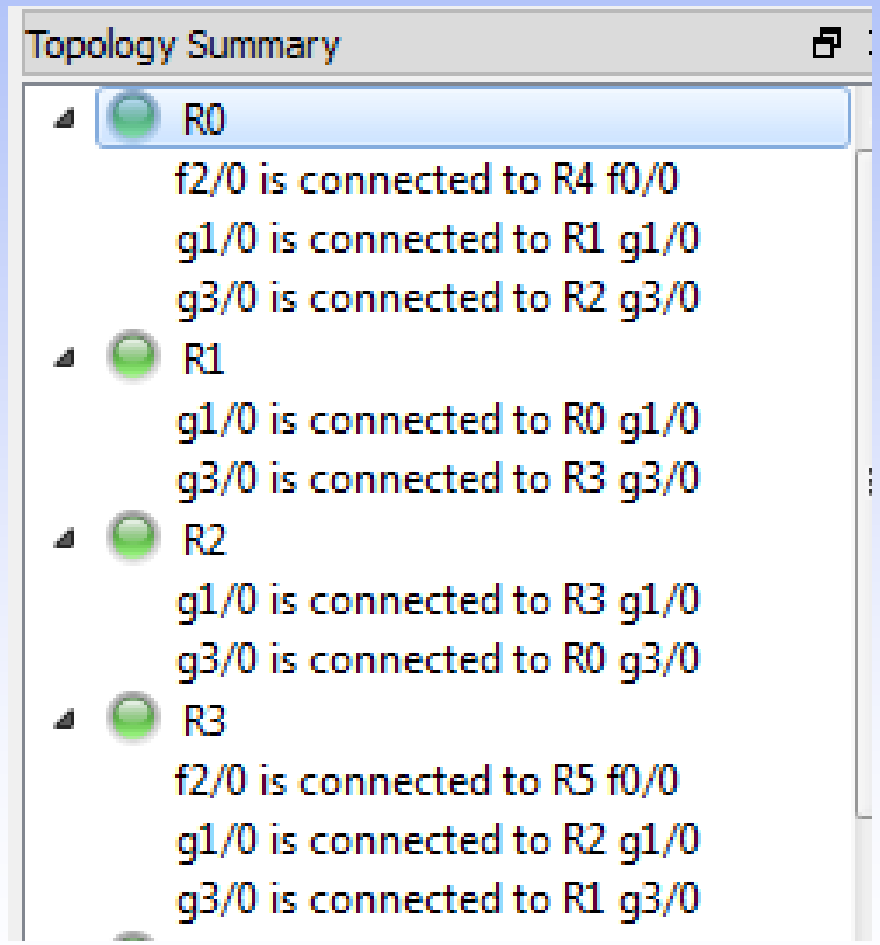
Modules Required



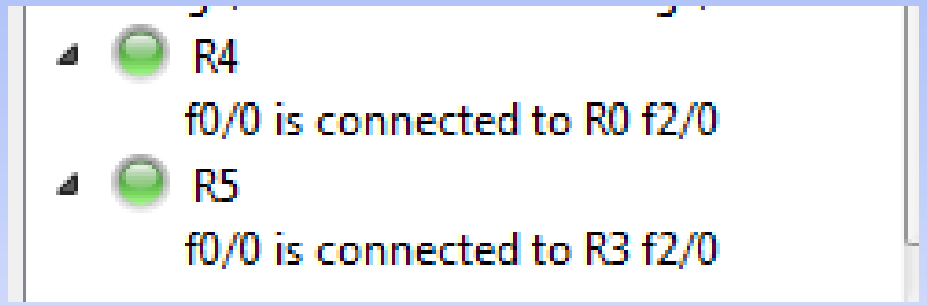
Modules Required

- The modules are
  - Slot 0
    - C7200-IO-FE
  - Slot 1
    - PA-GE
  - Slot 2
    - PA-2FE-TX
  - Slot 3
    - PA-GE

Connections



Connections



Lab Network

- The routers are all running this IOS
  - c7200-advipservicesk9-mz.150-1.M5.bin

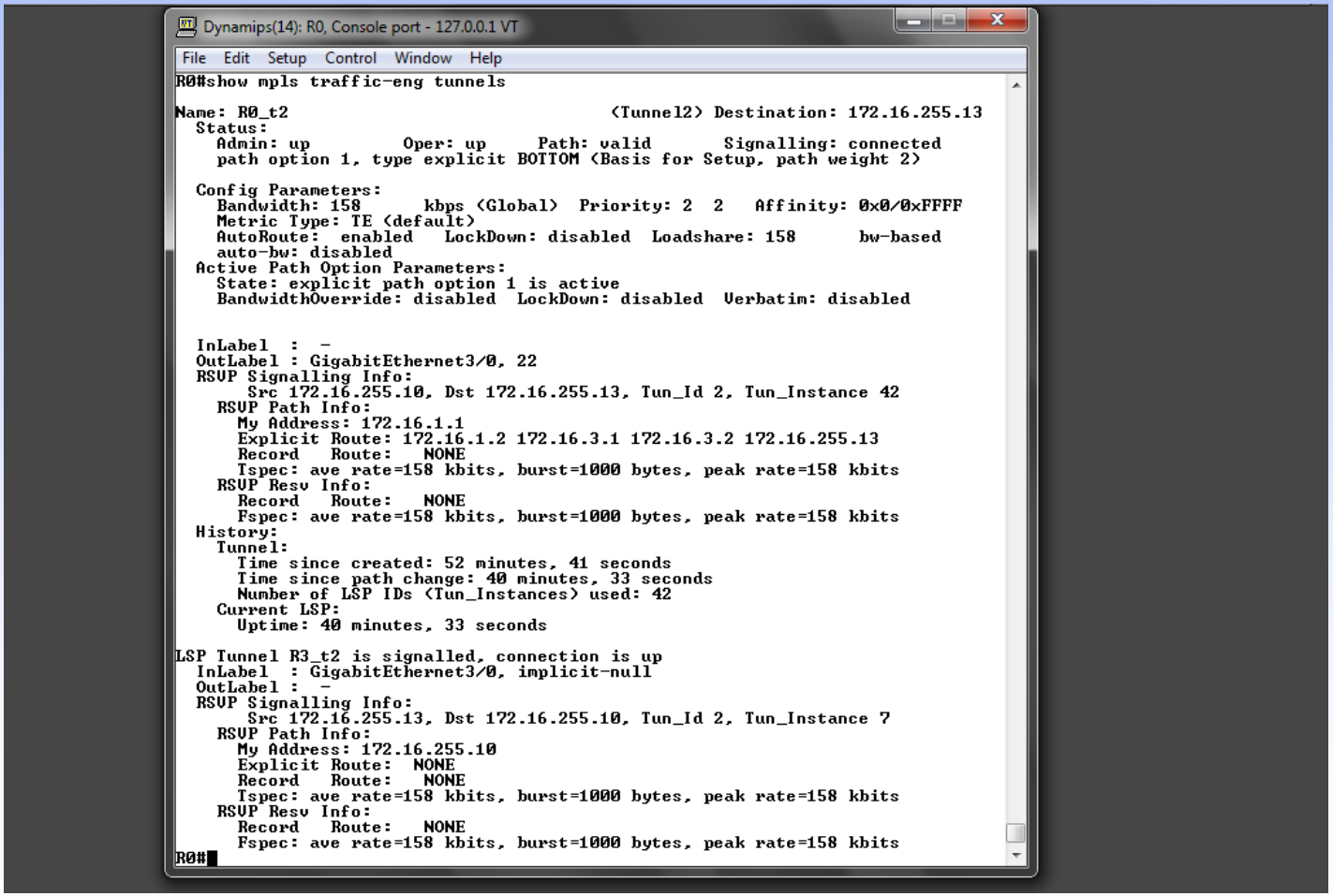
Configuration

- As the configurations are lengthy for this many routers they are provided as separate links to copy and paste txt files listed just below this lab's link
- Download each one of these, then copy and paste the contents to each router based on the name of the file and the corresponding router

Verify Connectivity

- Let’s see if it worked
- Enter
  - show mpls traffic-eng tunnels
- This shows

Verify Connectivity



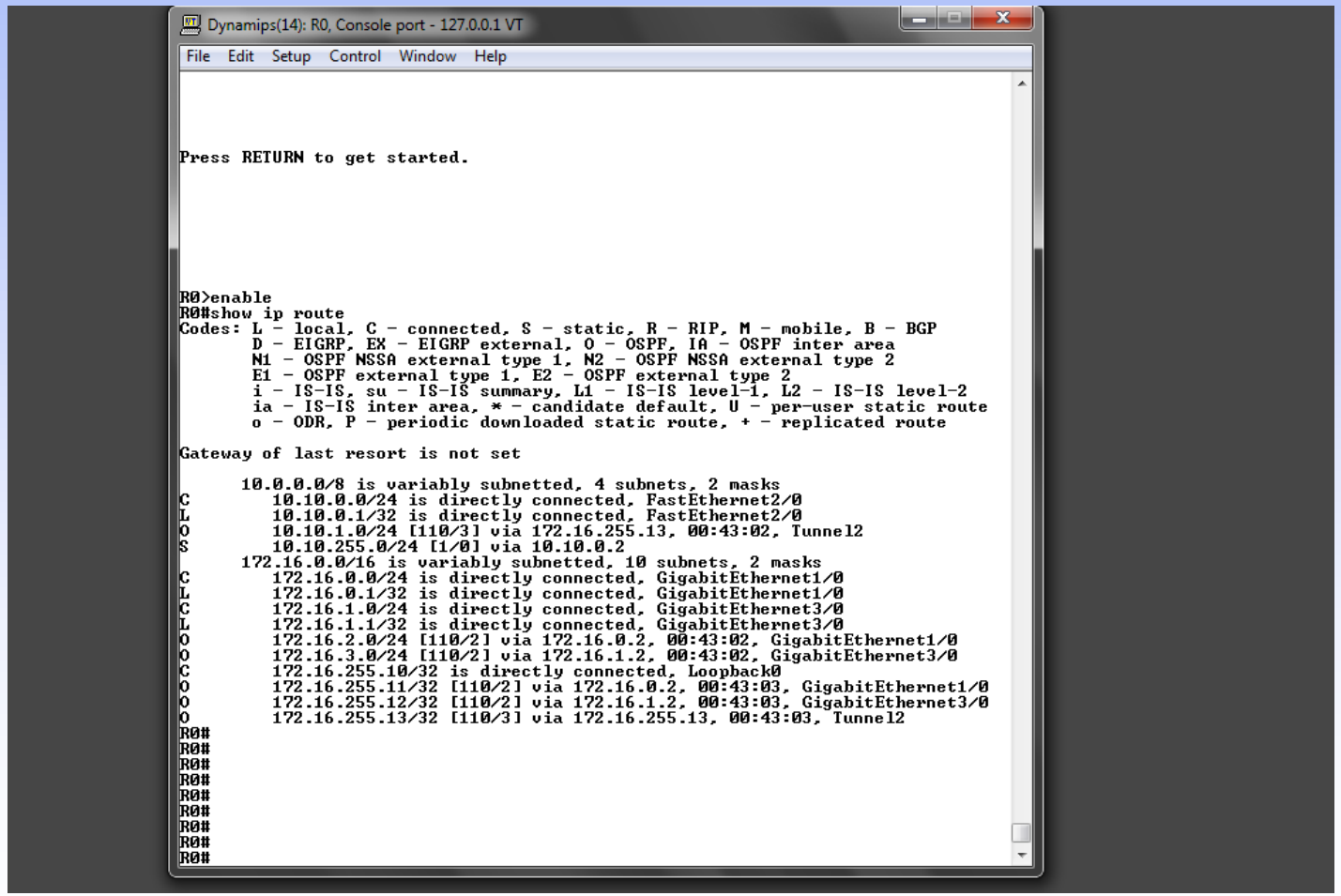
Verify Connectivity

- Ping all of the interfaces
- For example from R4 to R5
  - ping 10.10.1.2
- These should all work

Verify Connectivity

- Examine the routing table
- Here from R0

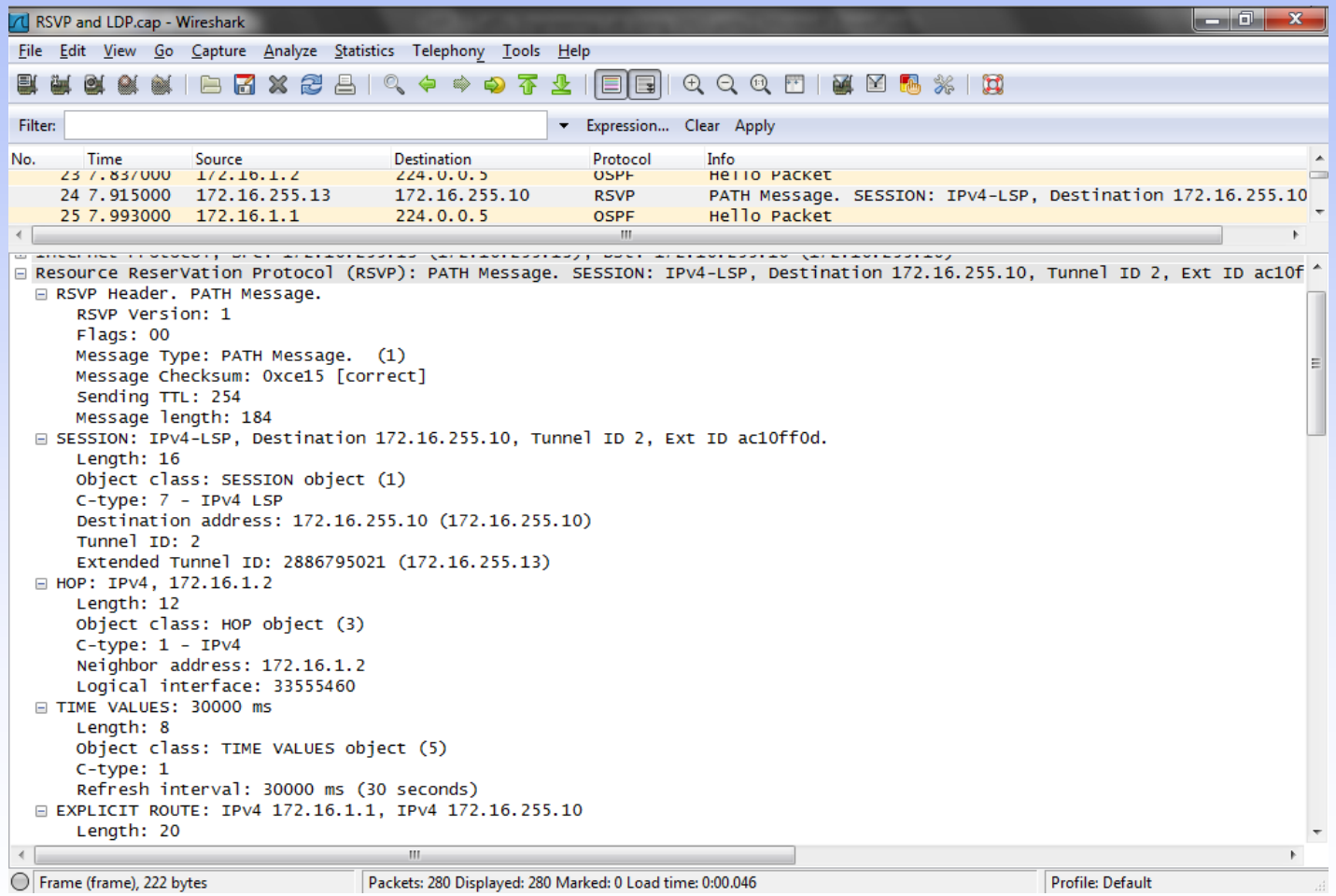
Verify Connectivity



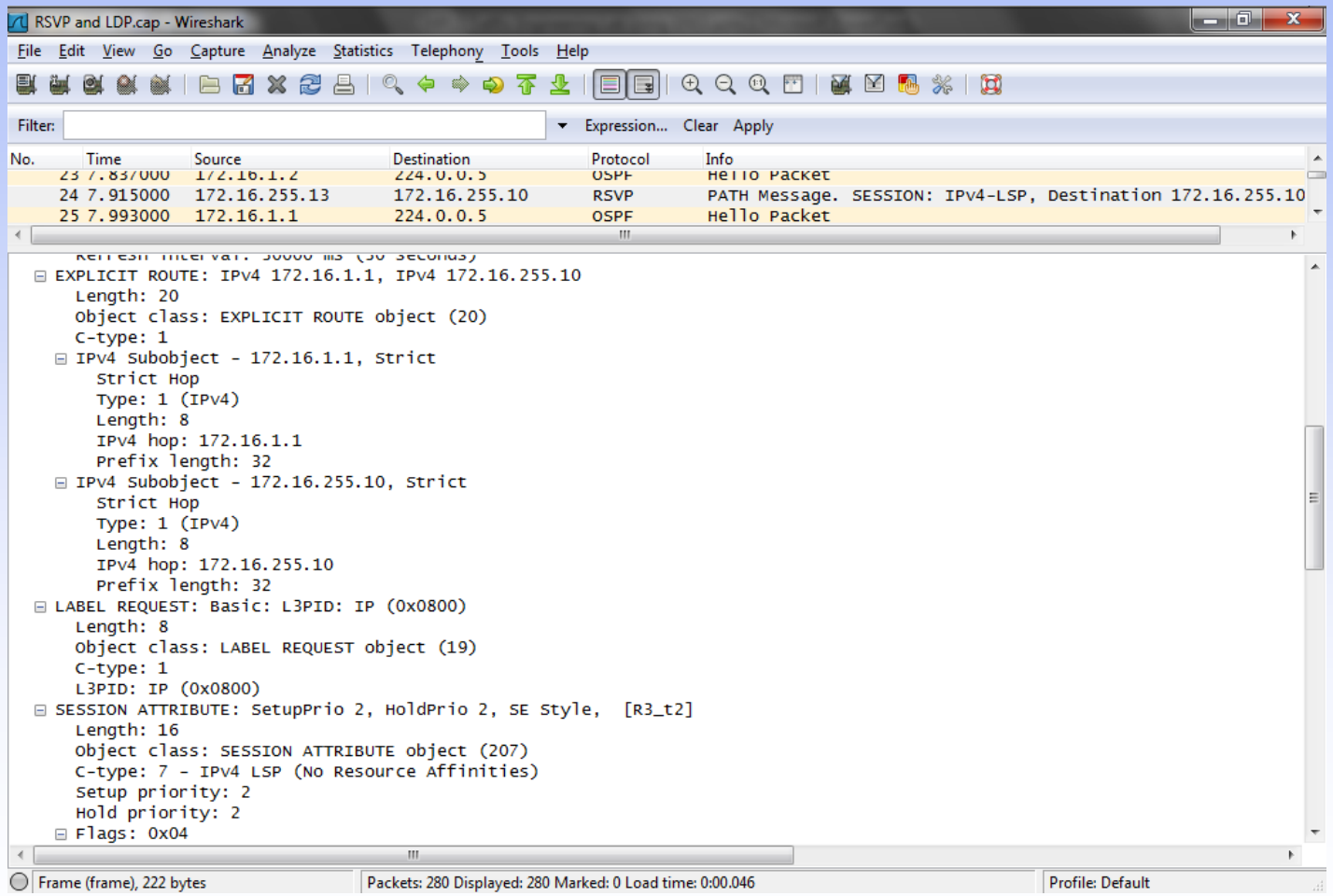
RSVP Capture File

- Let’s open the same capture file
- We will see how RSVP did its work for us
- Go to frame 24
- Expand all of the RSVP level
- Here the two ends are talking to each other in a path message over tunnel 2
- As we can see there is a lot to say

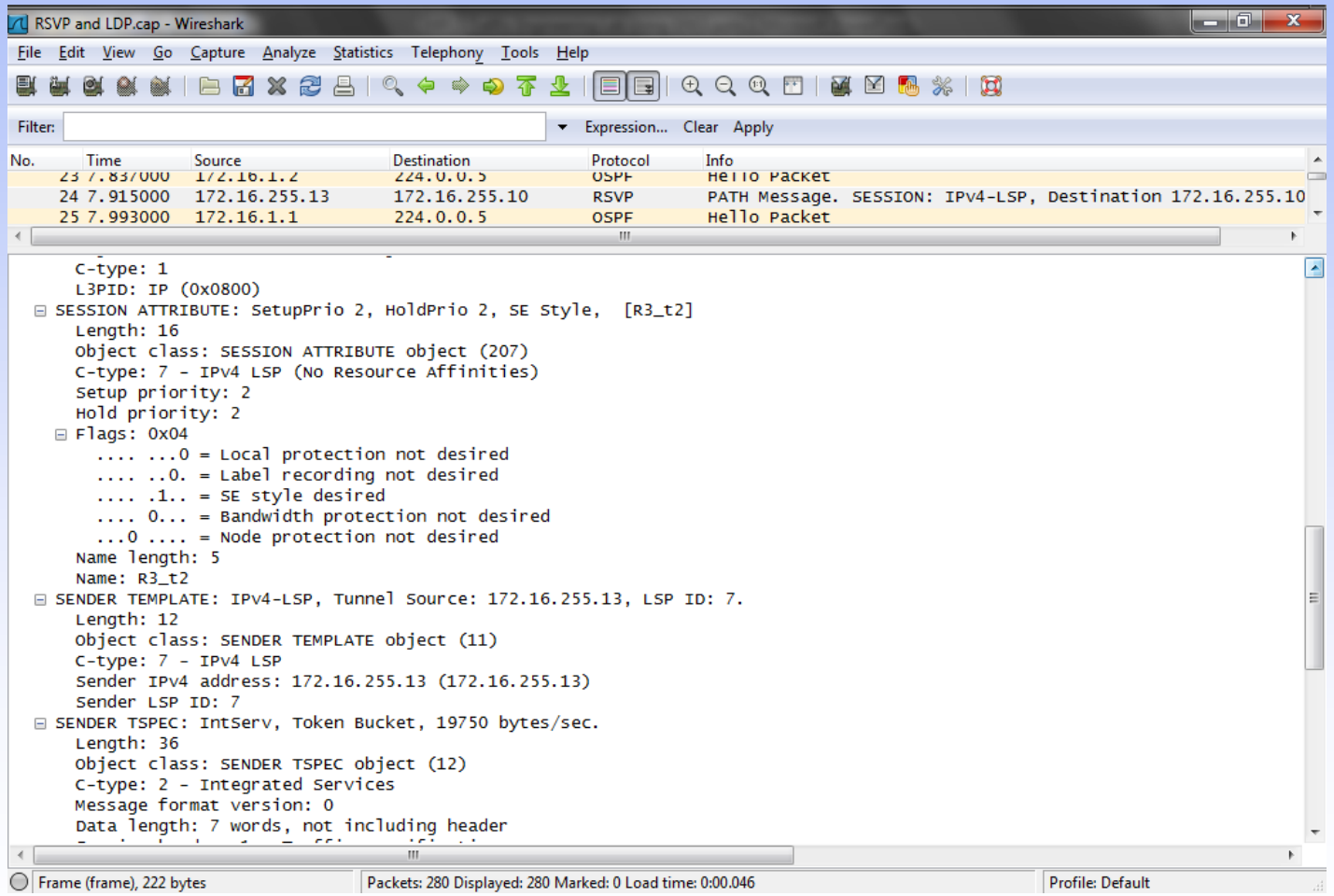
RSVP Capture File



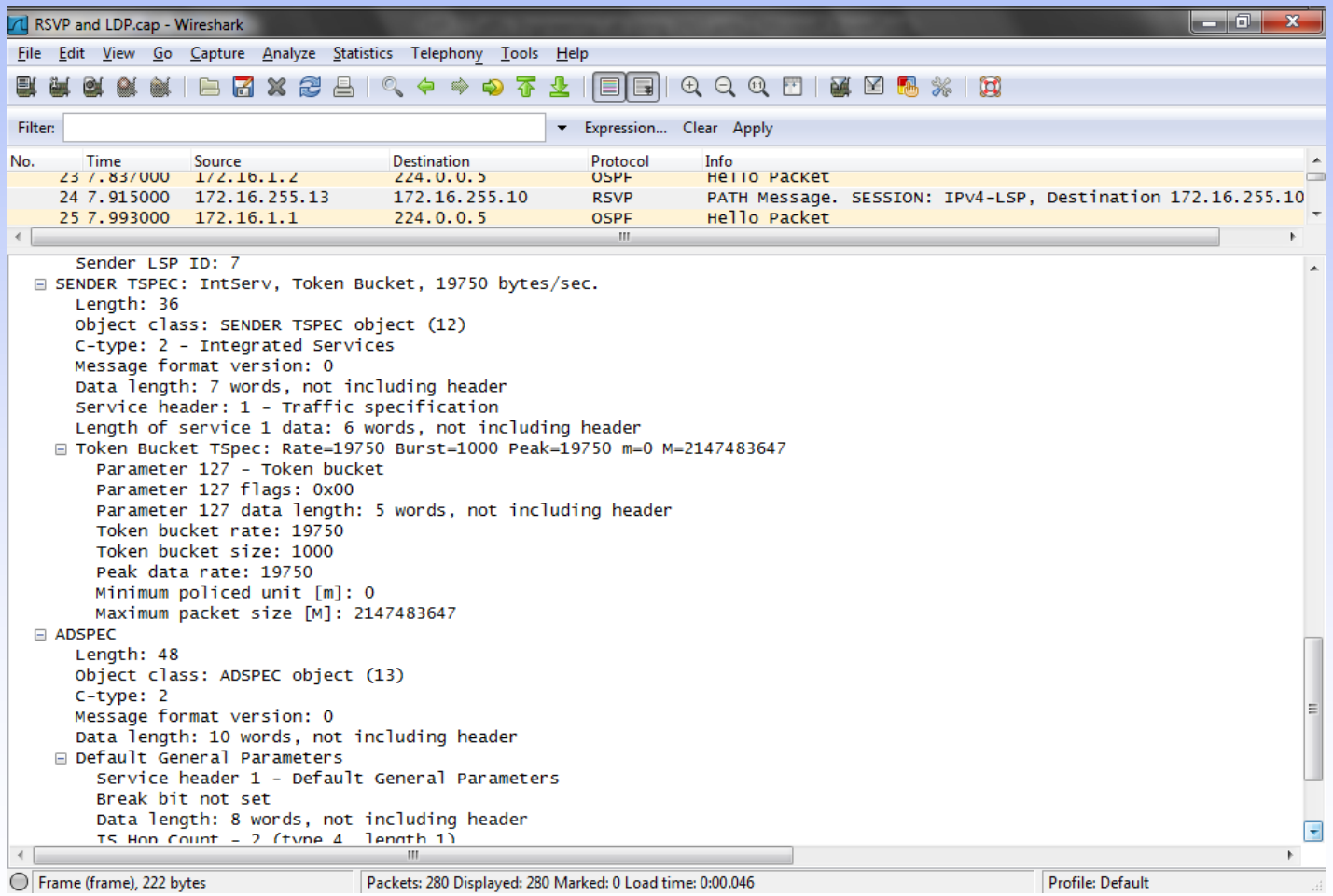
RSVP Capture File



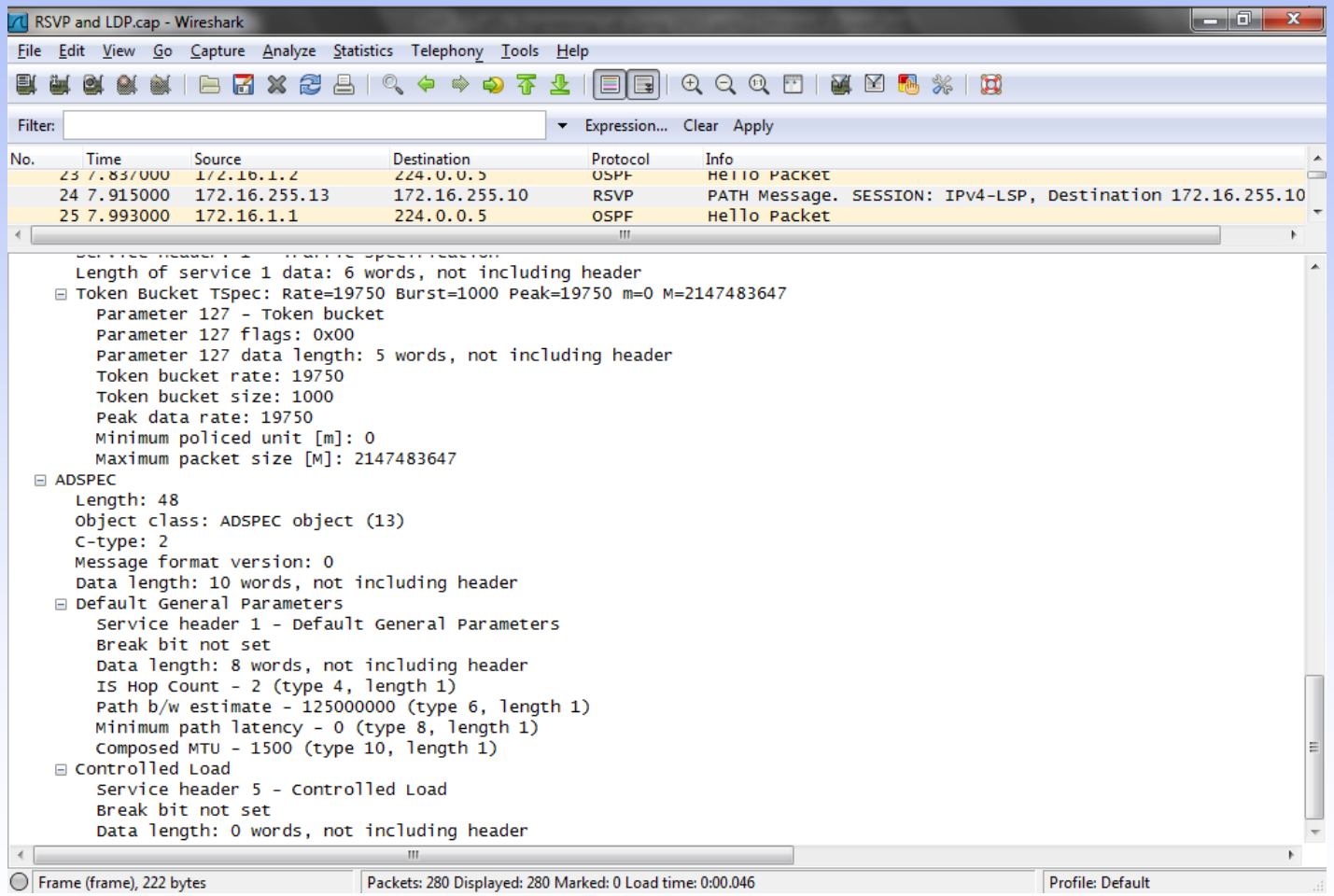
RSVP Capture File



RSVP Capture File



RSVP Capture File



What Do The Commands Do

- Let's look at some of the commands used to see what they do
  - ip cef
    - To turn on CEF – Cisco Express Forwarding
    - This is required by Cisco routers doing tag switching of which label switching is a form
    - As Cisco says
      - CEF switching is a proprietary form of scalable switching intended to tackle the problems associated with demand caching

What Do The Commands Do

  - With CEF switching, the information which is conventionally stored in a route cache is split up over several data structures
  - The CEF code is able to maintain these data structures in the Gigabit Route Processor
  - The data structures that provide optimized lookup for efficient packet forwarding include
- It is on by default in some devices

– mpls traffic-eng tunnels

- Enables traffic engineering on the router

What Do The Commands Do

- tunnel destination 172.16.255.13
  - The IP address of the end of the tunnel
  - Where the traffic is going
- tunnel mode mpls traffic-eng
  - Specifies the encapsulation method for the tunnel
  - In this case mpls

What Do The Commands Do

– tunnel mpls traffic-eng autoroute announce
  - This tells the routing protocol to consider the existences of the tunnel in its route calculations
  - Otherwise the routing protocol will not send traffic through the tunnel
  - If not this, then a static route will have to be used

What Do The Commands Do

- tunnel mpls traffic-eng priority 2 2
  - This configures the setup and reservation priority for the tunnel
  - The first number is the priority
  - The second is the hold
  - The numbers are the same
- tunnel mpls traffic-eng bandwidth 158
  - This is the bandwidth of the tunnel in kbps
  - The range is 1 to 4294967295

What Do The Commands Do

- tunnel mpls traffic-eng path-option 1 explicit name BOTTOM
  - This sets up a path option for the tunnel
  - In this case the path is an IP explicit path related back to the tunnel destination
  - The path is also in this case given a name
- no routing dynamic
  - To prevent routing updates being sent through the tunnel
  - They still go out, just not through the tunnel

What Do The Commands Do

- mpls ip
  - Enables the router to perform forwarding of MPLS labels in IPv4 packets along normally routed paths
- mpls traffic-eng tunnels
  - Sets up MPLS traffic engineering for an interface

What Do The Commands Do

- ip rsvp bandwidth 750000
  - Specifies how much bandwidth can be used by traffic engineering
- ip rsvp resource-provider none
  - To enable or in this case disable any resource-provider, in other words a quality of service setting, for aggregate flow
  - Aggregate flow refers to the traffic and its corresponding QoS requirements

What Do The Commands Do

- mpls ldp autoconfig area 0
  - This command is to ease the configuration of LDP for the routing protocol
  - Without it all of the interfaces would have to be setup one by one for LDP
  - LDP is the Label Distribution Protocol
- mpls traffic-eng router-id Loopback0
  - This tells us the router identifier for the node is the IP address of that interface

What Do The Commands Do

- mpls traffic-eng area 0
  - When OSPF is the routing protocol this configures the router to flood traffic engineering for the specified OSPF area

What Do The Commands Do

- ip explicit-path name BOTTOM enable
  - Specifies an explicit path name or number
  - Enables that path
  - The commands that follow detail the path or paths
  - Such as
    - next-address 172.16.1.2
    - next-address 172.16.3.2
  - Bottom or top forces traffic though a specific path

MPLS with Traffic Engineering

- As we can see when compared to the basic MPLS configuration this one is much more complex
- But MPLS with traffic engineering is the main point to MPLS, therefore a configuration along these lines is called for