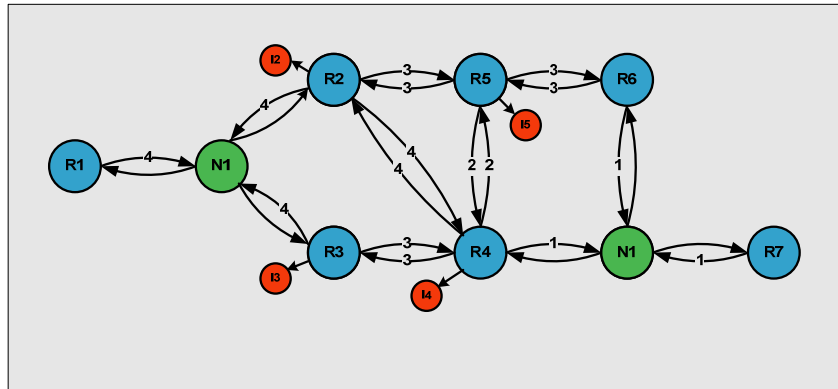


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Using a Router Simulator “DYNAMIPS” for the DOiT Workbook



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Using a Router Simulator “DYNAMIPS” for the DOiT Workbook

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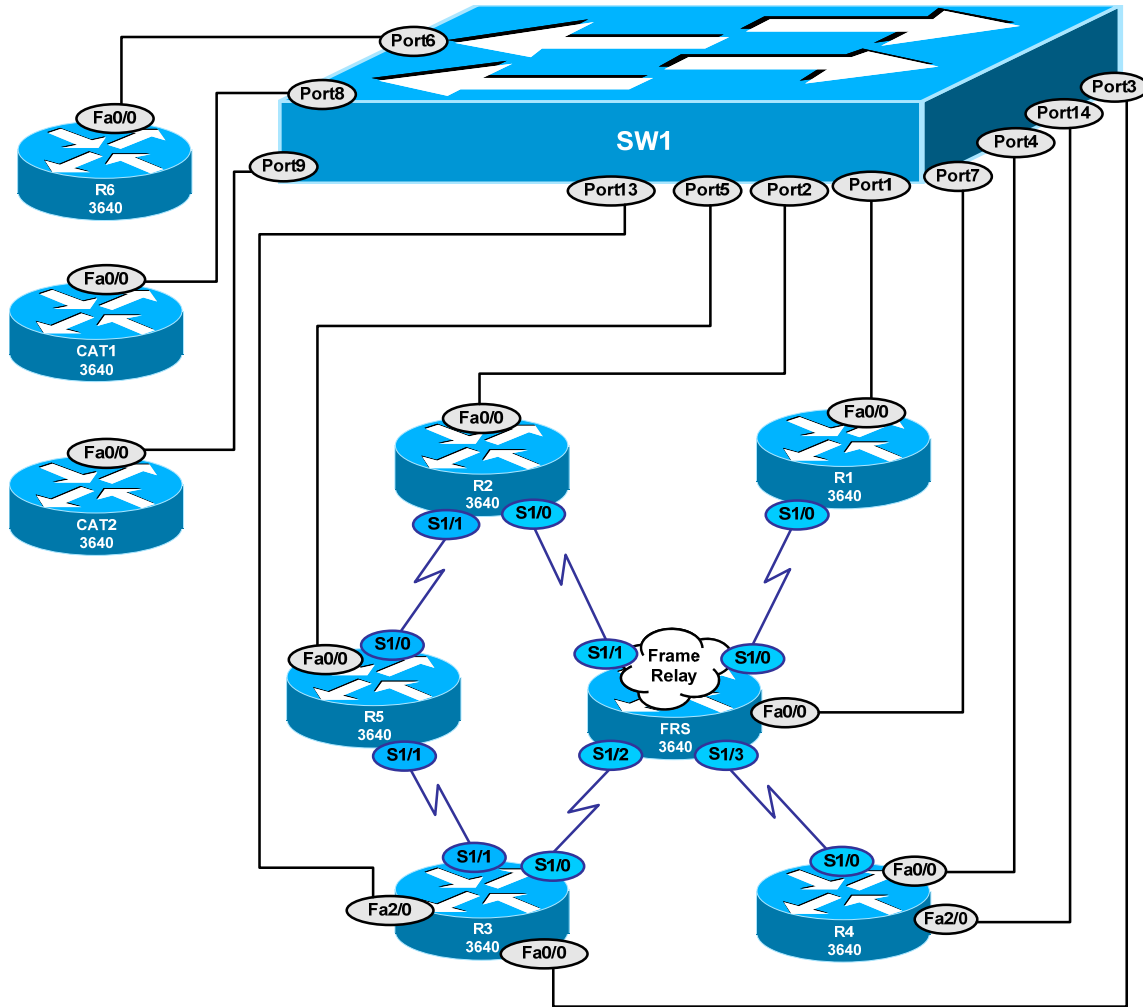
1.1 Dynamips/Dynagen Topology for DOiT Workbook

First of all, many thanks to Christophe Fillot and Greg Anuzelli for this software! It definitely opens up many new possibilities in the study process.

Please visit <http://www.ipflowl.utc.fr/dynamips> and <http://dyna-gen.sourceforge.net> for the installation instructions and documentation.

Since the router simulator does not simulate Catalyst switches, the catalyst sections of the DOiT workbook will not be a part of the scenarios. You will have to provide a work around. We will show how to use the dynamips simulator for the DOiT scenarios using examples of the setup and configuration of DOiT sample lab. The following diagram illustrates the cabling topology:

Netmasterclass 200v6 POD Layout



Note: The devices CAT1 and CAT2 are just the routes in the simulated topology.

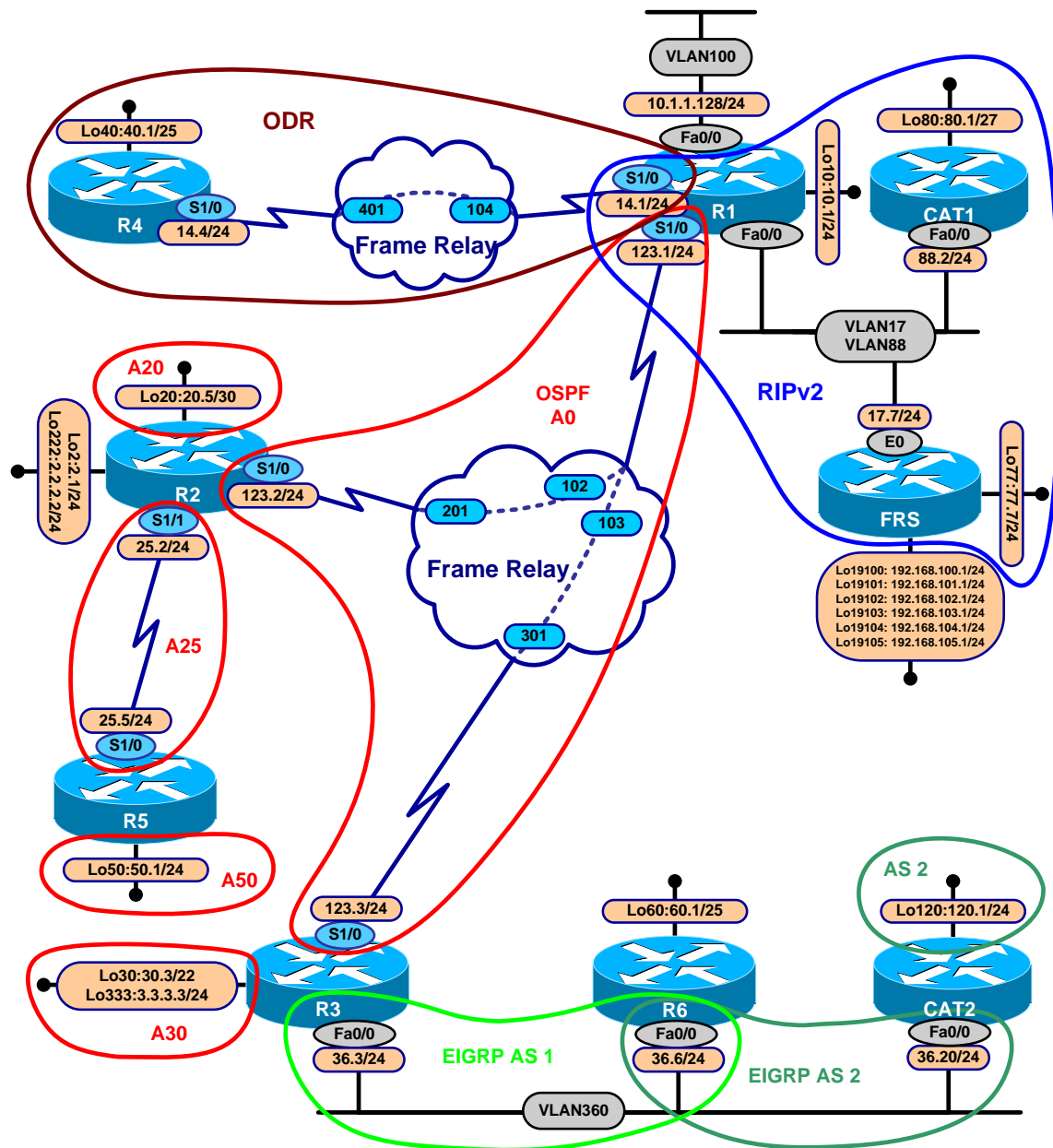
Suggested approach with the DOiT labs under the simulated environment:

1. Look at the DOiT scenario diagrams and VLAN tables.
 - Make a list of all data links involved in the scenario.
 - Draw the new diagrams and modify the interface numbering (serial interfaces and fast Ethernet interfaces).

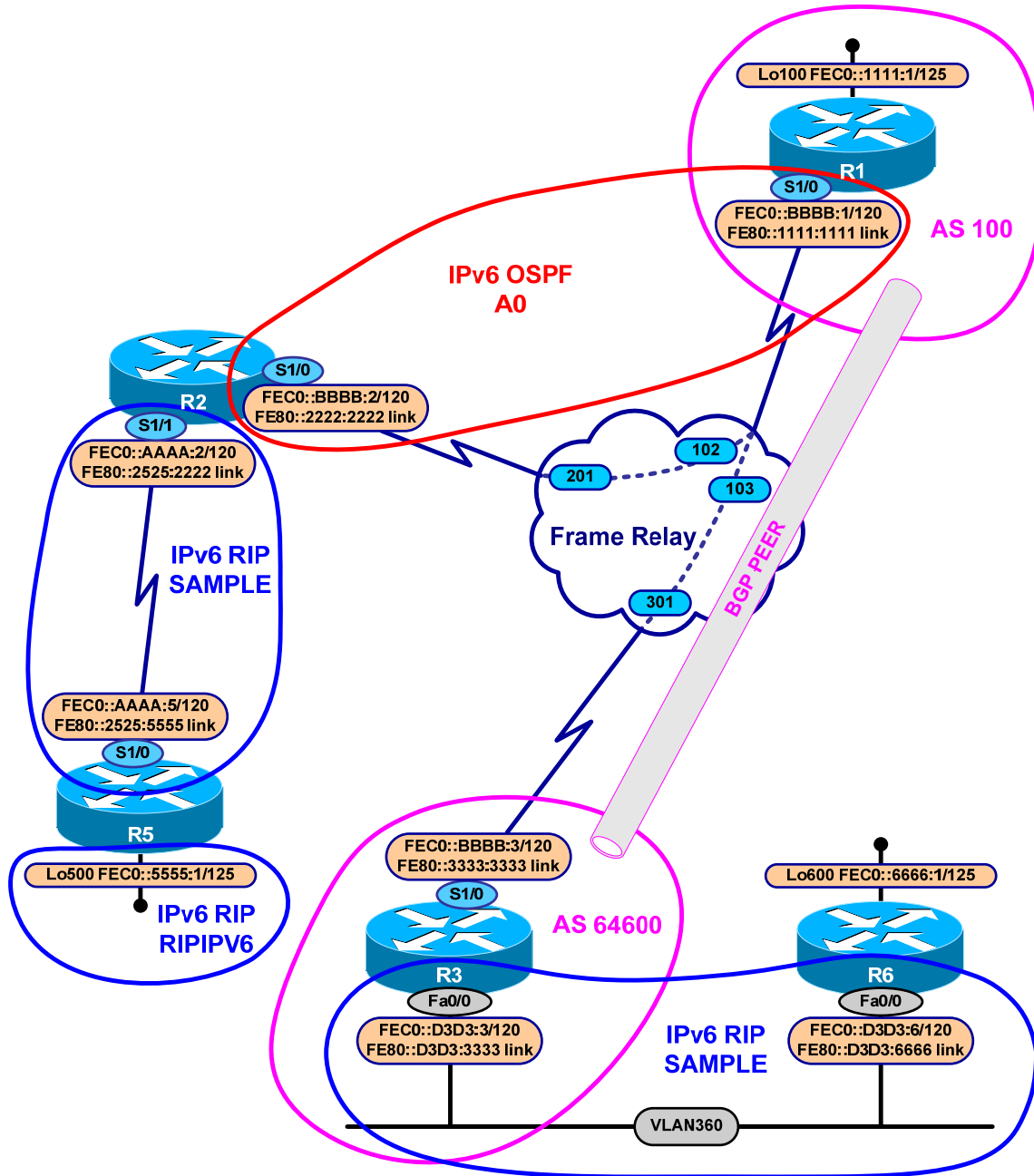
- Create a network file for the scenario with the list of routers and Ethernet virtual switch. Configure access or trunk ports on the dynamips virtual Ethernet switch.
 - Replace ISL configuration with DOT1Q
 - Network files will be similar to the DOiT Sample scenario explained later in this document, as well as DOiT Scenario 1 network file attached in appendix B.
2. Modify the initial configuration scripts to reflect the changed interface numbers
 3. Perform required configuration of the scenario on your routers.
 4. Perform routing (IGP and BGP) configuration on the CAT1 and CAT2, as well as IOS features common to a cisco router and a cisco 3550 switch.
 5. Compare results with the SHOWiT engine
 6. Troubleshoot and verify with the TCL procedures supplied with the scenarios in your portal.

The next two diagrams display modified IPv4 and IPv6 diagrams for the DOiT Sample Scenario (carefully look at the interfaces):

Netmasterclass DOiT-200v6 SAMPLE Scenario IPv4 IGP diagram



Netmasterclass DOiT-200v6 SAMPLE Scenario IPv6 IGP diagram



1.2 Configuring Dynamips/Dynagen Topology for DOiT Workbook

Step 1. Download and install dynamips and dynagen packages from their respective sites. You need a computer with a lot of memory (2 Gig). Choose your favorite operating system to host the simulator. We use Read Hat 9.0 linux in this example. Make sure you upgrade your Python to the latest version.

Step 2. Configure the network file. We suggest to uncompress IOS image. The following is an example of cabling setup for the DOiT Sample scenario nmc-sample.net:

```
[localhost]
workingdir = /home/study/
autostart = true

[[3640]]
idlepc = 0x606100e8
image = /home/study/c3640-jk9o3s-mz.124-5-uncompressed.bin
ram = 128

[[ROUTER FRS]]
console = 2007
model = 3640
s1/0 = R1 s1/0
s1/1 = R2 s1/0
s1/2 = R3 s1/0
s1/3 = R4 s1/0
F0/0 = SW1 7
[[ROUTER R1]]
console = 2001
model = 3640
F0/0 = SW1 1
#
[[ROUTER R2]]
console = 2002
model = 3640
s1/1 = R5 s1/0
#
[[ROUTER R3]]
console = 2003
model = 3640
F0/0 = SW1 3
#
[[ROUTER R4]]
console = 2004
model = 3640
#
[[ROUTER R5]]
```

```
console = 2005
model = 3640
#
[[ROUTER R6]]
console = 2006
model = 3640
F0/0 = SW1 6
#
[localhost:7201]
udp = 11000
#
[[3640]]
idlepc = 0x606100e8
image = /home/study/c3640-jk9o3s-mz.124-5-uncompressed.bin
ram = 128
#
[[ROUTER CAT1]]
console = 2008
model = 3640
ram = 128
F0/0 = SW1 8
#
[[ROUTER CAT2]]
console = 2009
model = 3640
ram = 128
F0/0 = SW1 9
#
[[ETHSW SW1]]
1 = dot1q 1
3 = access 360
6 = access 360
7 = access 17
8 = access 88
9 = access 360
```

1.3 Running Dynamips/Dynagen and accessing routers

Step 3. Run two dynamips processes:

```
nice dynamips -H 7200 &
nice dynamips -H 7201 &
```

Step 4. Start router instances and configure network topology used for the DOiT sample scenario:

```
./dynagen ../nmc-sample.net
```

Reading configuration file...

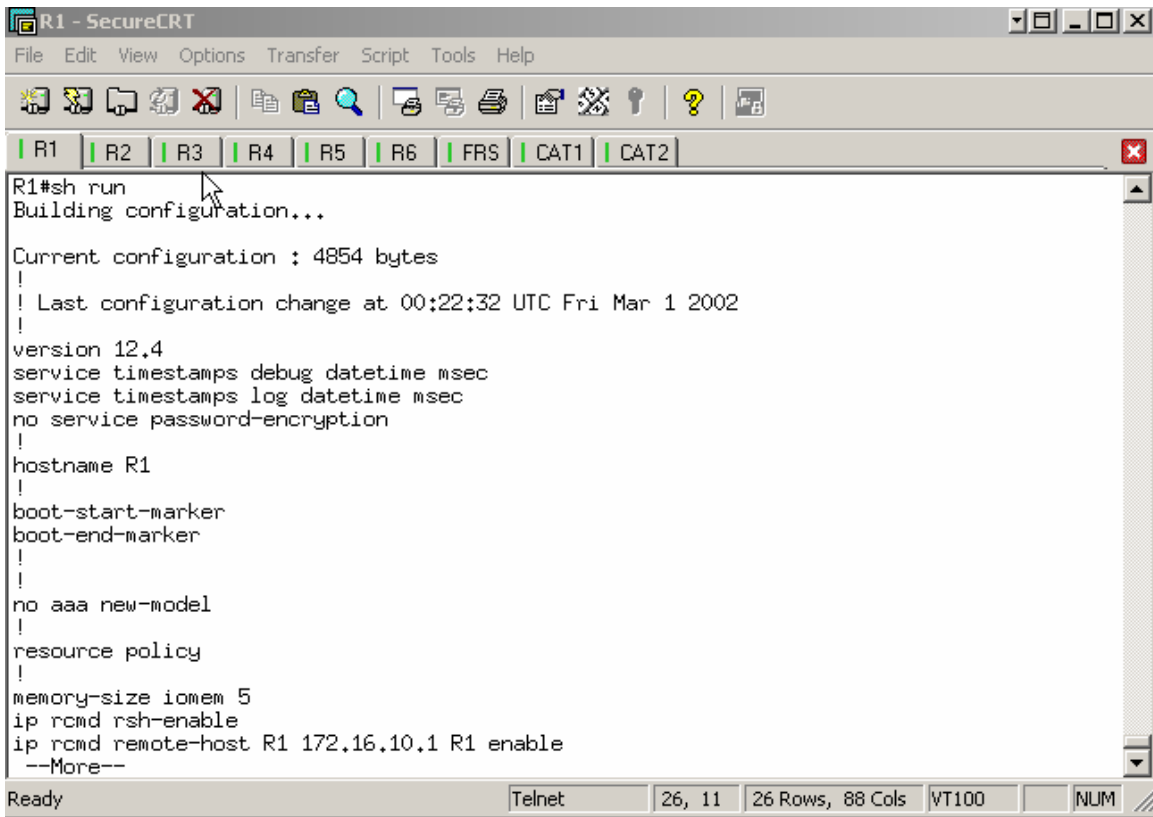
....

....

Your list of devices should look similar to a following:

```
=> list
Name      Type      State      Server      Console
R1        3640      running    localhost:7200  2001
R2        3640      running    localhost:7200  2002
R3        3640      running    localhost:7200  2003
R4        3640      running    localhost:7200  2004
R5        3640      running    localhost:7200  2005
R6        3640      running    localhost:7200  2006
FRS       3640      running    localhost:7200  2007
CAT1      3640      running    localhost:7201  2008
CAT2      3640      running    localhost:7201  2009
SW1       ETHSW     n/a        localhost:7201  n/a
=>
```

Step 5. Open multiple telnet sessions to your unix machine using ports 2001 through 2009:



```

R1 - SecureCRT
File Edit View Options Transfer Script Tools Help
R1 | R2 | R3 | R4 | R5 | R6 | FRS | CAT1 | CAT2
R1#sh run
Building configuration...

Current configuration : 4854 bytes
!
! Last configuration change at 00:22:32 UTC Fri Mar 1 2002
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
resource policy
!
memory-size iomem 5
ip rcmd rsh-enable
ip rcmd remote-host R1 172.16.10.1 R1 enable
--More--
Ready Telnet 26, 11 26 Rows, 88 Cols VT100 NUM

```

Configure your routers.
Router configuration scripts are attached in appendix A:

Step4. Verify connectivity:

```

R1#tclsh
R1(tcl)#tclsh

R1(tcl)#
R1(tcl)#
R1(tcl)#foreach address {
+>(tcl)#172.16.10.1
+>(tcl)#172.16.17.1
+>(tcl)#172.16.88.1
+>(tcl)#172.16.123.1
+>(tcl)#172.16.14.1
+>(tcl)#10.1.1.128
+>(tcl)#FEC0::BBBB:1
+>(tcl)#FEC0::1111:1
+>(tcl)#172.16.20.5

```

```
+>(tcl)#172.16.123.2
+>(tcl)#172.16.2.1
+>(tcl)#172.16.25.2
+>(tcl)#2.2.2.2
+>(tcl)#FEC0::BBBB:2
+>(tcl)#FEC0::AAAA:2
+>(tcl)#172.16.123.3
+>(tcl)#172.16.36.3
+>(tcl)#172.16.30.3
+>(tcl)#3.3.3.3
+>(tcl)#FEC0::BBBB:3
+>(tcl)#FEC0::D3D3:3
+>(tcl)#172.16.14.4
+>(tcl)#172.16.40.1
+>(tcl)#172.16.25.5
+>(tcl)#172.16.50.1
+>(tcl)#FEC0::AAAA:5
+>(tcl)#FEC0::5555:1
+>(tcl)#172.16.60.1
+>(tcl)#172.16.36.6
+>(tcl)#FEC0::6666:1
+>(tcl)#FEC0::D3D3:6
+>(tcl)#172.16.17.7
+>(tcl)#172.16.77.7
+>(tcl)#192.168.100.1
+>(tcl)#192.168.101.1
+>(tcl)#192.168.102.1
+>(tcl)#192.168.103.1
+>(tcl)#192.168.104.1
+>(tcl)#192.168.105.1
+>(tcl)#172.16.80.1
+>(tcl)#172.16.88.2
+>(tcl)#172.16.36.20
+>(tcl)#172.16.120.1
+>(tcl)#} {
+>(tcl)#ping $address
+>(tcl)#}
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/8 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.16.17.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/8 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.16.88.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 172.16.123.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 224/248/312 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.14.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 164/298/408 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.128, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::BBBB:1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/4/8 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::1111:1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/3/4 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.5, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/128/208 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.123.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 112/141/176 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.2.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 76/113/148 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.25.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/113/148 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 96/136/236 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::BBBB:2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/141/176 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::AAAA:2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 76/105/136 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.123.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 96/141/216 ms
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.36.3, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/121/156 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.30.3, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 116/152/188 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/124/176 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::BBBB:3, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 80/130/164 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::D3D3:3, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 48/148/224 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.14.4, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 112/117/128 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.40.1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 76/119/196 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.25.5, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 124/217/276 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 172/210/320 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::AAAA:5, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 176/204/228 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::5555:1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 176/196/232 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.60.1, timeout is 2 seconds:
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 164/191/236 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.36.6, timeout is 2 seconds:
!!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 140/183/236 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::6666:1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 164/233/268 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FEC0::D3D3:6, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 104/196/240 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.17.7, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/61/88 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.77.7, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 48/84/132 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.100.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/81/104 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.101.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/65/100 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.102.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/49/76 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.103.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/75/116 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.104.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/53/76 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.105.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 48/75/116 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.80.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/78/96 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.88.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/41/92 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.36.20, timeout is 2 seconds:
```

```
!!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 168/204/220 ms  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 172.16.120.1, timeout is 2 seconds:  
!!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 212/307/364 ms  
R1(tcl)#tclquit
```

1.4 DOiT Sample Scenario Routers Configuration. Appendix A.

Appendix A

Router R1:

```
R1#sh run
Building configuration...

Current configuration : 4854 bytes
!
! Last configuration change at 00:22:32 UTC Fri Mar 1 2002
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
resource policy
!
memory-size iomem 5
ip rcmd rsh-enable
ip rcmd remote-host R1 172.16.10.1 R1 enable
ip rcmd source-interface Loopback10
ip tcp synwait-time 5
!
!
ip cef
no ip domain lookup
!
!
ip multicast-routing
!
ipv6 unicast-routing
!
!
!
!
!
```

```
!  
!  
!  
!  
!  
!  
!  
!  
!  
class-map match-all UDP-STREAM  
  match access-group 101  
  match packet length min 1024 max 1024  
!  
!  
policy-map UDP-TRAFFIC  
  class UDP-STREAM  
    police cir 8000 bc 1500 be 1500  
      conform-action transmit  
      exceed-action drop  
!  
!  
!  
!  
!  
interface Loopback10  
  ip address 172.16.10.1 255.255.255.0  
  ip pim dense-mode  
  ip igmp join-group 230.30.30.30  
!  
interface Loopback100  
  no ip address  
  ipv6 address FEC0::1111:1/125  
!  
interface FastEthernet0/0  
  no ip address  
  duplex auto  
  speed auto  
!  
interface FastEthernet0/0.17  
  encapsulation dot1Q 17  
  ip address 172.16.17.1 255.255.255.0  
  no ip redirects  
  no snmp trap link-status  
!  
interface FastEthernet0/0.88  
  encapsulation dot1Q 88  
  ip address 172.16.88.1 255.255.255.0  
  no ip redirects  
  no snmp trap link-status
```

```
!  
interface FastEthernet0/0.100  
  encapsulation dot1Q 100  
  ip address 10.1.1.128 255.255.255.0  
  no ip redirects  
  no snmp trap link-status  
  service-policy input UDP-TRAFFIC  
!  
interface Serial1/0  
  ip address 172.16.14.1 255.255.255.0  
  encapsulation frame-relay  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
  no fair-queue  
  cdp enable  
  frame-relay map ip 172.16.14.1 104  
  frame-relay map ip 172.16.14.4 104 broadcast  
  no frame-relay inverse-arp  
!  
interface Serial1/0.123 multipoint  
  ip address 172.16.123.1 255.255.255.0  
  ip pim dense-mode  
  ip ospf network broadcast  
  ipv6 address FEC0::BBBB:1/120  
  ipv6 address FE80::1111:1111 link-local  
  ipv6 ospf neighbor FE80::2222:2222  
  ipv6 ospf 1 area 0  
  frame-relay map ipv6 FE80::2222:2222 102 broadcast  
  frame-relay map ipv6 FE80::3333:3333 103 broadcast  
  frame-relay map ipv6 FEC0::BBBB:2 102  
  frame-relay map ipv6 FEC0::BBBB:3 103  
  frame-relay map ip 172.16.123.1 102  
  frame-relay map ip 172.16.123.2 102 broadcast  
  frame-relay map ip 172.16.123.3 103 broadcast  
!  
interface Serial1/1  
  no ip address  
  shutdown  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
!  
interface Serial1/2  
  no ip address  
  shutdown  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
!  
interface Serial1/3  
  no ip address  
  shutdown  
  serial restart-delay 0
```

```
no dce-terminal-timing-enable
!
router odr
 network 172.16.0.0
!
router ospf 100
 log-adjacency-changes
 redistribute odr subnets
 redistribute rip metric 20 subnets route-map RIP_TO_OSPF
 network 172.16.123.0 0.0.0.255 area 0
!
router rip
 version 2
 redistribute odr metric 1
 redistribute ospf 100 metric 1
 passive-interface default
 no passive-interface FastEthernet0/0.17
 no passive-interface FastEthernet0/0.88
 network 172.16.0.0
!
router bgp 100
 bgp log-neighbor-changes
 neighbor 172.16.17.7 remote-as 700
 neighbor 172.16.123.2 remote-as 64600
 neighbor FE80::3333:3333 remote-as 64600
 neighbor FE80::3333:3333 ebgp-multihop 255
 neighbor FE80::3333:3333 update-source Serial1/0.123
!
 address-family ipv4
 neighbor 172.16.17.7 activate
 neighbor 172.16.17.7 remove-private-as
 neighbor 172.16.123.2 activate
 neighbor FE80::3333:3333 activate
 no auto-summary
 no synchronization
 aggregate-address 192.168.100.0 255.255.252.0 as-set summary-only
 exit-address-family
!
 address-family ipv6
 neighbor FE80::3333:3333 activate
 neighbor FE80::3333:3333 route-map NH out
 network FEC0::1111:0/125
 redistribute connected
 redistribute ospf 1 match internal external 1 external 2
 no synchronization
 exit-address-family
!
ip http server
no ip http secure-server
!
!
```

```
!  
!  
ip prefix-list RIP_TO_OSPF seq 5 permit 172.16.80.0/27  
ip prefix-list RIP_TO_OSPF seq 10 permit 172.16.77.0/24  
ip prefix-list RIP_TO_OSPF seq 15 permit 172.16.17.0/24  
ip prefix-list RIP_TO_OSPF seq 20 permit 172.16.88.0/24  
ip prefix-list RIP_TO_OSPF seq 25 permit 172.16.10.0/24  
ip prefix-list RIP_TO_OSPF seq 30 permit 172.16.14.0/24  
access-list 101 permit udp host 10.1.1.1 host 10.1.1.128 eq 5128  
ipv6 router ospf 1  
  log-adjacency-changes  
  redistribute connected  
  redistribute bgp 100  
!  
!  
route-map NH permit 10  
  set ipv6 next-hop FEC0::BBBB:1  
!  
route-map RIP_TO_OSPF permit 10  
  match ip address prefix-list RIP_TO_OSPF  
!  
!  
!  
control-plane  
!  
!  
!  
!  
!  
!  
!  
!  
alias exec srb sh run | b  
alias exec sri sh run | i  
alias exec ship sh ip int brief  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
  no login  
!
```

```
ntp master 5
!  
end  
  
R1#
```



```

!
!
!
!
!
interface Tunnel203
 ip unnumbered Serial1/1
 ip pim dense-mode
 tunnel source 172.16.20.5
 tunnel destination 172.16.30.3
!
interface Loopback2
 ip address 172.16.2.1 255.255.255.0
!
interface Loopback20
 ip address 172.16.20.5 255.255.255.252
 ip pim dense-mode
 ip ospf network point-to-point
 ip igmp join-group 230.30.30.30
!
interface Loopback222
 ip address 2.2.2.2 255.255.255.0
!
interface Serial1/0
 ip address 172.16.123.2 255.255.255.0
 ip pim dense-mode
 encapsulation frame-relay
 ip ospf network broadcast
 ip ospf priority 0
 ipv6 address FEC0::BBBB:2/120
 ipv6 address FE80::2222:2222 link-local
 ipv6 ospf priority 0
 ipv6 ospf 1 area 0
 serial restart-delay 0
 no dce-terminal-timing-enable
 no fair-queue
 frame-relay map ipv6 FE80::1111:1111 201 broadcast
 frame-relay map ipv6 FE80::3333:3333 201
 frame-relay map ipv6 FEC0::BBBB:1 201
 frame-relay map ipv6 FEC0::BBBB:3 201
 frame-relay map ip 172.16.123.1 201 broadcast
 frame-relay map ip 172.16.123.2 201
 frame-relay map ip 172.16.123.3 201
 frame-relay interface-dlci 201
 no frame-relay inverse-arp
 frame-relay lmi-type cisco
!
interface Serial1/1
 ip address 172.16.25.2 255.255.255.0
 ip pim dense-mode
 ipv6 address FEC0::AAAA:2/120

```

```
ipv6 address FE80::2525:2222 link-local
ipv6 rip SAMPLE enable
serial restart-delay 0
no dce-terminal-timing-enable
!
interface Serial1/2
no ip address
shutdown
serial restart-delay 0
no dce-terminal-timing-enable
!
interface Serial1/3
no ip address
shutdown
serial restart-delay 0
no dce-terminal-timing-enable
!
router ospf 100
log-adjacency-changes
area 20 range 172.16.20.0 255.255.255.0
area 25 virtual-link 172.16.50.1
redistribute connected subnets route-map C_TO_OSPF
redistribute bgp 64600 subnets
passive-interface Tunnel203
network 172.16.20.4 0.0.0.3 area 20
network 172.16.25.0 0.0.0.255 area 25
network 172.16.123.0 0.0.0.255 area 0
default-information originate always
!
router bgp 64600
synchronization
bgp log-neighbor-changes
neighbor 172.16.123.1 remote-as 100
neighbor 172.16.123.3 remote-as 64600
no auto-summary
!
ip http server
no ip http secure-server
!
!
!
access-list 10 permit 172.16.2.0 0.0.0.255
ipv6 router ospf 1
log-adjacency-changes
redistribute connected
redistribute rip SAMPLE
!
ipv6 router rip SAMPLE
redistribute connected metric 1
redistribute ospf 1 metric 1
!
```

```
!  
route-map C_TO_OSPF permit 10  
  match ip address 10  
!  
!  
!  
control-plane  
!  
!  
!  
!  
!  
!  
!  
!  
alias exec srb sh run | b  
alias exec sri sh run | i  
alias exec ship sh ip int brief  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
  no login  
!  
!  
end  
  
R2#
```

Router R3:

```
R3#show run
Building configuration...

Current configuration : 4043 bytes
!
! No configuration change since last restart
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
resource policy
!
memory-size iomem 5
ip rcmd rsh-enable
ip rcmd remote-host R1 172.16.10.1 R1 enable
ip tcp synwait-time 5
!
!
ip cef
no ip domain lookup
!
!
ip multicast-routing
!
ipv6 unicast-routing
!
!
!
!
!
!
!
!
!
!
```

```
!  
!  
!  
!  
!  
!  
!  
!  
interface Tunnel302  
  ip unnumbered Serial11/0  
  ip pim dense-mode  
  tunnel source 172.16.30.3  
  tunnel destination 172.16.20.5  
!  
interface Loopback30  
  ip address 172.16.30.3 255.255.252.0  
  ip pim dense-mode  
  ip ospf network point-to-point  
  ip igmp join-group 230.30.30.30  
!  
interface Loopback333  
  ip address 3.3.3.3 255.255.255.0  
  ip ospf network point-to-point  
!  
interface FastEthernet0/0  
  ip address 172.16.36.3 255.255.255.0  
  no ip route-cache cef  
  no ip route-cache  
  duplex auto  
  speed auto  
  ipv6 address FEC0::D3D3:3/120  
  ipv6 address FE80::D3D3:3333 link-local  
  ipv6 rip SAMPLE enable  
  standby 1 ip 172.16.36.1  
  standby 1 priority 110  
  standby 1 preempt  
!  
interface Serial11/0  
  ip address 172.16.123.3 255.255.255.0  
  ip pim dense-mode  
  encapsulation frame-relay  
  ip ospf network broadcast  
  ip ospf priority 0  
  ipv6 address FEC0::BBBB:3/120  
  ipv6 address FE80::3333:3333 link-local  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
  no fair-queue  
  frame-relay map ipv6 FE80::1111:1111 301 broadcast  
  frame-relay map ipv6 FE80::2222:2222 301  
  frame-relay map ipv6 FEC0::BBBB:1 301
```

```
frame-relay map ipv6 FEC0::BBBB:2 301
frame-relay map ip 172.16.123.1 301 broadcast
frame-relay map ip 172.16.123.2 301
frame-relay map ip 172.16.123.3 301
no frame-relay inverse-arp
frame-relay lmi-type cisco
!
interface Serial1/1
no ip address
shutdown
serial restart-delay 0
no dce-terminal-timing-enable
!
interface Serial1/2
no ip address
shutdown
serial restart-delay 0
no dce-terminal-timing-enable
!
interface Serial1/3
no ip address
shutdown
serial restart-delay 0
no dce-terminal-timing-enable
!
router eigrp 1
redistribute ospf 100 metric 1500 100 255 1 1500
passive-interface default
no passive-interface FastEthernet0/0
network 172.16.36.0 0.0.0.255
distribute-list 10 out FastEthernet0/0
no auto-summary
no eigrp log-neighbor-changes
!
router ospf 100
log-adjacency-changes
area 30 range 3.0.0.0 255.0.0.0
redistribute eigrp 1 metric 20 subnets
passive-interface Tunnel302
network 3.3.3.0 0.0.0.255 area 30
network 172.16.28.0 0.0.3.255 area 30
network 172.16.123.0 0.0.0.255 area 0
!
router bgp 64600
bgp log-neighbor-changes
neighbor 172.16.36.6 remote-as 64600
neighbor 172.16.123.2 remote-as 64600
neighbor FE80::1111:1111 remote-as 100
neighbor FE80::1111:1111 ebgp-multihop 255
neighbor FE80::1111:1111 update-source Serial1/0
!
```

```
address-family ipv4
neighbor 172.16.36.6 activate
neighbor 172.16.36.6 route-reflector-client
neighbor 172.16.123.2 activate
neighbor 172.16.123.2 route-reflector-client
no neighbor FE80::1111:1111 activate
no auto-summary
synchronization
network 3.0.0.0
exit-address-family
!
address-family ipv6
neighbor FE80::1111:1111 activate
neighbor FE80::1111:1111 route-map NH out
redistribute connected
redistribute rip SAMPLE
no synchronization
exit-address-family
!
ip http server
no ip http secure-server
!
!
ip mroute 172.16.25.5 255.255.255.255 Tunnel302
!
access-list 10 permit 0.0.0.0
access-list 10 deny any
ipv6 router rip SAMPLE
redistribute connected metric 1
redistribute bgp 64600 metric 1
!
!
route-map NH permit 10
set ipv6 next-hop FEC0::BBBB:3
!
!
!
control-plane
!
!
!
!
!
!
!
!
!
alias exec srb sh run | b
alias exec sri sh run | i
alias exec ship sh ip int brief
!
```

```
line con 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
line aux 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
line vty 0 4
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  no login
!
ntp clock-period 17180061
ntp server 172.16.123.1
!
end

R3#
```



```
!  
!  
!  
!  
interface Loopback40  
  ip address 172.16.40.1 255.255.255.128  
!  
interface Serial1/0  
  ip address 172.16.14.4 255.255.255.0  
  encapsulation frame-relay  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
  cdp enable  
  frame-relay map ip 172.16.14.1 401 broadcast  
  frame-relay map ip 172.16.14.4 401  
  no frame-relay inverse-arp  
  frame-relay lmi-type cisco  
!  
interface Serial1/1  
  no ip address  
  shutdown  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
!  
interface Serial1/2  
  no ip address  
  shutdown  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
!  
interface Serial1/3  
  no ip address  
  shutdown  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
!  
ip http server  
ip http port 8090  
ip http access-class 36  
ip http authentication local  
no ip http secure-server  
ip http max-connections 2  
!  
!  
!  
access-list 36 permit 172.16.36.0 0.0.0.255  
!  
!  
!  
control-plane  
!
```

```
!  
!  
!  
!  
!  
!  
!  
!  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
  no login  
!  
!  
end  
  
R4#
```



```
log config
 logging enable
 logging size 300
 hidekeys
!
!
!
!
!
!
interface Loopback50
 ip address 172.16.50.1 255.255.255.0
 ip ospf network point-to-point
!
interface Loopback500
 no ip address
 ipv6 address FEC0::5555:1/125
 ipv6 rip RIIIPV6 enable
!
interface Serial1/0
 ip address 172.16.25.5 255.255.255.0
 ipv6 address FEC0::AAAA:5/120
 ipv6 address FE80::2525:5555 link-local
 ipv6 rip SAMPLE enable
 serial restart-delay 0
 clock rate 64000
 no dce-terminal-timing-enable
 no fair-queue
!
interface Serial1/1
 no ip address
 shutdown
 serial restart-delay 0
 no dce-terminal-timing-enable
!
interface Serial1/2
 no ip address
 shutdown
 serial restart-delay 0
 no dce-terminal-timing-enable
!
interface Serial1/3
 no ip address
 shutdown
 serial restart-delay 0
 no dce-terminal-timing-enable
!
router ospf 100
 log-adjacency-changes
 area 25 virtual-link 172.16.20.5
 network 172.16.25.0 0.0.0.255 area 25
```


Router R6:

```
R6#sh run
Building configuration...

Current configuration : 2319 bytes
!
! NVRAM config last updated at 00:05:31 UTC Fri Mar 1 2002
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
resource policy
!
memory-size iomem 5
ip rcmd rsh-enable
ip rcmd remote-host R1 172.16.10.1 R1 enable
ip tcp synwait-time 5
!
!
ip cef
no ip domain lookup
no ip dhcp use vrf connected
ip dhcp excluded-address 172.16.36.1 172.16.36.10
!
ip dhcp pool nmc
    network 172.16.36.0 255.255.255.0
    default-router 172.16.36.1
    dns-server 10.10.10.10
    domain-name nmc.net
!
ip dhcp pool 1
    host 172.16.36.61 255.255.255.0
    hardware-address 0050.04df.5f61
    default-router 172.16.36.1
    dns-server 10.10.10.10
    domain-name nmc.net
!
ip dhcp pool 2
    host 172.16.36.60 255.255.255.0
```



```
!  
router eigrp 2  
  redistribute eigrp 1  
  network 172.16.36.0 0.0.0.255  
  default-metric 1000 100 255 3 1500  
  auto-summary  
!  
router bgp 64600  
  no synchronization  
  bgp log-neighbor-changes  
  neighbor 172.16.36.3 remote-as 64600  
  no auto-summary  
!  
ip http server  
no ip http secure-server  
!  
!  
!  
access-list 10 permit 172.16.60.0 0.0.0.255  
ipv6 router rip SAMPLE  
  redistribute connected metric 1  
!  
!  
route-map C_TO_EIGRP permit 10  
  match ip address 10  
!  
!  
!  
control-plane  
!  
!  
!  
!  
!  
!  
!  
!  
!  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous
```

```
no login
!  
ntp clock-period 17179774  
ntp peer 172.16.36.3  
!  
end  
  
R6#
```



```
!  
!  
!  
!  
interface Loopback71  
  ip address 172.16.77.7 255.255.255.0  
!  
interface Loopback19100  
  ip address 192.168.100.1 255.255.255.0  
!  
interface Loopback19101  
  ip address 192.168.101.1 255.255.255.0  
!  
interface Loopback19102  
  ip address 192.168.102.1 255.255.255.0  
!  
interface Loopback19103  
  ip address 192.168.103.1 255.255.255.0  
!  
interface Loopback19104  
  ip address 192.168.104.1 255.255.255.0  
!  
interface Loopback19105  
  ip address 192.168.105.1 255.255.255.0  
!  
interface FastEthernet0/0  
  ip address 172.16.17.7 255.255.255.0  
  duplex auto  
  speed auto  
!  
interface Serial1/0  
  no ip address  
  encapsulation frame-relay  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
  no fair-queue  
  frame-relay intf-type dce  
  frame-relay route 102 interface Serial1/1 201  
  frame-relay route 103 interface Serial1/2 301  
  frame-relay route 104 interface Serial1/3 401  
!  
interface Serial1/1  
  no ip address  
  encapsulation frame-relay  
  serial restart-delay 0  
  no dce-terminal-timing-enable  
  frame-relay intf-type dce  
  frame-relay route 201 interface Serial1/0 102  
  frame-relay route 203 interface Serial1/2 302  
  frame-relay route 204 interface Serial1/3 402  
!
```

```

interface Serial1/2
  no ip address
  encapsulation frame-relay
  serial restart-delay 0
  no dce-terminal-timing-enable
  frame-relay intf-type dce
  frame-relay route 301 interface Serial1/0 103
  frame-relay route 302 interface Serial1/1 203
  frame-relay route 304 interface Serial1/3 403
!
interface Serial1/3
  no ip address
  encapsulation frame-relay
  serial restart-delay 0
  no dce-terminal-timing-enable
  frame-relay intf-type dce
  frame-relay route 401 interface Serial1/0 104
  frame-relay route 402 interface Serial1/1 204
  frame-relay route 403 interface Serial1/2 304
!
router rip
  version 2
  passive-interface default
  no passive-interface FastEthernet0/0
  network 172.16.0.0
!
router bgp 700
  no synchronization
  bgp log-neighbor-changes
  redistribute connected route-map C_TO_BGP
  neighbor 172.16.17.1 remote-as 100
  no auto-summary
!
no ip http server
no ip http secure-server
!
!
!
access-list 10 permit 192.168.100.0 0.0.3.255
access-list 10 permit 192.168.104.0 0.0.1.255
no cdp run
!
route-map C_TO_BGP permit 10
  match ip address 10
!
!
!
control-plane
!
!
!

```

```
!  
!  
!  
!  
!  
!  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
  no login  
!  
!  
end
```

FRS#


```
!  
interface Loopback80  
 ip address 172.16.80.1 255.255.255.224  
!  
interface FastEthernet0/0  
 ip address 172.16.88.2 255.255.255.0  
 duplex auto  
 speed auto  
!  
router rip  
 version 2  
 passive-interface default  
 no passive-interface FastEthernet0/0  
 network 172.16.0.0  
!  
no ip http server  
no ip http secure-server  
!  
!  
!  
!  
!  
control-plane  
!  
!  
!  
!  
!  
!  
!  
!  
!  
alias exec srb sh run | b  
alias exec sri sh run | i  
alias exec ship sh ip int brief  
!  
line con 0  
 exec-timeout 0 0  
 privilege level 15  
 logging synchronous  
line aux 0  
line vty 0 4  
 exec-timeout 0 0  
 privilege level 15  
 logging synchronous  
 no login  
line vty 5 15  
 login  
!  
!
```

end

CAT1#


```
!  
interface Loopback120  
  ip address 172.16.120.1 255.255.255.0  
!  
interface FastEthernet0/0  
  ip address 172.16.36.20 255.255.255.0  
  ip summary-address eigrp 2 172.16.120.0 255.255.254.0 5  
  duplex auto  
  speed auto  
!  
router eigrp 2  
  passive-interface default  
  no passive-interface FastEthernet0/0  
  network 172.16.36.0 0.0.0.255  
  network 172.16.120.0 0.0.0.255  
  no auto-summary  
  no eigrp log-neighbor-changes  
!  
ip http server  
no ip http secure-server  
!  
!  
!  
!  
!  
!  
control-plane  
!  
!  
!  
!  
!  
!  
!  
!  
alias exec srb sh run | b  
alias exec sri sh run | i  
alias exec ship sh ip int brief  
!  
line con 0  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
line aux 0  
line vty 0 4  
  exec-timeout 0 0  
  privilege level 15  
  logging synchronous  
  no login  
line vty 5 15
```

```
login  
!  
!  
end  
  
CAT2#
```

Appendix B.

Network file for the DOiT Scenario 1.

```
[localhost]
workingdir = /home/study/
autostart = true
```

```
[[3640]]
idlepc = 0x606100e8
image = /home/study/c3640-jk9o3s-mz.124-5-uncompressed.bin
ram = 128
```

```
[[ROUTER FRS]]
console = 2007
model = 3640
s1/0 = R1 s1/0
s1/1 = R2 s1/0
s1/2 = R3 s1/0
s1/3 = R4 s1/0
F0/0 = SW1 7
```

```
[[ROUTER R1]]
console = 2001
model = 3640
F0/0 = SW1 1
```

```
#
[[ROUTER R2]]
console = 2002
model = 3640
F0/0 = SW1 2
```

```
#
[[ROUTER R3]]
console = 2003
model = 3640
F0/0 = SW1 3
F2/0 = SW1 13
```

```
#
[[ROUTER R4]]
console = 2004
model = 3640
F0/0 = SW1 4
```

```
#
[[ROUTER R5]]
console = 2005
model = 3640
F0/0 = SW1 5
```

```
#
[[ROUTER R6]]
console = 2006
model = 3640
```

```
F0/0 = SW1 6
#
[localhost:7201]
udp = 11000
#
[[3640]]
idlepc = 0x606100e8
image = /home/study/c3640-jk9o3s-mz.124-5-uncompressed.bin
ram = 128
#
[[ROUTER CAT1]]
console = 2008
model = 3640
ram = 128
F0/0 = SW1 8
#
[[ROUTER CAT2]]
console = 2009
model = 3640
ram = 128
F0/0 = SW1 9
#
[[ETHSW SW1]]
1 = access 40
2 = access 10
3 = access 20
13 = access 30
4 = access 30
5 = access 20
6 = dot1q
7 = access 3000
8 = access 30
9 = access 10
```