Project Network

Cisco network

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EAL
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Teacher:

Project Network – Cisco Packet Tracer

By
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Scope of project

This is network project that will try cover the element that will be found in bigger and more advanced networks. It will give an overview of system required and how to set the devices up to work to getter. There has been some experimenting some have gone bad but more or less good. The report will start by giving a short overview of the network by a network diagram, of services and protocols used. Then it will get into more details and how services and protocols are working to getter

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Introduction

Package tracer, a Cisco educational tool has been used to make this project. Starts out by explain the the high level design to give a better overview. Because it consist of two site connected together it will be divided up in “Home Office” as a Backbone network and a offsite Office indicated below.

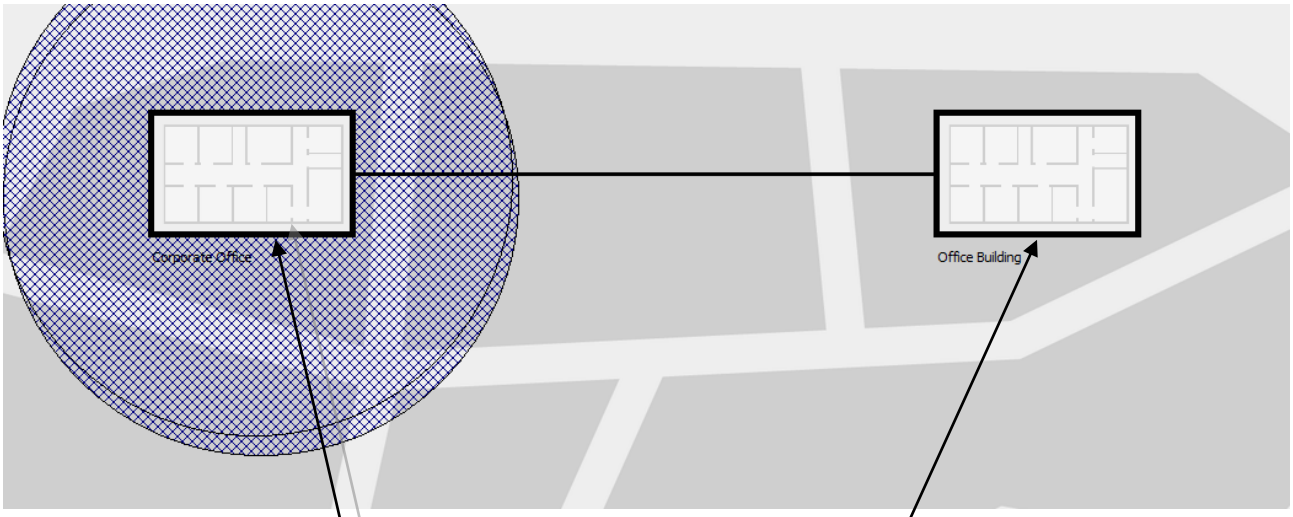


Fig 1 Locations

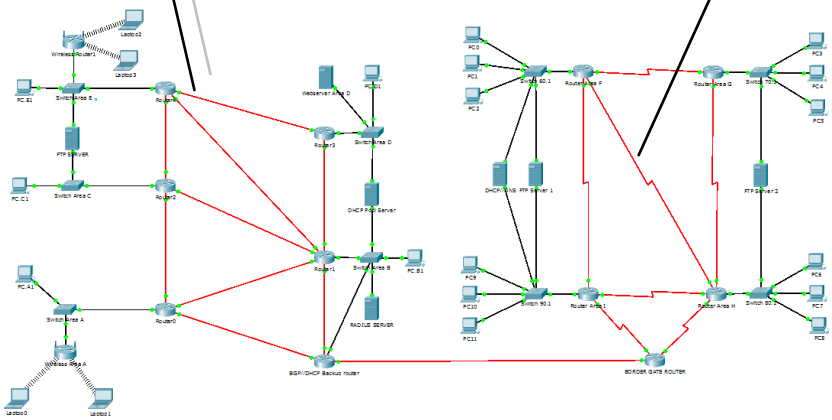


Fig 2 Full network diagram

Ospf with VLANs was to be implemented in the network together with BGP.

- Ospf on Networks
- BGP – between networks

DHCP Pool server for multiple subnets was added early to the project. The idea was to save server on the network supported by the ospf protocol. A high availability was set as demand and a therefore all servers was decided to have dual interfaces.

VLANs are added to spaned the entire Home office network with:

- **VLAN 1 - Management** so a Admin always will have access. This VLAN did not get added to the ospf net. A planning error with subnets and virtual interfaces it got lost and forgotten. As expalind later in the Chapter about ospf a solution is mention.
- **VLAN 100 – Wired desktops**
- **VLAN 200 – Wireless PC**

It was decided only to trunk the VLAN 100 and 200. Because VLAN didn't had a configuration on the routers

```
!
interface GigabitEthernet1/1
 switchport trunk allowed vlan 2-1001
 switchport mode trunk
 duplex full
 speed 1000
!
```

Simple mail system was implemented for internal use only since there are no internet connection yet.

A list specifiring shortly what services and protocols the project will cover

The service required

- OSPF
- BPG
- VLAN

Added services

- MAIL
- HSRP
- RADIUS
- Trunking

High Level Design For Home Office

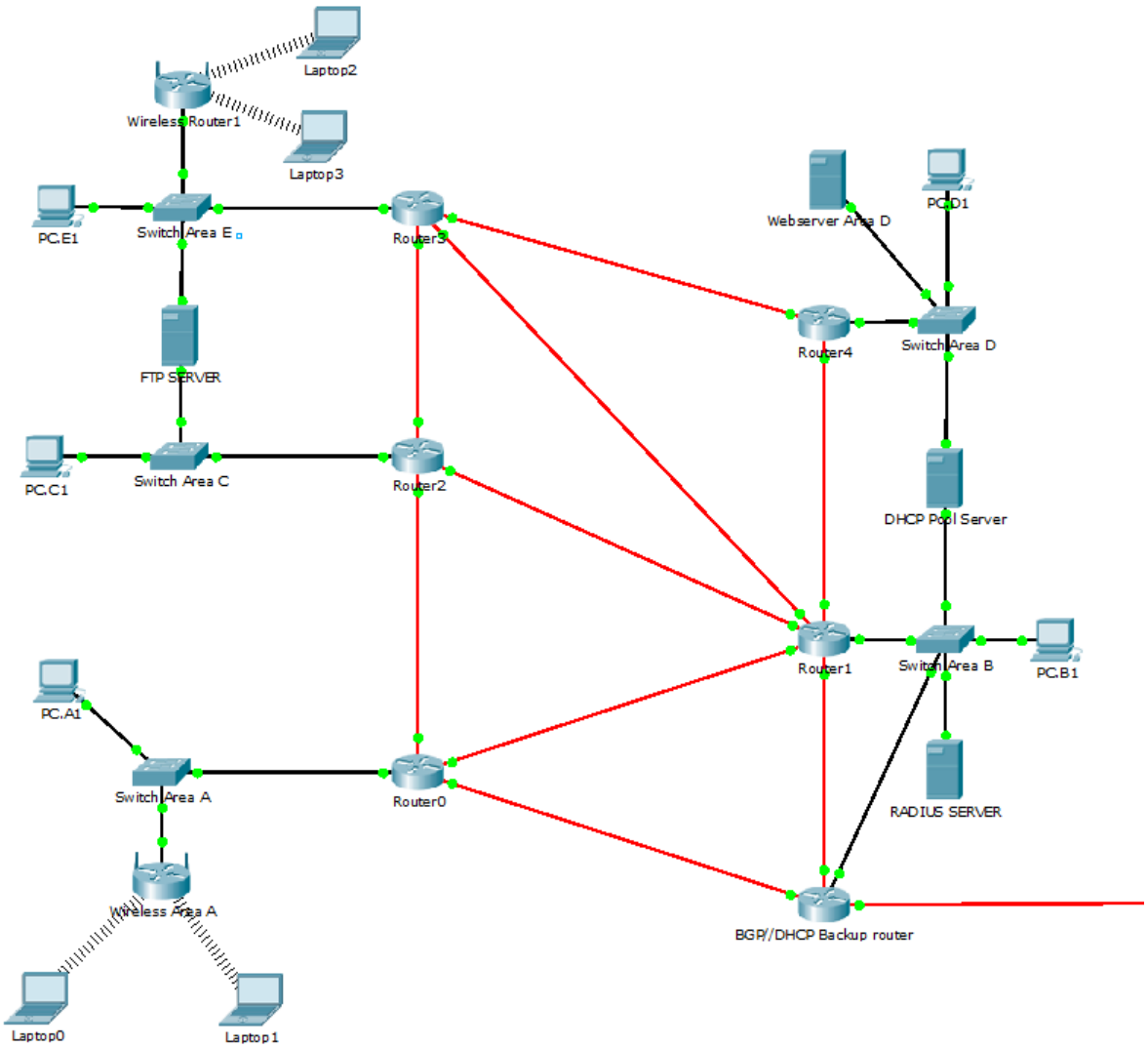


Fig 3 Home Office

- All servers except the Radius server have been fitted with duel interfaces. This is done for redundancy and connectivity. This Apply to both networks
- Routers are the type Generic-Empty, a package tracer router where there are no interfaces present.
- Node networks runs pure Gigabit Ethernet either with Fiber that is the red lines that also runs OSPF/BGP and the Black lines that is RJ-45 connection. The Wireless is running wireless 802.11b/g/n.

- Routers are running VLANs on 2 virtual interfaces distributed with OSPF
- Switches are of the type 2960, see port and ip range in LLD documentation
    - 3 VLANs,
        - VLAN 1 for management
        - VLAN 100 Wired Desktop
        - VLAN 200 Wireless
        - Only VLAN 100 and 200 are getting trunked
- Services.
    - A DHCP Pool server placed in area B. This server services all subnet with a predefined IP address range. This server runs the DNS for “Home Office for the internal web server and ftp server. The server is supplied with dual interface a redundancy purpose.
    - Web server are placed in the Area D hosting “supersite.dk”
    - RADIUS in Area B authenticate and authorize the 2 wireless networks in Area A and Area E
    - Mail server in Area D to service the “home Office with internally mail. This server is placed together with web server area D
    - FPT Server for data storage and backup
    - IP Phones on a separated network
    - Implement HSRP for redundancy to DHCP Server

High Level Design - Offsite Office

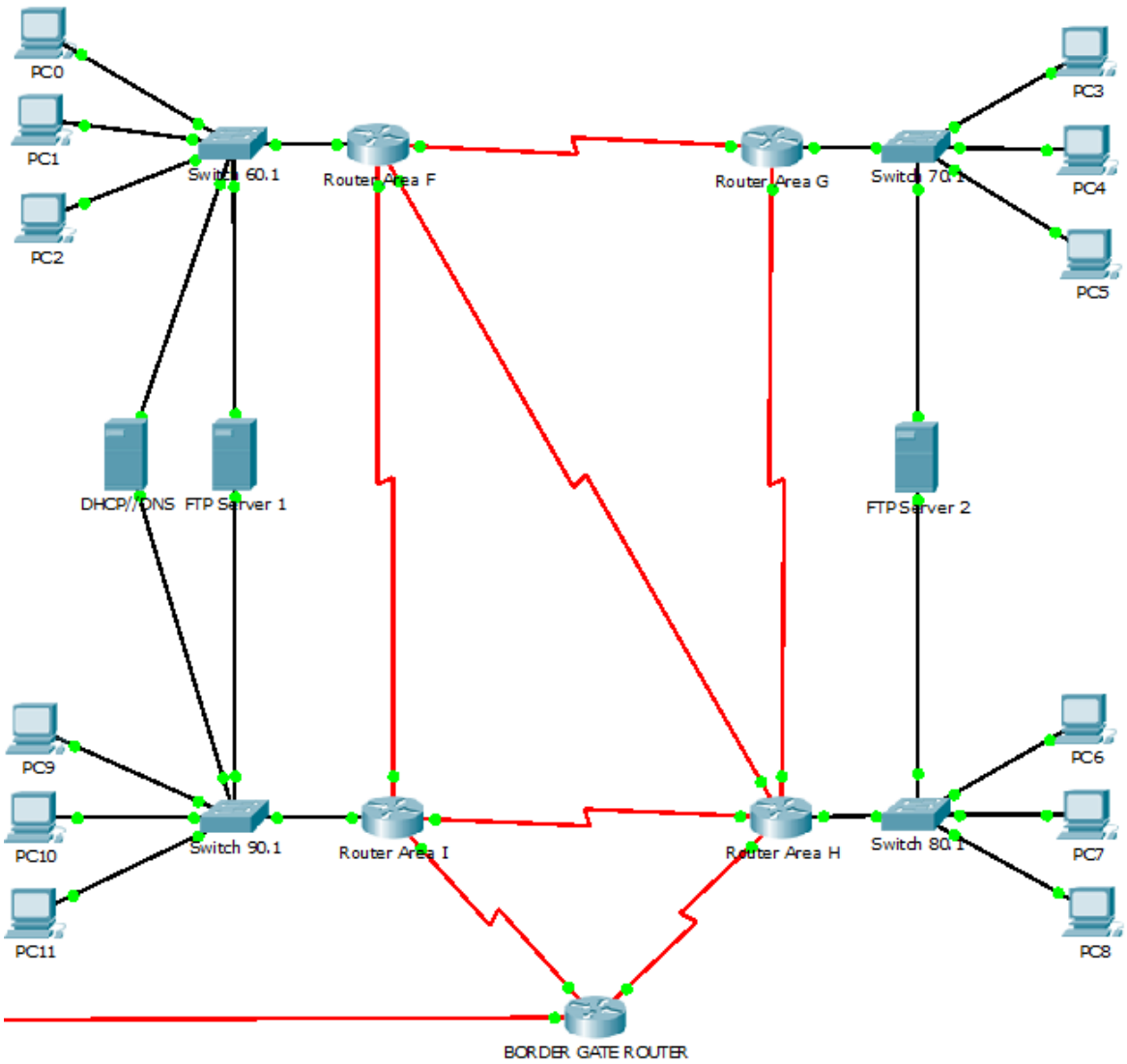


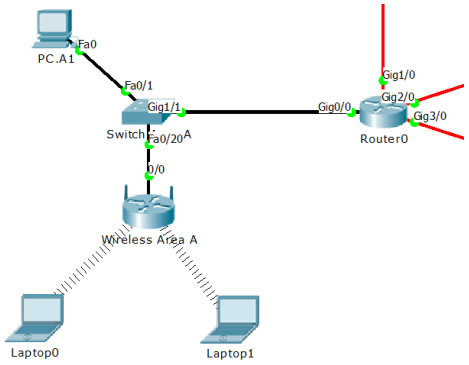
Fig 4 Offsite Office

- Link-types
  - Routers connected by Serial connections with clock rate 200000 for Ospf connectivity.
  - Gigabitethernet connection to switches.
  - Subnets running fastethernet
- Routers
  - Router Area F – Cisco 2911
  - Router Area G – Cisco 2911
  - Router Area H – Cisco 2911
  - Router Area I – Cisco 2911
  - Border Gate Router – Generic empty

- Switches (Name & VLANs)
  - Switch 60.1
  - Switch 70.1
  - Switch 80.1
  - Switch 90.1
  - All running default VLAN 1
- Services (DHCP, DNS, AAA, etc)
  - DHCP Pool server servicing 4 subnets at the Offsite Office
  - DNS server with DHCP Server providing DNS resolve to FTP Servers 1 and 2.
  - FPT Server 1 and FTP Server two are both configured in the DNS so a name resolve is possible

LLD - Home Office from Area A to E

Area A



Routing Table for Wireless Area A

Type	Network	Port	Next Hop IP	Metric
C	10.0.200.0/24	Vlan1	---	0/0
C	192.168.200.0/24	Internet	---	0/0
S	0.0.0.0/0	---	192.168.200.1	1/0
S	192.168.200.1/32	Internet	---	1/0

Fig 5Wireless Area Routing table

Routing table for Router0, See APPENDIX B Router tables

Area A

Name: **Router A**

Gig0/0
Gig0/0.1
Vlan 100
192.168.100.1
Gig0/0.2
Vlan 200
192.168.100.1
Gig1/0
Gig1/0.1
Vlan 100
1
Gig1/0.2
Vlan 200
5
Gig2/0
Gig2/0.1
VLAN100
9
Gig2/0.2
VLAN200
13
Gig3/0
Gig3/0.1
VLAN100
17
Gig3/0.2
VLAN100
21

Interface	Service	IP
fa0/1	Management	
fa0/2	Management	
fa0/3	PC.A1	PC.A1
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	Netgear Wireless	192.168.200.2
fa0/21	N/A	
fa0/22	N/A	
fa0/23	N/A	
fa0/24	N/A	
gi1/1	Link to Router A	
gi1/2	n/a	

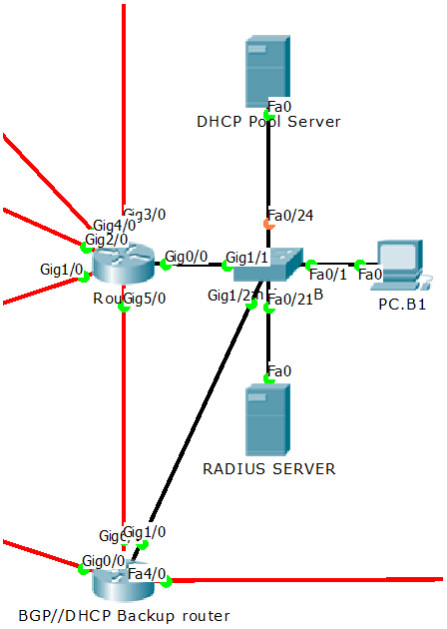
DHCP A Pool A
192.168.100.100
↓
192.168.100.255

VLANS
VLAN 1 Fa0/1-fa0/2 - Management
VLAN 100 Fa0/3-fa0/10 Desktop PC
VLAN 200 Fa0/11-fa0/20 Wireless PC

Wireless	
SSID	Area A
Encrypt	WPA-Enterprise

Area B

For Router1 Routing Tables, See APPENDIX B Router tables



Area B

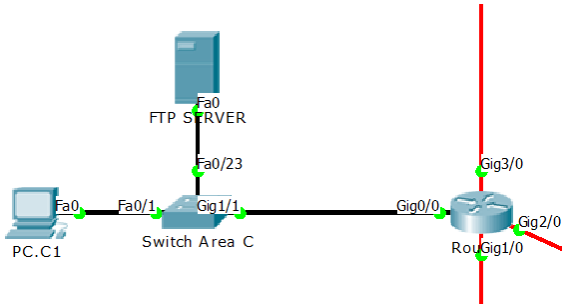
Name: Router B

Gig0/0	**Interface**	**Service**	**IP**
Gig0/0.1	fa0/1	Managment	
Vlan 100	fa0/2	Managment	
192.168.110.2	fa0/3	PcB.1	DHCP A Pool B
Gig0/0.2	fa0/4	N/A	
Vlan 200	fa0/5	N/A	
192.168.110.2	fa0/6	N/A	
Gig1/0	fa0/7	N/A	
Gig1/0.1	fa0/8	N/A	
Vlan 100	fa0/9	N/A	
10	fa0/10	N/A	
Gig1/0.2	fa0/11	N/A	
Vlan 200	fa0/12	N/A	
14	fa0/13	N/A	
Gig2/0	fa0/14	N/A	
Gig2/0.1	fa0/15	N/A	
VLAN100	fa0/16	N/A	
26	fa0/17	N/A	
Gig2/0.2	fa0/18	N/A	
VLAN200	fa0/19	N/A	
30	fa0/20	N/A	
Gig3/0	fa0/21	N/A	
Gig3/0.1	fa0/22	N/A	
VLAN100	fa0/23	N/A	
50	fa0/24	DHCP A Pool B	192.168.110.10
Gig3/0.2	gi1/1	Link to Router B	
VLAN100	gi1/2	n/a	
54			
Gig4/0			
Gig4/0.1			
VLAN100			
58			
Gig4/0.2			
Vlan 200			
62			
Gig5/0			
Gig5/0.1			
Vlan 100			
65			
Gig5/0.2			
Vlan 200			
69			

DHCP A Pool B
192.168.110.100
↓
192.168.110.255

VLANS
VLAN 1 Fa0/1-fa0/2 - Management
VLAN 100 Fa0/3-fa0/10 Desktop PC
VLAN 200 Fa0/11-fa0/20 Wireless PC

Area C



For Router2 Routing Table, See APPENDIX B Router tables

Area C

Name: **Router C**

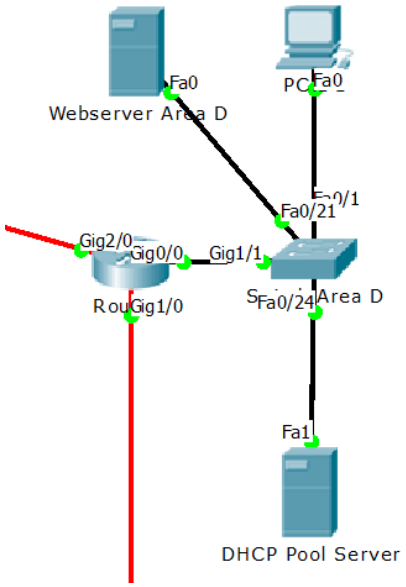
Gig0/0
Gig0/0.1
Vlan 100
192.168.120.1
Gig0/0.2
Vlan 200
192.168.220
Gig1/0
Gig1/0.1
Vlan 100
2
Gig1/0.2
Vlan 200
6
Gig2/0
Gig2/0.1
VLAN100
25
Gig2/0.2
VLAN200
29
Gig3/0
Gig3/0.1
VLAN100
33
Gig3/0.2
VLAN100
37

Interface	Service	IP
fa0/1	Managment	
fa0/2	Managment	
fa0/3	PcC.1	DHCP A Pool C
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	N/A	
fa0/22	N/A	
fa0/23	FTP SERVER	192.168.120.11
fa0/24	N/A	
gi1/1	Link to Router C	
gi1/2	n/a	

DHCP A Pool C
192.168.120.100
↓
192.168.120.255

VLANS
VLAN 1 Fa0/1-fa0/2 - Management
VLAN 100 Fa0/3-fa0/10 Desktop PC
VLAN 200 Fa0/11-fa0/20 Wireless PC

Area D



For Router3´s Routing Table, See APPENDIX B Router tables

Area D

Name: **Router D**

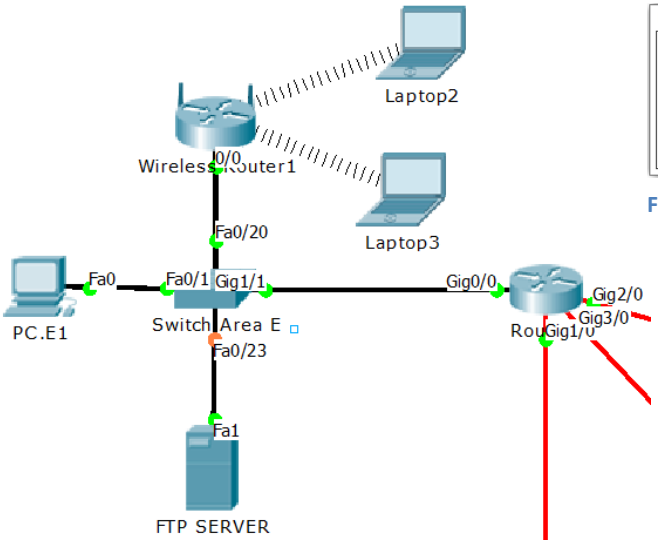
Gig0/0	
Gig0/0.1	
Vlan 100	
192.168.130.1	
Gig0/0.2	
Vlan 200	
192.168.130.1	
Gig1/0	
Gig1/0.1	
Vlan 100	
42	
Gig1/0.2	
Vlan 200	
46	
Gig2/0	
Gig2/0.1	
VLAN100	
57	
Gig2/0.2	
VLAN200	
61	

Interface	Service	IP
fa0/1	Managment	
fa0/2	Managment	
fa0/3	PcD.1	DHCP A Pool C
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	Web Server D	192.168.130.13
fa0/22	N/A	
fa0/23	N/A	
fa0/24	DHCP A Pool D	192.168.130.10
gi1/1	Link to Router B	
gi1/2	n/a	

DHCP A Pool D
192.168.130.100
↓
192.168.130.255

VLANS
VLAN 1 Fa0/1-fa0/2 - Management
VLAN 100 Fa0/3-fa0/10 Desktop PC
VLAN 200 Fa0/11-fa0/20 Wireless PC

Area E



Routing Table for Wireless Router1

Type	Network	Port	Next Hop IP	Metric
C	10.0.240.0/24	Vlan1	---	0/0
C	192.168.240.0/24	Internet	---	0/0
S	0.0.0.0/0	---	192.168.240.1	1/0
S	192.168.240.1/32	Internet	---	1/0

Fig 6 Routing table for wireless router 1

Area E

Name: **Router E**

	Interface	Service	IP
Gig0/0			
Gig0/0.1	fa0/1	Management	
Vlan 100	fa0/2	Management	
192.168.140.1	fa0/3	PC.E1	DHCP A Pool E
Gig0/0.2	fa0/4	N/A	
Vlan 200	fa0/5	N/A	
192.168.140.1	fa0/6	N/A	
Gig1/0	fa0/7	N/A	
Gig1/0.1	fa0/8	N/A	
Vlan 100	fa0/9	N/A	
34	fa0/10	N/A	
Gig1/0.2	fa0/11	N/A	
Vlan 200	fa0/12	N/A	
38	fa0/13	N/A	
Gig2/0	fa0/14	N/A	
Gig2/0.1	fa0/15	N/A	
VLAN100	fa0/16	N/A	
41	fa0/17	N/A	
Gig2/0.2	fa0/18	N/A	
VLAN200	fa0/19	N/A	
45	fa0/20	N/A	
Gig3/0	fa0/21	N/A	
Gig3/0.1	fa0/22	N/A	
VLAN100	fa0/23	FTP Server	192.168.140.11
49	fa0/24	N/A	
Gig3/0.2	gi1/1	Link to Router E	
VLAN100	gi1/2	n/a	
53			

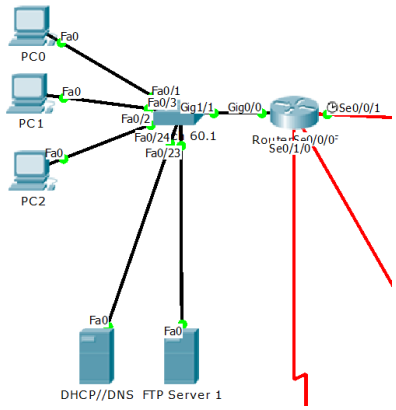
DHCP A Pool E
192.168.140.100
↓
192.168.140.255

VLANS	
VLAN 1 Fa0/1-fa0/2 - Management	
VLAN 100 Fa0/3-fa0/10 Desktop PC	
VLAN 200 Fa0/11-fa0/20 Wireless PC	

Wireless	
SSID	Area A
Encrypt	WPA-Enterprise

Area F

For Router Area F see Router Area F Router Table



Area F

Name: **Router F**

Interface	IP	Link to..
Giga0/0	192.168.60.1/24	Area F
Giga0/1	N/A	N/A
Se0/0/0	192.168.250.6	Router I
Se0/0/1	192.168.250.9/30	Router G
Se0/1/0	192.168.250.26/30	Router H
Se0/1/1	N/A	N/A

DHCP Pool B
192.168.60.100
↓
192.168.60.255

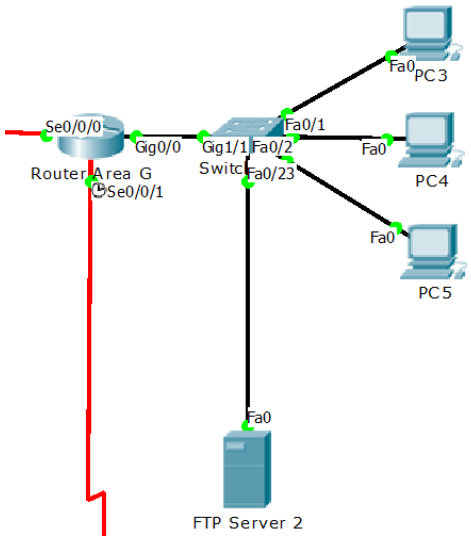
VLAN 1: Fa0/1 - Fa0/24

Loopback 0
172.16.250.1

Interface	Service	IP
fa0/1	PC0	DHCP Pool F
fa0/2	PC1	DHCP Pool F
fa0/3	PC2	DHCP Pool F
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	N/A	
fa0/22	N/A	
fa0/23	FTP Server 1	192.168.60.11
fa0/24	DHCP Pool Server	192.168.60.10
gi1/1	Link to Router F	
gi1/2	n/a	

Area G

For Router Area G Routing table see Router Area G Router Table



Area G

Name: **Router G**

Interface	IP	Link to..
Giga 0/0	192.168.70.1/24	Area G
Giga 0/1	N/A	N/A
Se0/0/0	192.168.250.10/30	Router F
Se0/0/1	192.168.250.13/30	Router H

DHCP Pool G
192.168.70.100
↓
192.168.70.253

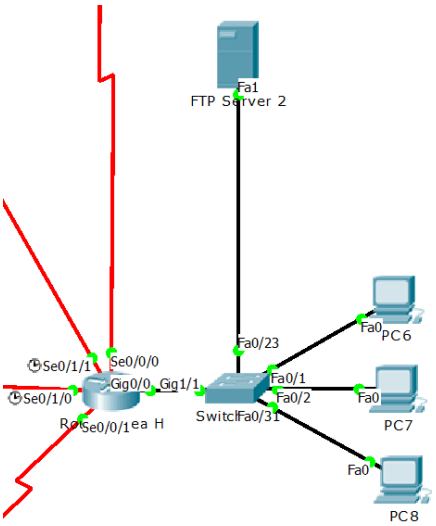
VLAN 1: Fa0/1 - Fa0/24

Loopback 0
172.16.250.2

Interface	Service	IP
fa0/1	PC3	DHCP Pool G
fa0/2	PC4	DHCP Pool G
fa0/3	PC5	DHCP Pool G
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	N/A	
fa0/22	N/A	
fa0/23	FTP Server 2	192.168.70.11
fa0/24	N/A	
gi1/1	Link to Router G	
gi1/2	n/a	

Area H

For Router Area H routing Table See Router Area H Router Table



Area H

Name: **Router H**

Interface	IP	Link to..
Giga0/0	192.168.40.1/24	Area H
Giga0/1	N/A	N/A
Se0/0/0	192.168.250.14/30	Router G
Se0/0/1	192.168.250.17/30	Border Router
Se0/1/0	192.168.250.21/30	Router I
Se0/1/1	192.168.250.25/30	Router F

DHCP Pool B
192.168.80.100
↓
192.168.80.255

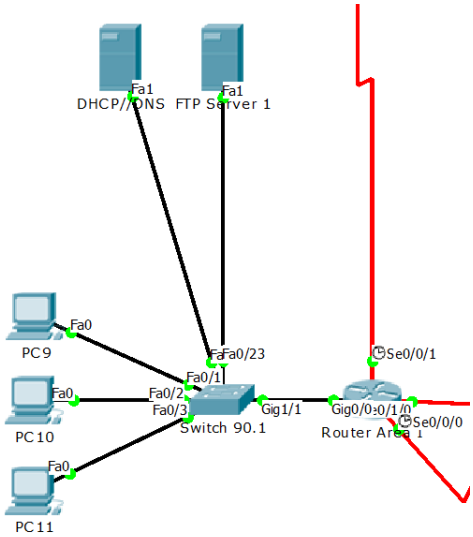
VLAN 1: Fa0/1 - Fa0/24

Loopback 0
172.16.250.3

Interface	Service	IP
fa0/1	PC6	DHCP Pool H
fa0/2	PC7	DHCP Pool H
fa0/3	PC8	DHCP Pool H
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	N/A	
fa0/22	N/A	
fa0/23	FTP Server 2	192.168.80.11
fa0/24	N/A	
gi1/1	Link to Router H	
gi1/2	N/A	

Area I

For Router Area I routing Table See BGP//DHCP Backup Router Router TableAPPENDIX B Router



Area I

Name: **Router I**

Interface	IP	Link to..
Giga0/0	192.168.90.1/24	Area I
Giga0/1	N/A	N/A
Se0/0/0	192.168.250.2/30	Border Router
Se0/0/1	192.168.250.5/30	Router F
Se0/1/0	192.168.250.22/30	Router H
Se0/1/1	N/A	

DHCP Pool B
192.168.90.100
↓
192.168.90.255

VLAN 1: Fa0/1 - Fa0/24

Loopback 0
172.16.250.4

Interface	Service	IP
fa0/1	PC9	DHCP Pool I
fa0/2	PC10	DHCP Pool I
fa0/3	PC11	DHCP Pool I
fa0/4	N/A	
fa0/5	N/A	
fa0/6	N/A	
fa0/7	N/A	
fa0/8	N/A	
fa0/9	N/A	
fa0/10	N/A	
fa0/11	N/A	
fa0/12	N/A	
fa0/13	N/A	
fa0/14	N/A	
fa0/15	N/A	
fa0/16	N/A	
fa0/17	N/A	
fa0/18	N/A	
fa0/19	N/A	
fa0/20	N/A	
fa0/21	N/A	
fa0/22	N/A	
fa0/23	FTP Server 1	192.168.90.11
fa0/24	DHCP Pool Server	192.168.90.10
gi1/1	Link to Router B	
gi1/2	n/a	

tables

BPG routers with Company IP Addressing Policy

For router tables please see APPENDIX B Router tablesLoopback interface and Telnet

Company IP Policy		
Importent Ips		
DHCP A Pool server	192.168.110.10	192.168.130.10
DNS A Server	192.168.110.10	192.168.130.10
FTP Server	192.168.120.11	192.168.140.11

DHCP Pool servers	x.x.x.10
File servers	x.x.x.11
Printers	x.x.x.12

Swith Ports	
1-20	Devices
21	Servers
22	Printers
23	FTP Servers
24	DHCP/DNS

VLANS
VLAN 1 Area 0 - Management
VLAN 1 Area 1 - Default
VLAN 100 - Desktop PC
VLAN 200 Wireless PC

BGP/DHCP
Gig6/0
Gig0/0.1
Vlan 100
192.168.110.3
Gig0/0.2
Vlan 200
192.168.210.3
Gig1/0
Gig1/0.1
Vlan 100
18
Gig1/0.2
Vlan 200
22
Gig2/0
Gig2/0.1
VLAN100
66
Gig2/0.2
VLAN200
70
Fa4/0
AS nr 65515
172.17.1.1
Neighbor
172.17.1.2
AS nr 65516
Redistribute
BGP 65516
OSPF 10

Border Router
Se2/0
Vlan 1
192.168.250.1
Se3/0
Vlan 100
192.168.0.30
Fa4/0
AS nr 65516
172.17.1.2
Neighbor
172.17.1.1
AS nr 65515
Redistribute
BGP 65516
OSPF 1

Routing Protocols

OSPF in relations with project

Routing network based on 255.255.255.252 a 30 bit network. See LLD for IP details.

- Router ospf <Id. Nr.> (Process nr)
- Network 192.168.0.0 0.0.0.3 <wildcard mask> Area 1<ID>
- Network 192.168.1.1 0.0.0.255 <wildcard mask> Area 1<ID>

All network connected to the router has to be configured this way.

A Router will be assign as designated router (DR) and one as Backup designated router (BDR). All routers have a default priority of 1. If this is not change the router with the highest IP address will by default be chosen as DR and the next highest the BDR. This can be change by editing priority manual. DRs cannot be preempted by routers with a higher priority once they have been elected, so we'll need to disconnect all routers from the network in order to force a new election.

DR and BDR

The purpose of a DR/BDR is to be the “one router” (sounds like the matrix) to which all other routers are adjacent (the router that has all the routes on the network). Using a DR reduces the number of adjacencies that consume bandwidth and processing to n – 1 (Larger networks will however still require more processing even if you are using a DR). With a DR the adjacencies scale more effectively and efficiently with the network (as one can see in the below figure and table).

To show this in a graphic way one can see how this “adjacency” relationship works without a DR, with a DR, and with a DR and BDR with a small example network using 5 routers.

Number of Adjacencies = n(n-1)/2

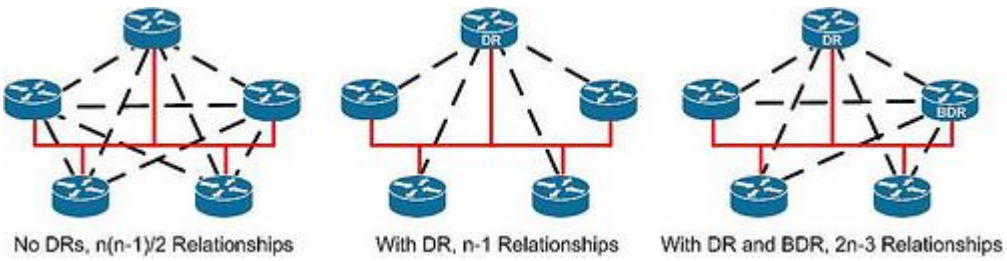


Fig 7 DR

The job of the DR

The role of the DR is to receive updates and distribute these updates to each segment router, making sure that each router acknowledges receipt and has a synchronized copy of the Link-State Database (LSDB).

Routers advertise changes to the "All DRs" multicast address of 224.0.0.6 where the DR then advertise the Link-State advertisements (LSAs) using the "AllSPF" multicast address 224.0.0.5 where each router then ack receipt. The BDR listens passively to this exchange and maintains a relationship with all the routers.

If the DR stops producing hellos, the BDR promotes itself and assumes the role of DR.

224.0.0.5 - All OSPF enabled routers listen to this address.
224.0.0.6 - DR/BDR router listen to this address.

Router1 has been force to be DR by setting a high priority on the router. It seems naturally when all other routers in area 0 has a connection to this router.

A priority on ospf has to be added to the interface by

Enable

Configure terminal

Interface gigabit 1/0.1

Ip ospf priority 100

```
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.10 255.255.255.252
 ip ospf priority 100
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.14 255.255.255.252
 ip ospf priority 100
```

Fig 8 Priority setting

Have made two network and simulated that the 192.168.250.0 Ospf net is located in another building.

The cost of a jump in ospf can be change for pushing data a specific path.

OSPF

The ospf network is setup with a 30bit netmask. This means that the connection between every router is a small network by itself.

E.g the connection com router0 to router2 contains the first network of many.

192.168.0.0 Network
192.168.0.1 available IP
192.168.0.2 available IP
192.168.0.3 broadcast address

255.255.255.252 subnet.

OSPF works by the router is told what network it is connected to it. And broadcast it to the networks it is connected by a “Hello package”.

No.	Time	Source	Destination	Protocol	Length	Info
5	2.639102	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
14	12.64943	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
32	22.66870	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
58	32.67875	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
63	42.68885	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
85	52.68960	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
95	62.69899	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
103	72.70903	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet
114	82.71904	10.0.1.133	224.0.0.5	OSPF	78	Hello Packet

Fig 9 Example from a Pfsense ospf network

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route ospf 1
Router(config-router)#net 192.168.0.1 0.0.0.3 area 0
Router(config-router)#
```

Fig 10 OSPF Network addition

Configuring a router for ospf is simple. How to configure the network from above.

After entering the configure terminal the router OSPF with a process number is entered. The “1” is the process number for this OSPF network. Then the specified network will be added with a Area number.

- Net – Short for Network
- 192.168.0.1 - is the network that the router would like to tell its neighbors’ about
- 0.0.0.3 – this is a wildcard netmask. It is the reverse of the subnet mask.
- Area 0 - Backbone area. The area all other areas has to pass through.

```
router ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.0.3 area 0
 network 192.168.0.4 0.0.0.3 area 0
 network 192.168.0.8 0.0.0.3 area 0
 network 192.168.0.12 0.0.0.3 area 0
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
 network 192.168.200.0 0.0.0.255 area 0
!
```

Fig 11 Router0 OSPF 1 Networks

Running VLAN on OSPF

Three VLANs are current active in the two networks. Site A or home office has VLAN 1 for management, VLAN 100 for desktop pc/wire connections and VLAN 200 for Wireless.

At the moment VLAN 1 can only be from within the troubled subnet what is because it has not been configured to be routed with ospf. For splitting the two VLANs up, the VLAN 100 and 200 routers where config with 2 virtual interfaces each on one physical interface.

That means if the Gig0/0 has be configured for the two VLANs the configuration would look like this.

```
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.140.1 255.255.255.0
 ip helper-address 192.168.130.10
 ip helper-address 192.168.110.10
!
```

Fig 12 VLAN interface config

At the moment the two VLANs on the same IP address scheme 192.168.0.X. And it will make more difficult to maintain and fault isolation.

A reconfigure of the two ospf networks would work better it the networks where divided into two more elaborated networks.

Eg.

- VLAN 100 reconfigured to 192.168.100.x
- VLAN 200 reconfigured to 192.168.200.x

And the virtual interfaces could be change to the for clarity of what VLAN is on what interface.

Eg.

- Interface Gigaethernet0/0.100 for VLAN 100
- Interface Gidaethernet0/0.200 for VLAN 200

And then use the IP number x on the two virtual interfaces. But without time and Package tracer issues it is dropped.

Redistribute static

2 wireless connected routers are connected area A and area E. These two networks are on the 200 VLAN and is been authenticated by the radius server. See the chapter about Radius for details.

For getting these two networks on the OSPF network Cisco says to use these “Stub” networks but instead of that a static route has been added to the to router0 (Area A) and router4 (Area E)

- Router4 > enable
- Router4 # configure terminal
- Router4(config)# ip route 10.0.240.0 255.255.255.0 192.168.240.2

In the OSPF Config >> route ospf 1

- Redistribute static

Like redistributing the OSPF 1 , 10 and the BPG the router will annonce it is attach to this static ip.

But at the moment it will not sending adjacencies out. And it looks like a Package tracer issue.

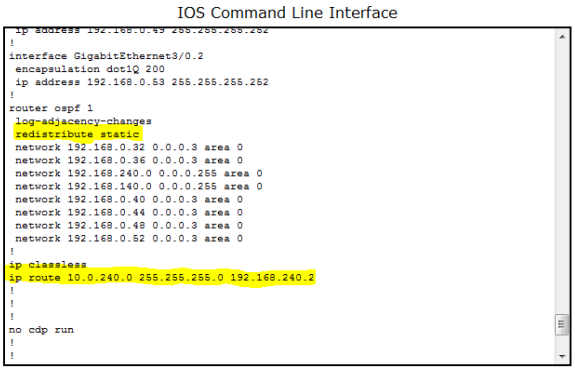


Fig 13 stadic route confiig

Area 0 for main building and Area 1 for offsite office building. These two networks are connected by a fiber connection running BGP. The routers connecting the two network are “BGP//backup router” and “Border gate router”

BGP

Border gateway protocol – It is with this protocol the internet is communicates with. It uses TCP for connections to it´s neighbour. A BGP router has to know all its neighbors' in its network.

This project consists of two BGP routers. The BGP//DHCP Backup router and the Border gate router. The two routers are simulated to be in two locations, See layout of physical layout in the Introduction part for details.

This report will not go into details about reflecting other then this functions can be used instead of manually configure all and/or new added router.

Fig 14 BGP//DHCP <<>> Border gate router

This is the two routers that are connecting Home office with a office offsite.
There being used two generic-empty routers with listed interfaces

BGP//DHCP Backup Router

- Gig0/0 - Gigabitethernet fiber connection
- Gig1/0 - Gigabitethernet fiber connection
- Fa4/0 – fastethernet fiber connection. Should be replaced with a Gigabit fiber connection
- Gig6/0 – Gigabitethernet RJ-45 connection

Border Gate Router

- Se2/0 serial connection. Should be replaced with a Gigabit Ethernet connection
- Se3/0 serial connection. Should be replaced with a Gigabit Ethernet connection
- Fa4/0 – fastethernet fiber connection. Should be replaced with a Gigabit fiber connection

BGP Config

```
router ospf 1
 log-adjacency-changes
 redistribute bgp 65515
 network 192.168.0.16 0.0.0.3 area 0
 network 192.168.0.20 0.0.0.3 area 0
 network 192.168.110.0 0.0.0.255 area 0
 network 192.168.210.0 0.0.0.255 area 0
 network 192.168.0.64 0.0.0.3 area 0
 network 192.168.0.68 0.0.0.3 area 0
!
router bgp 65515
 bgp log-neighbor-changes
 no synchronization
 neighbor 172.17.1.2 remote-as 65516
 redistribute ospf 1
!
```

Fig 15 BGP Running Conf

Router has be config with AS.Nr 65515 that is a private AS.nr. This number is only allowed in a private network. AS.Nr from 1 to 65512 are public and these can be bought by companies that is in need of a AS.Nr. It is only large companys that is investing in these. Companies like Cisco, IBM e.g.

- Bgp Log-neighbor-Changes

Tells the router to log BPG neighbor changes.

- Neigbour 172.17.1.2 remote-as 65516

This config line tells BGP//DHCP that is has a neighbor on IP Address 172.17.1.2 with the AS.nr. of 65516

- Redistribute OSPF 1

This is a smart way to tell the BGP routers neighbors that here is a OSPF network that we would like to redistribute on the neighbors network.

```
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/32 is subnetted, 5 subnets
B       172.16.250.1 [20/129] via 172.17.1.2, 01:02:12
B       172.16.250.2 [20/129] via 172.17.1.2, 01:02:12
B       172.16.250.3 [20/65] via 172.17.1.2, 01:02:12
B       172.16.250.4 [20/65] via 172.17.1.2, 01:02:12
B       172.16.250.5 [20/20] via 172.17.1.2, 01:02:12
C    172.17.0.0/16 is directly connected, FastEthernet4/0
     192.168.0.0/30 is subnetted, 18 subnets
O       192.168.0.0 [110/3] via 192.168.0.65, 01:01:10, GigabitEthernet1/0.1
```

Fig 16 BGP Routing Table

See the whole routing table in the APPENDIX B Router tables

Mail Configuration

Setting up mail is simple and straight through. The Mail server is running on the same server as the Web server so it will be easy to add a alias or CNAME as it is called in Package tracer. This will in the real world be a MX DNS directory instead.

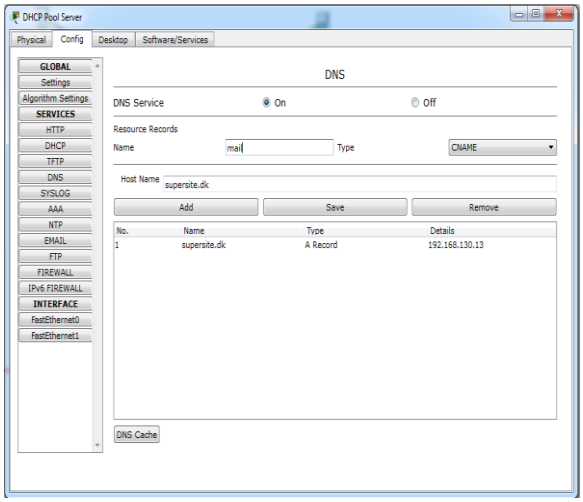


Fig 18 DNS Mail Config

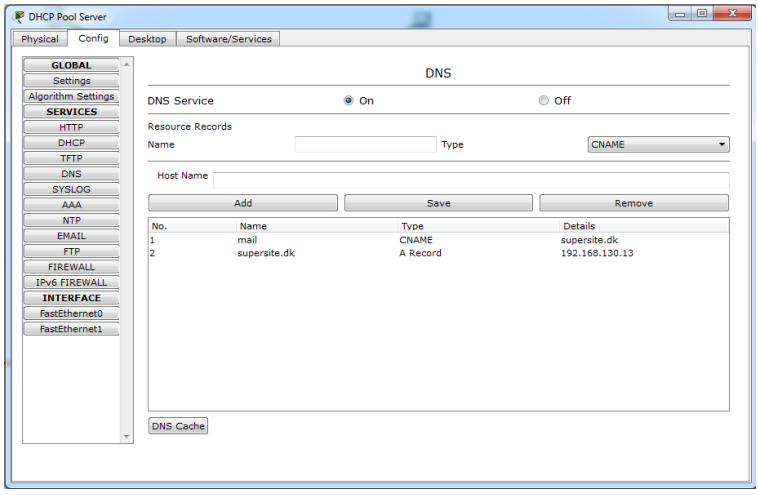


Fig 17 DNS Record

Then the mail Server and client is configured on the mail server.

Test clients are

- Test1/Test1
- Test2/Test2

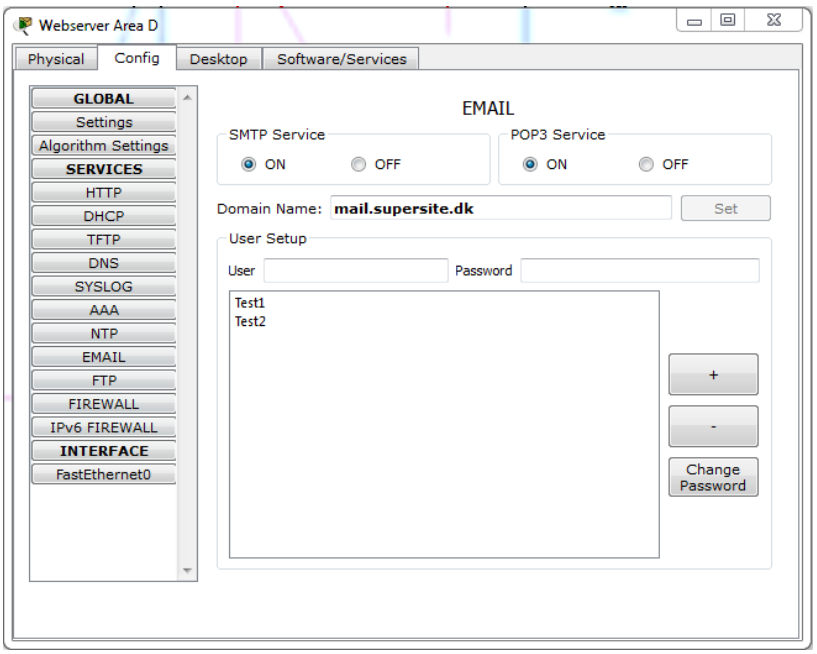


Fig 19 Mail server config

Then the client machines have to be configureted.

- Test1 configured on PC.D1
- Test2 configured on PC.B1

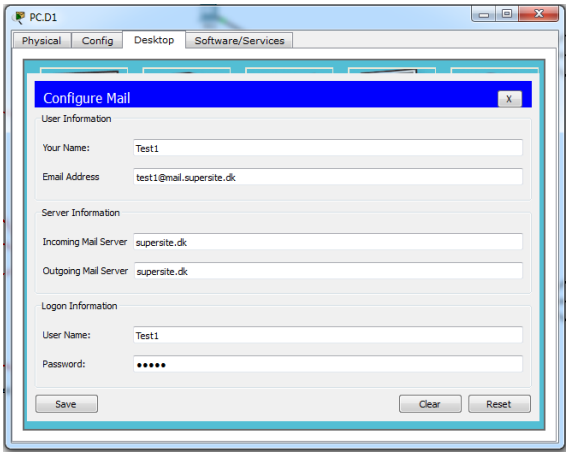


Fig 21 Client config on PC.D1

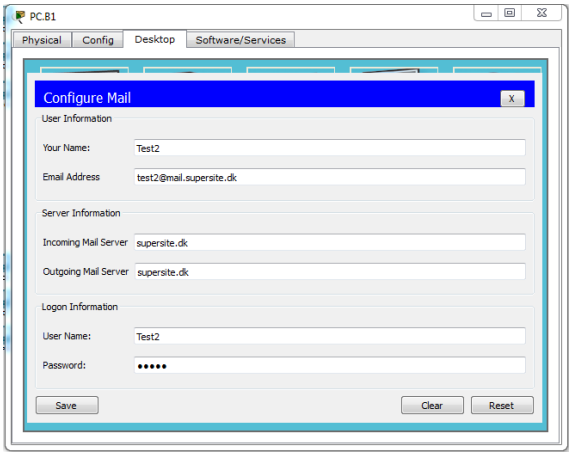


Fig 20 Client config on PC.B1

Testing mail settings by sending a test mail.

Fig 22 Sending a test mail to Test 2 -PC.B1

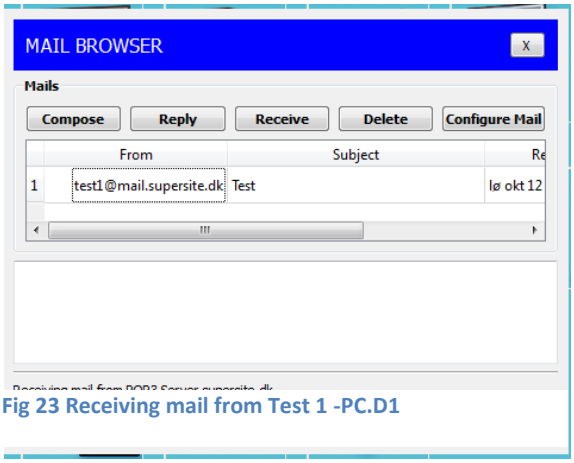


Fig 23 Receiving mail from Test 1 -PC.D1

The requirements for having only one DHCP server for all subnet a DHCP pool was defined in the DHCP Pool Server.

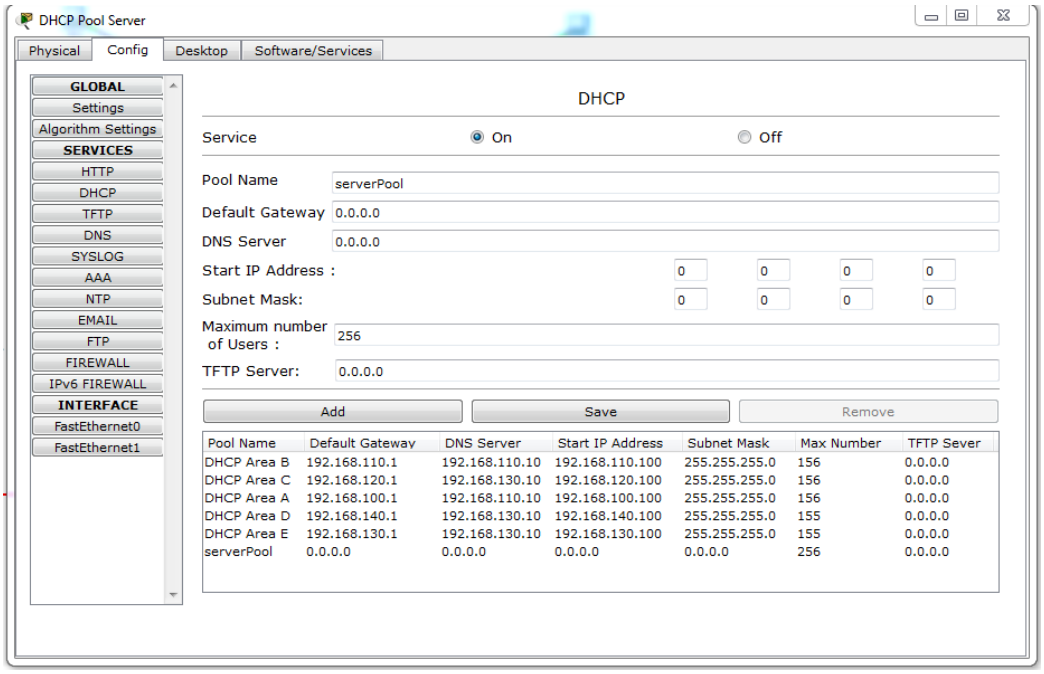


Fig 24 DHCP Pools

These are the created pools for the Home Office network. A client pc on subnet “Area A” can´t directly make a DHCP request because client PC doesn´t know where on the network the server is located. Therefore “IP Helper” has to be introduced to every router

This is applied to the LAN side of a Router like this:

```
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.100.1 255.255.255.0
 ip helper-address 192.168.110.10
 ip helper-address 192.168.130.10
!
```

There are 2 interfaces on the server therefore two “IP Helper” addresses

HSRPHSRP – HOT STANDBY ROUTER PROTOCOL

How HSRP work

HSRP uses the exchange of multicast messages to communicate a configured priority with other routers in the same standby group. The priority defines which router will be the primary and which router(s) will be secondary in the group. The default priority is 100; the router with the highest priority will be the primary for the group. If the priorities are the same, the first router up becomes the primary. Any prioritization is then based on the IP address. If a new router (at the same priority) joins, it doesn't bump the current primary router, even if its IP address is higher;

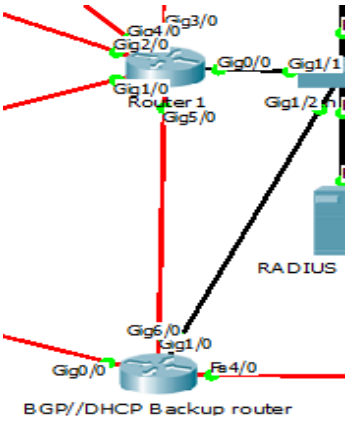


Fig 25 HSRP Routers

however, it can bump the current standby router.

If priorities are different, a new router joining with a higher priority becomes active, even if preemption is not configured; however, if the router is already up and its priority changes (because of tracking or reconfiguration), it won't bump the primary without preemption configured.

HSRP uses three types of multicast messages to exchange standby group information:

Hello— The hello message contains the sending router's priority and state information. Hellos are exchanged every three seconds. If a router fails to send a hello in a specified amount of time, the receiving router, if priority dictates, becomes the primary router for the group.

Coup— When a secondary router becomes the primary router, it sends a coup message to the routers in the group.

Resign— When the primary router is about to shut down, or when it has received a hello message with a higher priority than its own, it forfeits the primary position with a resign message.

Added this protocol to the network project for redundancy for radius, DHCP and mail if a router should fail,

Router1 and “BGP // DHCP Backup Router” are the two redundancy routers.

Project Network, adding HSRP

By setting up a virtual interface as a default gateway.

The two sub-interfaces on the routers are as followed

- Router1
  - Gig0/0.1 192.168.110.2/24 for VLAN 100
  - Gig0/0.2 192.168.210.2/24 for VLAN 200
- BGP // DHCP Backup Router
  - Gig6/0.1 192.168.110.3/24 for VLAN 100
  - Gig6/0.2 192.168.210.3/24 for VLAN 200

By adding standby <nr> ip <ip address> : this sets up the virtual interface that will work as the default gateway

So to added active/standby interface to:

- Router1
  - Gig0/0.1 >> standby 1 ip 192.168.110.1
  - Gig0/0.2 >> standby 1 ip 192.168.210.1
- BGP//DHCP Backup Router
  - Gig6/0.1 >> standby 1 ip 192.168.110.1
  - Gig6/0.2 >> standby 1 ip 192.168.210.1

In this design the Router 1 is the router that is preferd in use. Therefore a priority is placed in with HSRP config and it has been set up as when it will come back online it will again take over as Area B main router

Prority code in this case and the fall back after error on router 1

- Standby 1 priority 200 standby <nr> Priority <nr>
- Standby 1 preempt standby <nr> preempt

Configuration Commands for HSRP

Configuration of router1´s to virtual interfaces for VLAN 100 and VLAN 200

- Router1(config)#interface Gig0/0.1
- Router1 (config-if)#ip address 192.168.110.2
- Router1 (config-if)#standby 1 ip 192.168.110.1
- Router1 (config-if)#standby 1 priority 200
- Router1 (config-if)#standby 1 preempt

- Router1 (config)#interface Gig0/0.2
- Router1 (config-if)#ip address 192.168.210.2
- Router1 (config-if)#standby 2 ip 192.168.110.1
- Router1 (config-if)#standby 2 priority 200
- Router1 (config-if)#standby 2 preempt

Configuration of BGP//DHCP Backup Router to virtual interfaces for VLAN 100 and VLAN 200

- Router1(config)#interface Gig0/0.1
- Router1 (config-if)#ip address 192.168.110.3
- Router1 (config-if)#standby 1 ip 192.168.110.1
- Router1 (config-if)#standby 1 priority 50

- Router1 (config)#interface Gig0/0.2
- Router1 (config-if)#ip address 192.168.210.3
- Router1 (config-if)#standby 2 ip 192.168.110.1
- Router1 (config-if)#standby 2 priority 50

HSRP Documentation of Concept

Show standby settings for Router1 and BGP// DHCP backrouter

```
Router#sh standby
GigabitEthernet0/0.1 - Group 1 (version 2)
  State is Active
    18 state changes, last state change 00:15:34
  Virtual IP address is 192.168.110.1
  Active virtual MAC address is 0000.0C9F.F001
    Local virtual MAC address is 0000.0C9F.F001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.798 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.110.3, priority 200 (expires in 9 sec)
  Priority 200 (configured 200)
  Group name is hsrp--1 (default)
GigabitEthernet0/0.2 - Group 2 (version 2)
  State is Active
    15 state changes, last state change 00:15:46
  Virtual IP address is 192.168.210.1
  Active virtual MAC address is 0000.0C9F.F002
    Local virtual MAC address is 0000.0C9F.F002 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.347 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.210.3, priority 200 (expires in 6 sec)
  Priority 200 (configured 200)
  Group name is hsrp--2 (default)
Router#
```

Fig 26 Rouer1 standby settings

```
  State is Standby
    18 state changes, last state change 00:15:55
  Virtual IP address is 192.168.110.1
  Active virtual MAC address is 0000.0C9F.F001
    Local virtual MAC address is 0000.0C9F.F001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.372 secs
  Preemption disabled
  Active router is 192.168.110.2, priority 50 (expires in 7 sec)
    MAC address is 0000.0C9F.F001
  Standby router is local
  Priority 50 (configured 50)
  Group name is hsrp--1 (default)
GigabitEthernet6/0.2 - Group 2 (version 2)
  State is Standby
    16 state changes, last state change 00:15:55
  Virtual IP address is 192.168.210.1
  Active virtual MAC address is 0000.0C9F.F002
    Local virtual MAC address is 0000.0C9F.F002 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.832 secs
  Preemption disabled
  Active router is 192.168.210.2, priority 50 (expires in 7 sec)
    MAC address is 0000.0C9F.F002
  Standby router is local
  Priority 50 (configured 50)
  Group name is hsrp--2 (default)
Router#
```

Fig 27 BGP//dchp backup souter settings

Testing HSRP

By setting Gig0/0.1 do down it will force a switch from active to standby and vice versa when back online

```
%HSRP-6-STATECHANGE: GigabitEthernet0/0.2 Grp 2 state Speak -> Standby

%HSRP-6-STATECHANGE: GigabitEthernet0/0.1 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: GigabitEthernet0/0.2 Grp 2 state Standby -> Active

%HSRP-6-STATECHANGE: GigabitEthernet0/0.1 Grp 1 state Standby -> Active
```

Fig 28 Router1 Down - Up

This is the CLI of the BHP. It shows that it has detected a resign multicast from router1 and take over the as the active router router byt as soon as the primary router comes online again it relingish its active part and goes on standby

```
Router#
%HSRP-6-STATECHANGE: GigabitEthernet6/0.1 Grp 1 state Standby -> Active

%HSRP-6-STATECHANGE: GigabitEthernet6/0.2 Grp 2 state Standby -> Active

00:15:25: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.2 f
rom FULL to DOWN, Neighbor Down: Dead timer expired

00:15:25: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.2 f
rom FULL to DOWN, Neighbor Down: Interface down or detached

00:15:25: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.1 f
rom FULL to DOWN, Neighbor Down: Dead timer expired

00:15:25: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.1 f
rom FULL to DOWN, Neighbor Down: Interface down or detached

00:15:54: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.1 f
rom LOADING to FULL, Loading Done

00:15:55: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.210.1 on GigabitEthernet6/0.2 f
rom LOADING to FULL, Loading Done

%HSRP-6-STATECHANGE: GigabitEthernet6/0.1 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: GigabitEthernet6/0.2 Grp 2 state Speak -> Standby
```

But there is a problem that does that it will not send data and request from the HSRP network. Because of time issues this has not been corrected.

RADIUS

A Radius server running in Area B is authentication server for the wireless connectivity.

- Wireless Area A placed in the Area A
- Wireless Area B placed in Area F.

The radius server does only authenticate and authorized connection to VLAN 200.

2 example users are added a user1 and a user2. These are only added for testing purposes.

Server Settings for running as a RADIUS.

- Client name
- Client IP
- Secrete
- Server Type

These are the required settings for setting up what kind of areas to be authenticated and authorized by the RADIUS server.

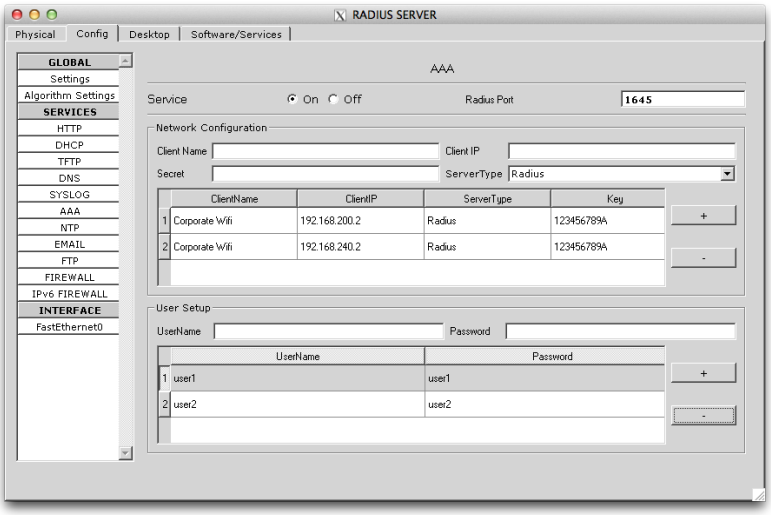


Fig 29 AAA Settings

In **Fejl! Henvisningskilde ikke fundet.**, show a sample configuration. It was tried to have the same network name so the wireless would be a corporate one instead of a area based network. But it could not simulate and show how it would change from one AP to another. Later the two client names were changed to Area A and Area B for wireless. But for more clarification the name should be Area A and Area E as the network area there are associated with.

When Clients and users are configures as desired the wireless AP has be associated with the RADIUS server so the UserPC will be authenticated through the wireless AP.

NETGEAR WIRELESS AP SETUP

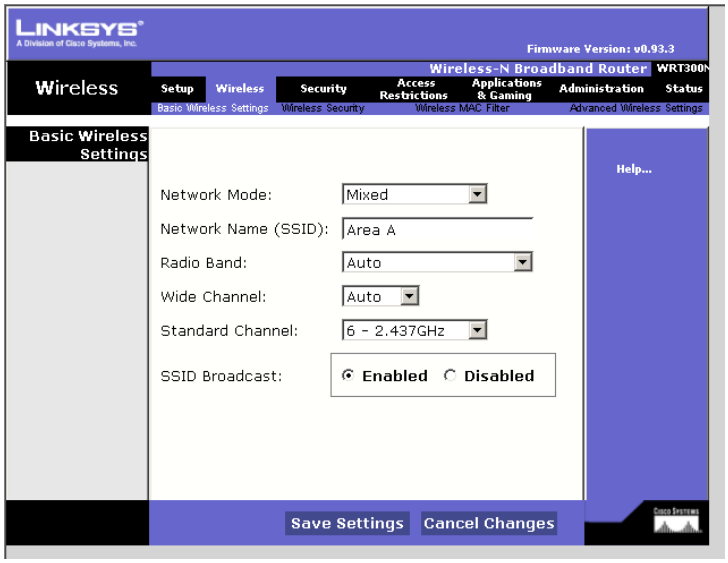


Fig 30 Basic Wireless network settings

Fig 30 Basic Wireless network settings, shows a basic setup of SSID, Channel and SSID Broadcast en/dis

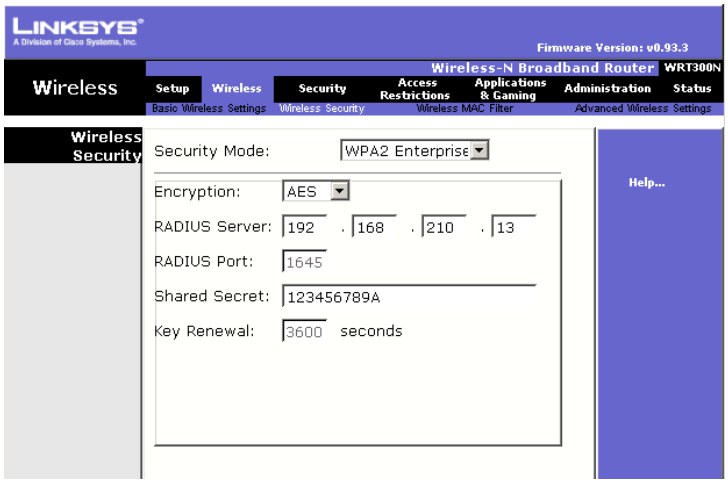


Fig 31 Wireless security settings

Fig 31 Wireless security settings**Fejl! Henvisningskilde ikke fundet.** is where the magic happens.

- Security mode - WPA2-Enterprise
- Encryption – AES

The settings then points to the RADIUS server IP and a shared secret is supplied to the config.

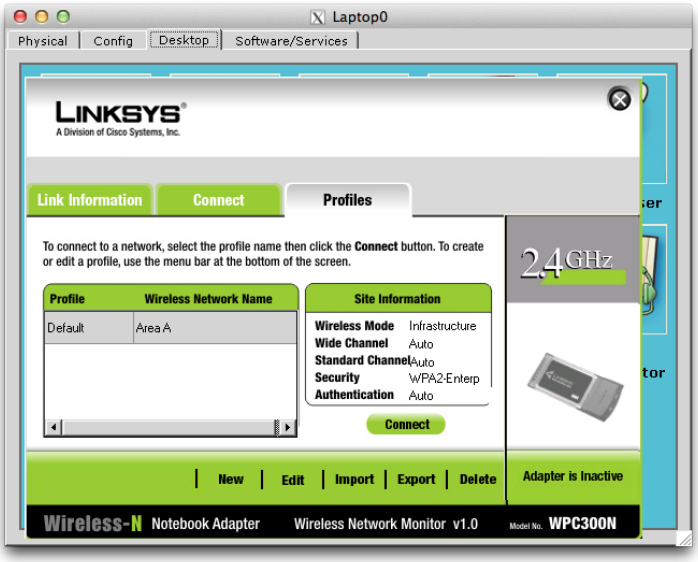


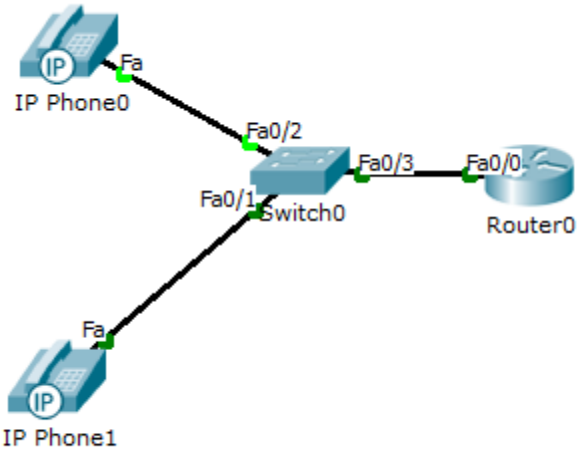
Fig 32 UserPC Config

The userPC has is now configured to use the wireless WPA2-enterprise.

A profile is sat up to use the connection to the Netgear Wireless AP.

Setting up IP Phones.

Wanted to use phones on VLAN 200 but the router I had chosen to use (generic-empty) did not support it. A little network showing how this could be made and how it is configured



Configure the FA 0/0 interface

- Router0>enable
- Router0#configure terminal
- Router0(config)#interface FastEthernet0/0
- Router0(config-if)#ip address 192.168.10.1 255.255.255.0
- Router0(config-if)#no shutdown

The DHCP server is needed to provide an IP address and the TFTP server location for each IP phone connected to the network.

- Router0(config)#ip DHCP pool VOICE #Create DHCP pool named VOICE
- Router0(DHCP-config)#network 192.168.10.0 255.255.255.0 #DHCP network
- Router0(DHCP-config)#default-router 192.168.10.1 #The default router IP address#
- Router0(DHCP-config)#option 150 ip 192.168.10.1 #Mandatory for voip configuration.

After the configuration, wait a moment and check that 'IP Phone 1' has received an IP address by placing your cursor over the phone until a configuration summary appears.

Configuring the Call Manager Express

You must now configure the Call Manager Express telephony service on Router0 to enable voip on your network.

- Router0(config)#telephony-service #Configuring the router for telephony services#
- Router0(config-telephony)#max-dn 5 #Define the maximum number of directory numbers#
- Router0(config-telephony)#max-ephones 5 #Define the maximum number of phones#
- Router0(config-telephony)#ip source-address 192.168.10.1 port 2000 #IP Address source#
- Router0(config-telephony)#auto assign 4 to 6 #Automatically assigning ext numbers to buttons#
- Router0(config-telephony)#auto assign 1 to 5 #Automatically assigning ext numbers to buttons#

Configure a voice VLAN on Switch0

Apply the following configuration on Switch0 interfaces. This configuration will separate voice and data traffic in different VLANs on Switch0. Data packets will be carried on the access VLAN.

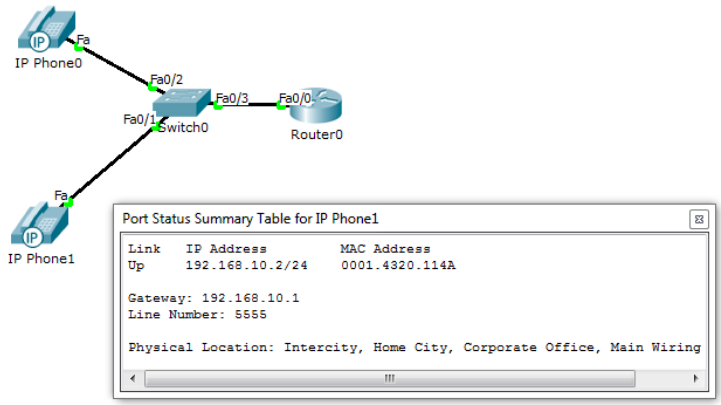
- Switch0(config)#interface range fa0/1 – 5 #Configure interface range#
- Switch0(config-if-range)#switchport mode access
- Switch0(config-if-range)#switchport voice VLAN 1 #Define the VLAN on which voice packets will be handled#

Configuring the phone directory for IP Phone 1

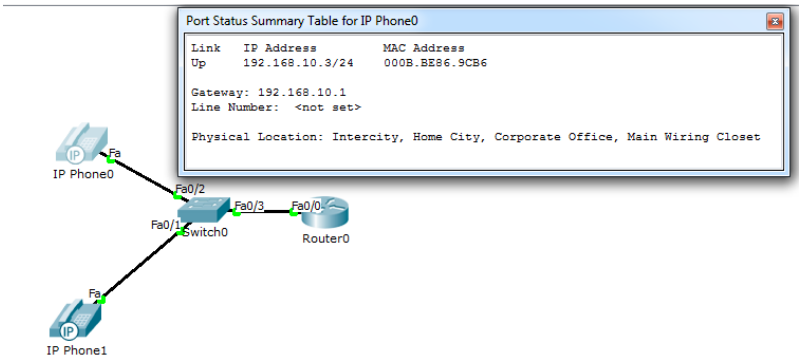
Although 'IP Phone 1' (IP Phone 1) is connected to Switch0, it needs additional configuration before being able to communicate to anything. A phone number is need to configure Router0 so a phone number is assigned to the IP phone.

- Router0(config)#ephone-dn 1 #Defining the first directory entry#
- Router0(config-ephone-dn)#number 5555 #Assign the phone number to this entry#

Verifying the configuration



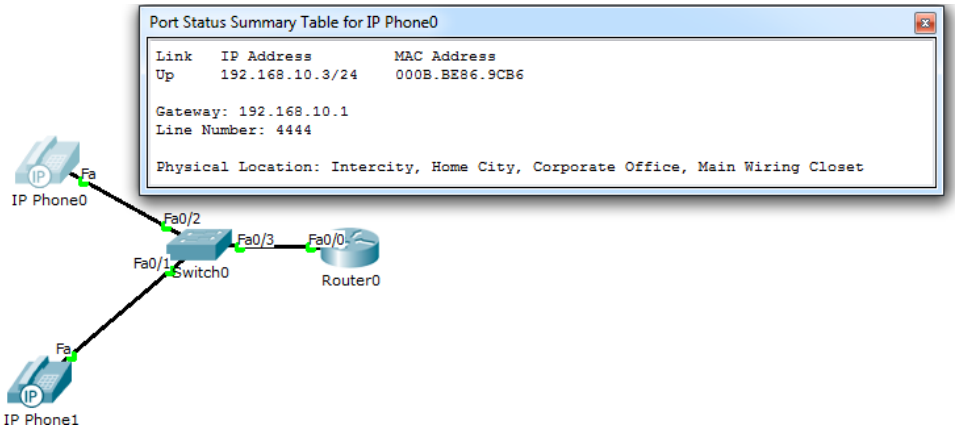
Configuring the phone directory for IP Phone 2



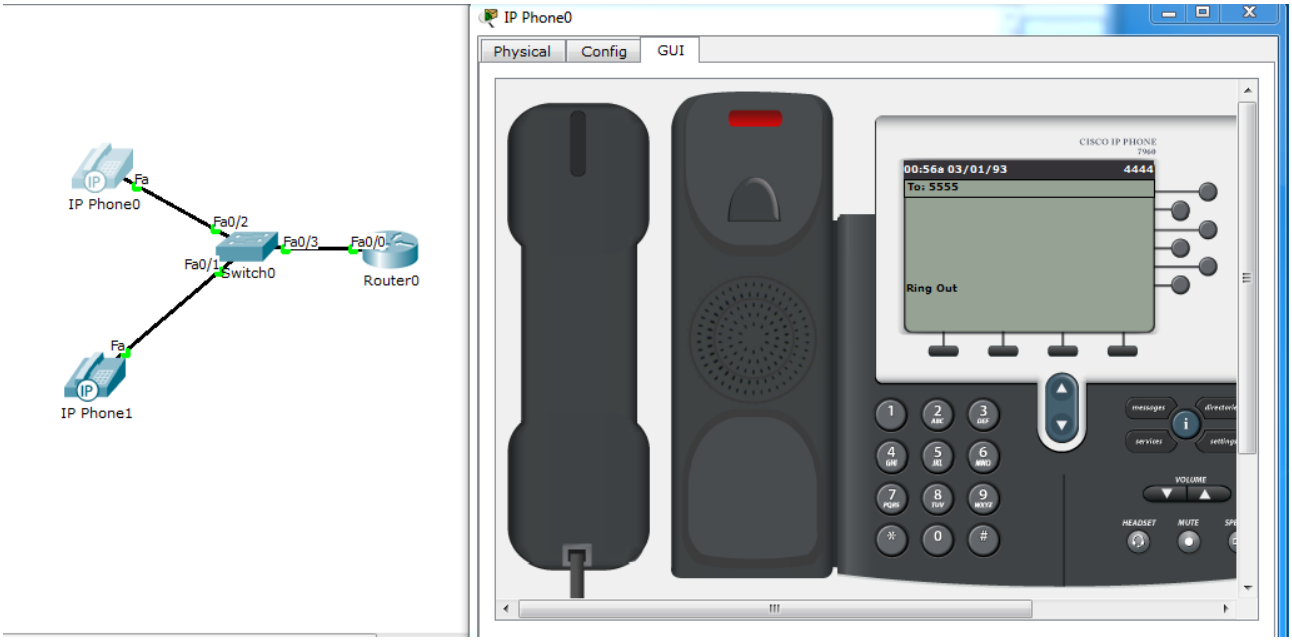
Connected IP Phone1 to Switch0 and power the phone ON using the power adapter

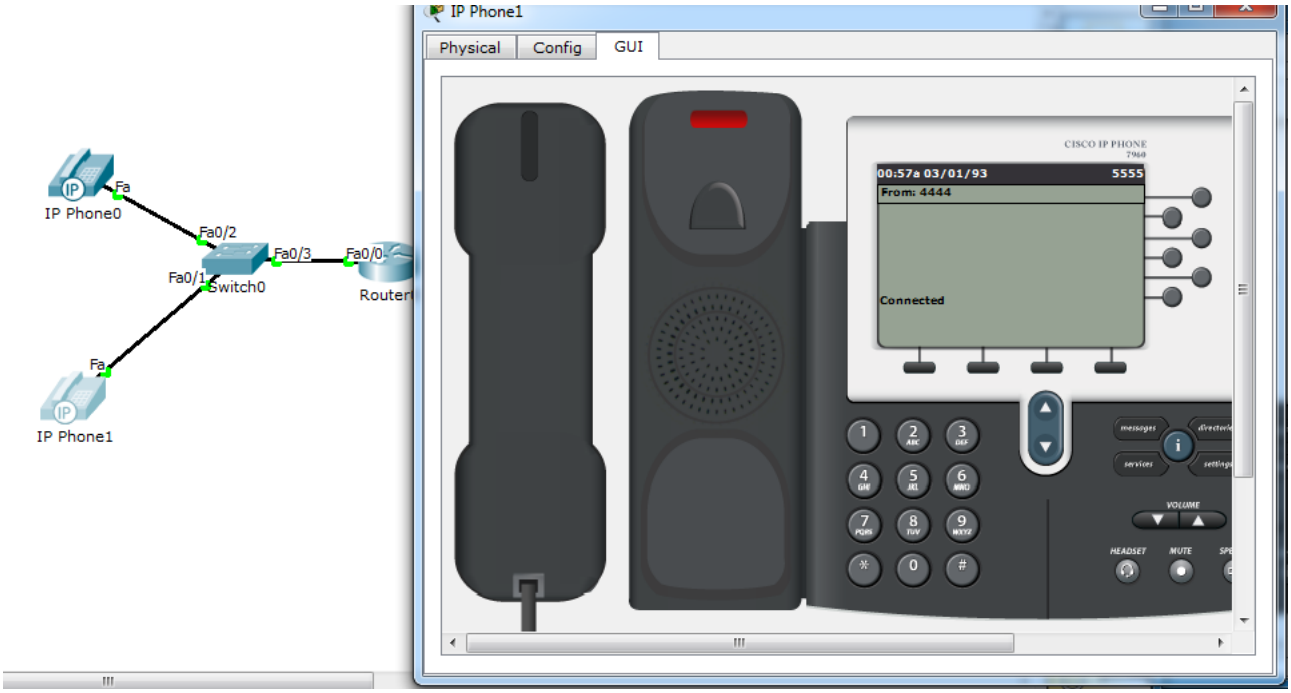
- Router0(config)#ephone-dn 2 #Defining the first directory entry#
- Router0(config-ephone-dn)#number 4444 #Assign the phone number to this entry#

Verifying the configuration



Verifying the connectivity





Conclusion

What work and what did not. All required services and protocol is implemented in the network at is running as it suppose to do. Planning the implementation could have gone better than it has. The first network where without VLAN is the ospf network. And the addition of VLANs was a challenge. First the routers use could not be used. The Serial connection does not support the virtual interfacing. And it is a very slow kind of connection. Therefore the network was build up and ripped down again for the addition of the two VLANs. A decision was made only to implement the VLAN in the Home office network as this is only an exercise or a small learning project.

The network routers was changed to run fiber connections and the network was sat up and it working perfectly. As this point it was discovered that this chosen router, a Generic- empty did not support “telephony-service” as is the service for running IP Phones over the network. Therefore Radius was implemented instead but only the wireless connections. This Radius would have made a perfect addition to telnet to routers.

A redundancy protocol was a wish, and the thought about using Vrrp was researched but Package tracer do not support it. A similar protocol, Cisco´s own HSRP was implemented instead but this gave a problem that the time did set at stop for. The connection out did not work. It may be some configuration issues that in a later time will be looked in too.

The Mail and web server gives a false positive about how easy it is to set up a mail and web server and get the DNS to resolve the name. 10 mins and the setup and configuration were done. Think there is some details missing.

Overall the project was a success. Many hours has been put into playing with package tracer and see what this learning tools is useful for. That is has a lot of bugs that get locks files and says files are not compatible is a pain.

The learning goals were accomplished in a good way.

APPENDIXES

APPENDIX A Router running Config

Router0

```
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
interface GigabitEthernet0/0
 no ip address
 ip helper-address 192.168.110.10
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.100.1 255.255.255.0
 ip helper-address 192.168.110.10
 ip helper-address 192.168.130.10
!
interface GigabitEthernet0/0.2
 encapsulation dot1Q 200
 ip address 192.168.200.1 255.255.255.0
 ip helper-address 192.168.210.10
 ip helper-address 192.168.230.10
!
interface GigabitEthernet1/0
 no ip address
 ip helper-address 192.168.110.10
!
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.1 255.255.255.252
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.5 255.255.255.252
!
interface GigabitEthernet2/0
 no ip address
!
interface GigabitEthernet2/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.9 255.255.255.252
!
```

```
interface GigabitEthernet2/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.13 255.255.255.252
!
interface GigabitEthernet3/0
 no ip address
!
interface GigabitEthernet3/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.17 255.255.255.252
!
interface GigabitEthernet3/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.21 255.255.255.252
!
interface FastEthernet4/0
 no ip address
 duplex auto
 speed auto
!
router ospf 1
 log-adjacency-changes
 redistribute static
 network 192.168.0.0 0.0.0.3 area 0
 network 192.168.0.4 0.0.0.3 area 0
 network 192.168.0.8 0.0.0.3 area 0
 network 192.168.0.12 0.0.0.3 area 0
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
 network 192.168.200.0 0.0.0.255 area 0
 network 10.0.200.0 0.0.0.255 area 0
!
ip classless
ip route 10.0.200.0 255.255.255.0 192.168.200.2
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router1

```
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface GigabitEthernet0/0
 no ip address
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.110.1 255.255.255.0
 ip helper-address 192.168.130.10
!
interface GigabitEthernet0/0.2
 encapsulation dot1Q 200
 ip address 192.168.210.1 255.255.255.0
 ip helper-address 192.168.230.10
!
interface GigabitEthernet1/0
 no ip address
!
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.10 255.255.255.252
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.14 255.255.255.252
!
interface GigabitEthernet2/0
 no ip address
```

```
!
interface GigabitEthernet2/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.26 255.255.255.252
!
interface GigabitEthernet2/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.30 255.255.255.252
!
interface GigabitEthernet3/0
 no ip address
!
interface GigabitEthernet3/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.58 255.255.255.252
!
interface GigabitEthernet3/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.62 255.255.255.252
!
interface GigabitEthernet4/0
 no ip address
!
interface GigabitEthernet4/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.50 255.255.255.252
!
interface GigabitEthernet4/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.54 255.255.255.252
!
interface GigabitEthernet5/0
 no ip address
!
interface GigabitEthernet5/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.65 255.255.255.252
!
interface GigabitEthernet5/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.69 255.255.255.252
!
router ospf 1
 log-adjacency-changes
 network 192.168.0.8 0.0.0.3 area 0
 network 192.168.0.12 0.0.0.3 area 0
 network 192.168.110.0 0.0.0.255 area 0
 network 192.168.210.0 0.0.0.255 area 0
 network 192.168.0.24 0.0.0.3 area 0
 network 192.168.0.28 0.0.0.3 area 0
 network 192.168.0.56 0.0.0.3 area 0
 network 192.168.0.60 0.0.0.3 area 0
 network 192.168.0.64 0.0.0.3 area 0
 network 192.168.0.68 0.0.0.3 area 0
 network 192.168.0.52 0.0.0.3 area 0
 network 192.168.0.48 0.0.0.3 area 0
```

```
!
ip classless
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router2

```
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface GigabitEthernet0/0
 no ip address
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.120.1 255.255.255.0
 ip helper-address 192.168.110.10
 ip helper-address 192.168.130.10
!
interface GigabitEthernet0/0.2
 encapsulation dot1Q 200
 ip address 192.168.220.1 255.255.255.0
 ip helper-address 192.168.210.10
 ip helper-address 192.168.230.10
!
interface GigabitEthernet1/0
 no ip address
!
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.2 255.255.255.252
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.6 255.255.255.252
```

```
!
interface GigabitEthernet2/0
 no ip address
!
interface GigabitEthernet2/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.25 255.255.255.252
!
interface GigabitEthernet2/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.29 255.255.255.252
!
interface GigabitEthernet3/0
 no ip address
!
interface GigabitEthernet3/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.33 255.255.255.252
!
interface GigabitEthernet3/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.37 255.255.255.252
!
router ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.0.3 area 0
 network 192.168.0.4 0.0.0.3 area 0
 network 192.168.120.0 0.0.0.255 area 0
 network 192.168.220.0 0.0.0.255 area 0
 network 192.168.0.24 0.0.0.3 area 0
 network 192.168.0.28 0.0.0.3 area 0
 network 192.168.0.32 0.0.0.3 area 0
 network 192.168.0.36 0.0.0.3 area 0
!
ip classless
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router3

```
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface GigabitEthernet0/0
 no ip address
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.130.1 255.255.255.0
 ip helper-address 192.168.110.10
!
interface GigabitEthernet0/0.2
 encapsulation dot1Q 200
 ip address 192.168.230.1 255.255.255.0
 ip helper-address 192.168.210.10
!
interface GigabitEthernet1/0
 no ip address
!
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.57 255.255.255.252
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.61 255.255.255.252
!
interface GigabitEthernet2/0
```

```
 no ip address
!
interface GigabitEthernet2/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.42 255.255.255.252
!
interface GigabitEthernet2/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.46 255.255.255.252
!
router ospf 1
 log-adjacency-changes
 network 192.168.130.0 0.0.0.255 area 0
 network 192.168.230.0 0.0.0.255 area 0
 network 192.168.0.56 0.0.0.3 area 0
 network 192.168.0.60 0.0.0.3 area 0
 network 192.168.0.40 0.0.0.3 area 0
 network 192.168.0.44 0.0.0.3 area 0
!
ip classless
!
!
!
no cdp run
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router4

```
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface GigabitEthernet0/0
 no ip address
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.1
 encapsulation dot1Q 100
 ip address 192.168.140.1 255.255.255.0
 ip helper-address 192.168.130.10
 ip helper-address 192.168.110.10
!
interface GigabitEthernet0/0.2
 encapsulation dot1Q 200
 ip address 192.168.240.1 255.255.255.0
 ip helper-address 192.168.210.10
 ip helper-address 192.168.230.10
!
interface GigabitEthernet1/0
 no ip address
!
interface GigabitEthernet1/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.34 255.255.255.252
!
interface GigabitEthernet1/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.38 255.255.255.252
```

```
!
interface GigabitEthernet2/0
 no ip address
!
interface GigabitEthernet2/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.41 255.255.255.252
!
interface GigabitEthernet2/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.45 255.255.255.252
!
interface GigabitEthernet3/0
 no ip address
!
interface GigabitEthernet3/0.1
 encapsulation dot1Q 100
 ip address 192.168.0.49 255.255.255.252
!
interface GigabitEthernet3/0.2
 encapsulation dot1Q 200
 ip address 192.168.0.53 255.255.255.252
!
router ospf 1
 log-adjacency-changes
 redistribute static
 network 192.168.0.32 0.0.0.3 area 0
 network 192.168.0.36 0.0.0.3 area 0
 network 192.168.240.0 0.0.0.255 area 0
 network 192.168.140.0 0.0.0.255 area 0
 network 192.168.0.40 0.0.0.3 area 0
 network 192.168.0.44 0.0.0.3 area 0
 network 192.168.0.48 0.0.0.3 area 0
 network 192.168.0.52 0.0.0.3 area 0
 network 10.0.240.0 0.0.0.255 area 0
!
ip classless
ip route 10.0.240.0 255.255.255.0 192.168.240.2
!
!
!
no cdp run
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router Area F

```
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname "Router F"
!
!
!
!
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FTX152438U0
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
interface GigabitEthernet0/0
 ip address 192.168.60.1 255.255.255.0
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
 duplex full
 speed 1000
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 ip address 192.168.250.6 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/0/1
 ip address 192.168.250.9 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/1/0
```

```
 ip address 192.168.250.26 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/1/1
 no ip address
 shutdown
!
interface VLAN1
 no ip address
 shutdown
!
router ospf 1
 log-adjacency-changes
!
router ospf 10
 log-adjacency-changes
 network 192.168.250.4 0.0.0.3 area 1
 network 192.168.250.24 0.0.0.3 area 1
 network 192.168.250.8 0.0.0.3 area 1
 network 192.168.60.0 0.0.0.255 area 1
!
ip classless
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router Area G

```
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname "Router G"
!
!
!
!
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FTX1524ERA7
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
interface GigabitEthernet0/0
 ip address 192.168.70.1 255.255.255.0
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
 duplex full
 speed 1000
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 ip address 192.168.250.10 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/0/1
 ip address 192.168.250.13 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
```

```
!
interface VLAN1
 no ip address
 shutdown
!
router ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.0.3 area 1
!
router ospf 10
 log-adjacency-changes
 network 192.168.250.8 0.0.0.3 area 1
 network 192.168.250.12 0.0.0.3 area 1
 network 192.168.70.0 0.0.0.255 area 1
!
ip classless
!
!
!
no cdp run
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router Area H

```
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname "Router H"
!
!
!
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FTX15245VL2
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
interface GigabitEthernet0/0
 ip address 192.168.80.1 255.255.255.0
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
 duplex full
 speed 1000
!
interface GigabitEthernet0/1
 no ip address
 duplex full
 speed 1000
 shutdown
!
interface Serial0/0/0
 ip address 192.168.250.14 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/0/1
 ip address 192.168.250.17 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/1/0
```

```
 ip address 192.168.250.21 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/1/1
 ip address 192.168.250.25 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface VLAN1
 no ip address
 shutdown
!
router ospf 10
 log-adjacency-changes
 network 192.168.250.12 0.0.0.3 area 1
 network 192.168.250.16 0.0.0.3 area 1
 network 192.168.250.20 0.0.0.3 area 1
 network 192.168.250.24 0.0.0.3 area 1
 network 192.168.80.0 0.0.0.255 area 1
!
ip classless
!
!
!
no cdp run
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

Router Area I

```
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname "Router I"
!
!
!
!
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FTX1524MUQ2
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
interface GigabitEthernet0/0
 ip address 192.168.90.1 255.255.255.0
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
 duplex full
 speed 1000
!
interface GigabitEthernet0/1
 no ip address
 ip helper-address 192.168.90.10
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 ip address 192.168.250.2 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/0/1
 ip address 192.168.250.5 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
```

```
interface Serial0/1/0
 ip address 192.168.250.22 255.255.255.252
 ip helper-address 192.168.60.10
 ip helper-address 192.168.90.10
!
interface Serial0/1/1
 no ip address
 shutdown
!
interface VLAN1
 no ip address
 shutdown
!
router ospf 10
 log-adjacency-changes
 network 192.168.250.0 0.0.0.3 area 1
 network 192.168.250.4 0.0.0.3 area 1
 network 192.168.250.20 0.0.0.3 area 1
 network 192.168.90.0 0.0.0.255 area 1
!
ip classless
!
!
!
no cdp run
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

APPENDIX B Router tables

Router0 Routing Table

```
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E – EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o – ODR
       P - periodic downloaded static route
Gateway of last resort is not set
     10.0.0.0/24 is subnetted, 1 subnets
S       10.0.200.0 [1/0] via 192.168.200.2

     192.168.0.0/30 is subnetted, 18 subnets
C       192.168.0.0 is directly connected, GigabitEthernet1/0.1
C       192.168.0.4 is directly connected, GigabitEthernet1/0.2
C       192.168.0.8 is directly connected, GigabitEthernet2/0.1
C       192.168.0.12 is directly connected, GigabitEthernet2/0.2
C       192.168.0.16 is directly connected, GigabitEthernet3/0.1
C       192.168.0.20 is directly connected, GigabitEthernet3/0.2
O       192.168.0.24 [110/2] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
                     [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
                     [110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O       192.168.0.28 [110/2] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
                     [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
                     [110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O       192.168.0.32 [110/2] via 192.168.0.2, 00:09:12, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.6, 00:09:12, GigabitEthernet1/0.2
O       192.168.0.36 [110/2] via 192.168.0.2, 00:09:12, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.6, 00:09:12, GigabitEthernet1/0.2
```

O 192.168.0.40 [110/3] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
[110/3] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
[110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.44 [110/3] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
[110/3] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
[110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.48 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.52 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.56 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.60 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.64 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.0.68 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O E2 192.168.60.0/24 [110/20] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/20] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O E2 192.168.70.0/24 [110/20] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/20] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O E2 192.168.80.0/24 [110/20] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/20] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O E2 192.168.90.0/24 [110/20] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/20] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
C 192.168.100.0/24 is directly connected, GigabitEthernet0/0.1
O 192.168.110.0/24 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.120.0/24 [110/2] via 192.168.0.2, 00:09:12, GigabitEthernet1/0.1
[110/2] via 192.168.0.6, 00:09:12, GigabitEthernet1/0.2
O 192.168.130.0/24 [110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.140.0/24 [110/3] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
[110/3] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
[110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
C 192.168.200.0/24 is directly connected, GigabitEthernet0/0.2

O 192.168.210.0/24 [110/2] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/2] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.220.0/24 [110/2] via 192.168.0.2, 00:09:12, GigabitEthernet1/0.1
[110/2] via 192.168.0.6, 00:09:12, GigabitEthernet1/0.2
O 192.168.230.0/24 [110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2
O 192.168.240.0/24 [110/3] via 192.168.0.2, 00:09:02, GigabitEthernet1/0.1
[110/3] via 192.168.0.6, 00:09:02, GigabitEthernet1/0.2
[110/3] via 192.168.0.10, 00:09:02, GigabitEthernet2/0.1
[110/3] via 192.168.0.14, 00:09:02, GigabitEthernet2/0.2

Router1 routing table

```
Router#
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    192.168.0.0/30 is subnetted, 18 subnets
O      192.168.0.0 [110/2] via 192.168.0.9, 00:17:15, GigabitEthernet1/0.1
                   [110/2] via 192.168.0.13, 00:17:15, GigabitEthernet1/0.2
                   [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                   [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
O      192.168.0.4 [110/2] via 192.168.0.9, 00:17:15, GigabitEthernet1/0.1
                   [110/2] via 192.168.0.13, 00:17:15, GigabitEthernet1/0.2
                   [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                   [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
C      192.168.0.8 is directly connected, GigabitEthernet1/0.1
C      192.168.0.12 is directly connected, GigabitEthernet1/0.2
O      192.168.0.16 [110/2] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                    [110/2] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
O      192.168.0.20 [110/2] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                    [110/2] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
C      192.168.0.24 is directly connected, GigabitEthernet2/0.1
C      192.168.0.28 is directly connected, GigabitEthernet2/0.2
O      192.168.0.32 [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                    [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
                    [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                    [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
O      192.168.0.36 [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                    [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
                    [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                    [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
O      192.168.0.40 [110/2] via 192.168.0.57, 00:17:15, GigabitEthernet3/0.1
                    [110/2] via 192.168.0.61, 00:17:15, GigabitEthernet3/0.2
                    [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                    [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
O      192.168.0.44 [110/2] via 192.168.0.57, 00:17:15, GigabitEthernet3/0.1
```

```
                [110/2] via 192.168.0.61, 00:17:15, GigabitEthernet3/0.2
                [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
C       192.168.0.48 is directly connected, GigabitEthernet4/0.1
C       192.168.0.52 is directly connected, GigabitEthernet4/0.2
C       192.168.0.56 is directly connected, GigabitEthernet3/0.1
C       192.168.0.60 is directly connected, GigabitEthernet3/0.2
C       192.168.0.64 is directly connected, GigabitEthernet5/0.1
C       192.168.0.68 is directly connected, GigabitEthernet5/0.2
O E2 192.168.60.0/24 [110/20] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                [110/20] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
O E2 192.168.70.0/24 [110/20] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                [110/20] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
O E2 192.168.80.0/24 [110/20] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                [110/20] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
O E2 192.168.90.0/24 [110/20] via 192.168.0.66, 00:17:15, GigabitEthernet5/0.1
                [110/20] via 192.168.0.70, 00:17:15, GigabitEthernet5/0.2
O    192.168.100.0/24 [110/2] via 192.168.0.9, 00:17:15, GigabitEthernet1/0.1
                [110/2] via 192.168.0.13, 00:17:15, GigabitEthernet1/0.2
C    192.168.110.0/24 is directly connected, GigabitEthernet0/0.1
O    192.168.120.0/24 [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
O    192.168.130.0/24 [110/2] via 192.168.0.57, 00:17:15, GigabitEthernet3/0.1
                [110/2] via 192.168.0.61, 00:17:15, GigabitEthernet3/0.2
O    192.168.140.0/24 [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
O    192.168.200.0/24 [110/2] via 192.168.0.9, 00:17:15, GigabitEthernet1/0.1
                [110/2] via 192.168.0.13, 00:17:15, GigabitEthernet1/0.2
C    192.168.210.0/24 is directly connected, GigabitEthernet0/0.2
O    192.168.220.0/24 [110/2] via 192.168.0.25, 00:17:15, GigabitEthernet2/0.1
                [110/2] via 192.168.0.29, 00:17:15, GigabitEthernet2/0.2
O    192.168.230.0/24 [110/2] via 192.168.0.57, 00:17:15, GigabitEthernet3/0.1
                [110/2] via 192.168.0.61, 00:17:15, GigabitEthernet3/0.2
O    192.168.240.0/24 [110/2] via 192.168.0.49, 00:17:15, GigabitEthernet4/0.1
                [110/2] via 192.168.0.53, 00:17:15, GigabitEthernet4/0.2
Router#
```

Router2 Router Table

```
Router>en
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     192.168.0.0/30 is subnetted, 18 subnets
C       192.168.0.0 is directly connected, GigabitEthernet1/0.1
C       192.168.0.4 is directly connected, GigabitEthernet1/0.2
O       192.168.0.8 [110/2] via 192.168.0.1, 00:20:33, GigabitEthernet1/0.1
                    [110/2] via 192.168.0.5, 00:20:33, GigabitEthernet1/0.2
                    [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
                    [110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O       192.168.0.12 [110/2] via 192.168.0.1, 00:20:33, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.5, 00:20:33, GigabitEthernet1/0.2
                     [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
                     [110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O       192.168.0.16 [110/3] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
                     [110/3] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O       192.168.0.20 [110/3] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
                     [110/3] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
C       192.168.0.24 is directly connected, GigabitEthernet2/0.1
C       192.168.0.28 is directly connected, GigabitEthernet2/0.2
C       192.168.0.32 is directly connected, GigabitEthernet3/0.1
C       192.168.0.36 is directly connected, GigabitEthernet3/0.2
O       192.168.0.40 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
O       192.168.0.44 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
O       192.168.0.48 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
```

[110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.0.52 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
[110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
[110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.0.56 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.0.60 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.0.64 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.0.68 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O E2 192.168.60.0/24 [110/20] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/20] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O E2 192.168.70.0/24 [110/20] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/20] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O E2 192.168.80.0/24 [110/20] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/20] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O E2 192.168.90.0/24 [110/20] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/20] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.100.0/24 [110/2] via 192.168.0.1, 00:20:43, GigabitEthernet1/0.1
[110/2] via 192.168.0.5, 00:20:43, GigabitEthernet1/0.2
O 192.168.110.0/24 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
C 192.168.120.0/24 is directly connected, GigabitEthernet0/0.1
O 192.168.130.0/24 [110/3] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
[110/3] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
[110/3] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/3] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O 192.168.140.0/24 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
[110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
O 192.168.200.0/24 [110/2] via 192.168.0.1, 00:20:43, GigabitEthernet1/0.1
[110/2] via 192.168.0.5, 00:20:43, GigabitEthernet1/0.2
O 192.168.210.0/24 [110/2] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
[110/2] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
C 192.168.220.0/24 is directly connected, GigabitEthernet0/0.2
O 192.168.230.0/24 [110/3] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
[110/3] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2

```
                [110/3] via 192.168.0.26, 00:20:33, GigabitEthernet2/0.1
                [110/3] via 192.168.0.30, 00:20:33, GigabitEthernet2/0.2
O    192.168.240.0/24 [110/2] via 192.168.0.34, 00:20:33, GigabitEthernet3/0.1
                [110/2] via 192.168.0.38, 00:20:33, GigabitEthernet3/0.2
Router#
```

Router3 Router Table

```
Router>en
Router# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

    192.168.0.0/30 is subnetted, 18 subnets
O       192.168.0.0 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                    [110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
                    [110/3] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
                    [110/3] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
O       192.168.0.4 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                    [110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
                    [110/3] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
                    [110/3] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
O       192.168.0.8 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                    [110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.12 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.16 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.20 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.24 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.28 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O       192.168.0.32 [110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
                     [110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
O       192.168.0.36 [110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
                     [110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
```

C 192.168.0.40 is directly connected, GigabitEthernet2/0.1
C 192.168.0.44 is directly connected, GigabitEthernet2/0.2
O 192.168.0.48 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
[110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
O 192.168.0.52 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
[110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
C 192.168.0.56 is directly connected, GigabitEthernet1/0.1
C 192.168.0.60 is directly connected, GigabitEthernet1/0.2
O 192.168.0.64 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.0.68 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O E2 192.168.60.0/24 [110/20] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/20] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O E2 192.168.70.0/24 [110/20] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/20] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O E2 192.168.80.0/24 [110/20] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/20] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O E2 192.168.90.0/24 [110/20] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/20] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.100.0/24 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.110.0/24 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.120.0/24 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
[110/3] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/3] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
C 192.168.130.0/24 is directly connected, GigabitEthernet0/0.1
O 192.168.140.0/24 [110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2
O 192.168.200.0/24 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.210.0/24 [110/2] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1
[110/2] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
O 192.168.220.0/24 [110/3] via 192.168.0.58, 00:24:21, GigabitEthernet1/0.1

[110/3] via 192.168.0.62, 00:24:21, GigabitEthernet1/0.2
[110/3] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/3] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2

C 192.168.230.0/24 is directly connected, GigabitEthernet0/0.2

O 192.168.240.0/24 [110/2] via 192.168.0.41, 00:24:21, GigabitEthernet2/0.1
[110/2] via 192.168.0.45, 00:24:21, GigabitEthernet2/0.2

Router4 Router Table

```
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
S       10.0.240.0 [1/0] via 192.168.240.2
     192.168.0.0/30 is subnetted, 18 subnets
O       192.168.0.0 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
                    [110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
O       192.168.0.4 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
                    [110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
O       192.168.0.8 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                    [110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O       192.168.0.12 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O       192.168.0.16 [110/3] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                     [110/3] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O       192.168.0.20 [110/3] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                     [110/3] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O       192.168.0.24 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
                     [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O       192.168.0.28 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
                     [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
                     [110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
C       192.168.0.32 is directly connected, GigabitEthernet1/0.1
C       192.168.0.36 is directly connected, GigabitEthernet1/0.2
C       192.168.0.40 is directly connected, GigabitEthernet2/0.1
```

C 192.168.0.44 is directly connected, GigabitEthernet2/0.2
C 192.168.0.48 is directly connected, GigabitEthernet3/0.1
C 192.168.0.52 is directly connected, GigabitEthernet3/0.2
O 192.168.0.56 [110/2] via 192.168.0.42, 00:30:00, GigabitEthernet2/0.1
[110/2] via 192.168.0.46, 00:30:00, GigabitEthernet2/0.2
[110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.0.60 [110/2] via 192.168.0.42, 00:30:00, GigabitEthernet2/0.1
[110/2] via 192.168.0.46, 00:30:00, GigabitEthernet2/0.2
[110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.0.64 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.0.68 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O E2 192.168.60.0/24 [110/20] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/20] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O E2 192.168.70.0/24 [110/20] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/20] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O E2 192.168.80.0/24 [110/20] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/20] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O E2 192.168.90.0/24 [110/20] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/20] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.100.0/24 [110/3] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
[110/3] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
[110/3] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/3] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.110.0/24 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.120.0/24 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
[110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
O 192.168.130.0/24 [110/2] via 192.168.0.42, 00:30:00, GigabitEthernet2/0.1
[110/2] via 192.168.0.46, 00:30:00, GigabitEthernet2/0.2
C 192.168.140.0/24 is directly connected, GigabitEthernet0/0.1
O 192.168.200.0/24 [110/3] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
[110/3] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
[110/3] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/3] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2
O 192.168.210.0/24 [110/2] via 192.168.0.50, 00:30:00, GigabitEthernet3/0.1
[110/2] via 192.168.0.54, 00:30:00, GigabitEthernet3/0.2

O 192.168.220.0/24 [110/2] via 192.168.0.33, 00:30:00, GigabitEthernet1/0.1
[110/2] via 192.168.0.37, 00:30:00, GigabitEthernet1/0.2
O 192.168.230.0/24 [110/2] via 192.168.0.42, 00:30:00, GigabitEthernet2/0.1
[110/2] via 192.168.0.46, 00:30:00, GigabitEthernet2/0.2
C 192.168.240.0/24 is directly connected, GigabitEthernet0/0.2

BGP//DHCP Backup Router Router Table

```
Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, FastEthernet4/0
     192.168.0.0/30 is subnetted, 18 subnets
O       192.168.0.0 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                    [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.4 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                    [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.8 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                    [110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.12 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
C       192.168.0.16 is directly connected, GigabitEthernet0/0.1
C       192.168.0.20 is directly connected, GigabitEthernet0/0.2
O       192.168.0.24 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.28 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.32 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.36 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.40 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.44 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O       192.168.0.48 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
                     [110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
```

O 192.168.0.52 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O 192.168.0.56 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O 192.168.0.60 [110/2] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/2] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
C 192.168.0.64 is directly connected, GigabitEthernet1/0.1
C 192.168.0.68 is directly connected, GigabitEthernet1/0.2
B 192.168.60.0/24 [20/129] via 172.17.1.1, 00:34:43
B 192.168.70.0/24 [20/129] via 172.17.1.1, 00:34:43
B 192.168.80.0/24 [20/65] via 172.17.1.1, 00:34:43
B 192.168.90.0/24 [20/65] via 172.17.1.1, 00:34:43
O 192.168.100.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
C 192.168.110.0/24 is directly connected, GigabitEthernet6/0.1
O 192.168.120.0/24 [110/3] via 192.168.0.65, 00:03:48, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:03:48, GigabitEthernet1/0.2
O 192.168.130.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O 192.168.140.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O 192.168.200.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
C 192.168.210.0/24 is directly connected, GigabitEthernet6/0.2
O 192.168.220.0/24 [110/3] via 192.168.0.65, 00:03:48, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:03:48, GigabitEthernet1/0.2
O 192.168.230.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
O 192.168.240.0/24 [110/3] via 192.168.0.65, 00:33:43, GigabitEthernet1/0.1
[110/3] via 192.168.0.69, 00:33:43, GigabitEthernet1/0.2
192.168.250.0/30 is subnetted, 7 subnets
B 192.168.250.0 [20/20] via 172.17.1.1, 00:34:43
B 192.168.250.4 [20/128] via 172.17.1.1, 00:34:43
B 192.168.250.8 [20/192] via 172.17.1.1, 00:34:43
B 192.168.250.12 [20/128] via 172.17.1.1, 00:34:43
B 192.168.250.16 [20/20] via 172.17.1.1, 00:34:43
B 192.168.250.20 [20/128] via 172.17.1.1, 00:34:43
B 192.168.250.24 [20/128] via 172.17.1.1, 00:34:43

Border gate router Router Table

Router#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

C 172.17.0.0/16 is directly connected, FastEthernet4/0
192.168.0.0/30 is subnetted, 18 subnets
B 192.168.0.0 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.4 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.8 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.12 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.16 [20/20] via 172.17.1.2, 00:35:37
B 192.168.0.20 [20/20] via 172.17.1.2, 00:35:37
B 192.168.0.24 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.28 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.32 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.36 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.40 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.44 [20/3] via 172.17.1.2, 00:35:37
B 192.168.0.48 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.52 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.56 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.60 [20/2] via 172.17.1.2, 00:35:37
B 192.168.0.64 [20/20] via 172.17.1.2, 00:35:37
B 192.168.0.68 [20/20] via 172.17.1.2, 00:35:37
O 192.168.60.0/24 [110/129] via 192.168.250.2, 00:35:07, Serial2/0
[110/129] via 192.168.250.17, 00:35:07, Serial3/0
O 192.168.70.0/24 [110/129] via 192.168.250.17, 00:35:07, Serial3/0
O 192.168.80.0/24 [110/65] via 192.168.250.17, 00:35:07, Serial3/0

O 192.168.90.0/24 [110/65] via 192.168.250.2, 00:35:07, Serial2/0
B 192.168.100.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.110.0/24 [20/20] via 172.17.1.2, 00:35:37
B 192.168.120.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.130.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.140.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.200.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.210.0/24 [20/20] via 172.17.1.2, 00:35:37
B 192.168.220.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.230.0/24 [20/3] via 172.17.1.2, 00:35:37
B 192.168.240.0/24 [20/3] via 172.17.1.2, 00:35:37
192.168.250.0/30 is subnetted, 7 subnets
C 192.168.250.0 is directly connected, Serial2/0
O 192.168.250.4 [110/128] via 192.168.250.2, 00:35:07, Serial2/0
O 192.168.250.8 [110/192] via 192.168.250.2, 00:35:07, Serial2/0
[110/192] via 192.168.250.17, 00:35:07, Serial3/0
O 192.168.250.12 [110/128] via 192.168.250.17, 00:35:07, Serial3/0
C 192.168.250.16 is directly connected, Serial3/0
O 192.168.250.20 [110/128] via 192.168.250.2, 00:35:07, Serial2/0
[110/128] via 192.168.250.17, 00:35:07, Serial3/0
192.168.250.24 [110/128] via 192.168.250.17, 00:35:07, Serial3/0

Router Area F Router Table

Router F#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

192.168.60.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.60.0/24 is directly connected, GigabitEthernet0/0
L 192.168.60.1/32 is directly connected, GigabitEthernet0/0
O 192.168.70.0/24 [110/65] via 192.168.250.10, 00:42:07, Serial0/0/1
O 192.168.80.0/24 [110/65] via 192.168.250.25, 00:42:07, Serial0/1/0
O 192.168.90.0/24 [110/65] via 192.168.250.5, 00:42:07, Serial0/0/0
O E2 192.168.100.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
O E2 192.168.110.0/24 [110/20] via 192.168.250.5, 00:41:47, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:47, Serial0/1/0
O E2 192.168.120.0/24 [110/20] via 192.168.250.5, 00:11:11, Serial0/0/0
[110/20] via 192.168.250.25, 00:11:11, Serial0/1/0
O E2 192.168.130.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
O E2 192.168.140.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
O E2 192.168.200.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
O E2 192.168.210.0/24 [110/20] via 192.168.250.5, 00:41:47, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:47, Serial0/1/0
O E2 192.168.220.0/24 [110/20] via 192.168.250.5, 00:11:11, Serial0/0/0
[110/20] via 192.168.250.25, 00:11:11, Serial0/1/0
O E2 192.168.230.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
O E2 192.168.240.0/24 [110/20] via 192.168.250.5, 00:41:17, Serial0/0/0
[110/20] via 192.168.250.25, 00:41:17, Serial0/1/0
192.168.250.0/24 is variably subnetted, 10 subnets, 2 masks

O 192.168.250.0/30 [110/128] via 192.168.250.5, 00:42:07, Serial0/0/0
C 192.168.250.4/30 is directly connected, Serial0/0/0
L 192.168.250.6/32 is directly connected, Serial0/0/0
C 192.168.250.8/30 is directly connected, Serial0/0/1
L 192.168.250.9/32 is directly connected, Serial0/0/1
O 192.168.250.12/30 [110/128] via 192.168.250.10, 00:42:07, Serial0/0/1
[110/128] via 192.168.250.25, 00:42:07, Serial0/1/0
O 192.168.250.16/30 [110/128] via 192.168.250.25, 00:42:07, Serial0/1/0
O 192.168.250.20/30 [110/128] via 192.168.250.5, 00:42:07, Serial0/0/0
[110/128] via 192.168.250.25, 00:42:07, Serial0/1/0
C 192.168.250.24/30 is directly connected, Serial0/1/0
L 192.168.250.26/32 is directly connected, Serial0/1/0

Router Area G Router Table

```
Router G#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

O    192.168.60.0/24 [110/65] via 192.168.250.9, 00:43:25, Serial0/0/0
     192.168.70.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.70.0/24 is directly connected, GigabitEthernet0/0
L       192.168.70.1/32 is directly connected, GigabitEthernet0/0
O    192.168.80.0/24 [110/65] via 192.168.250.14, 00:43:25, Serial0/0/1
O    192.168.90.0/24 [110/129] via 192.168.250.14, 00:43:25, Serial0/0/1
                     [110/129] via 192.168.250.9, 00:43:25, Serial0/0/0
O E2 192.168.100.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
O E2 192.168.110.0/24 [110/20] via 192.168.250.14, 00:43:25, Serial0/0/1
O E2 192.168.120.0/24 [110/20] via 192.168.250.14, 00:12:47, Serial0/0/1
O E2 192.168.130.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
O E2 192.168.140.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
O E2 192.168.200.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
O E2 192.168.210.0/24 [110/20] via 192.168.250.14, 00:43:25, Serial0/0/1
O E2 192.168.220.0/24 [110/20] via 192.168.250.14, 00:12:47, Serial0/0/1
O E2 192.168.230.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
O E2 192.168.240.0/24 [110/20] via 192.168.250.14, 00:42:55, Serial0/0/1
     192.168.250.0/24 is variably subnetted, 9 subnets, 2 masks
O       192.168.250.0/30 [110/192] via 192.168.250.14, 00:43:25, Serial0/0/1
                         [110/192] via 192.168.250.9, 00:43:25, Serial0/0/0
O       192.168.250.4/30 [110/128] via 192.168.250.9, 00:43:25, Serial0/0/0
C       192.168.250.8/30 is directly connected, Serial0/0/0
L       192.168.250.10/32 is directly connected, Serial0/0/0
C       192.168.250.12/30 is directly connected, Serial0/0/1
L       192.168.250.13/32 is directly connected, Serial0/0/1
O       192.168.250.16/30 [110/128] via 192.168.250.14, 00:43:25, Serial0/0/1
O       192.168.250.20/30 [110/128] via 192.168.250.14, 00:43:25, Serial0/0/1
O       192.168.250.24/30 [110/128] via 192.168.250.14, 00:43:25, Serial0/0/1
                          [110/128] via 192.168.250.9, 00:43:25, Serial0/0/0
```

Router Area H Router Table

```
Router H#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

O    192.168.60.0/24 [110/65] via 192.168.250.26, 00:45:15, Serial0/1/1
O    192.168.70.0/24 [110/65] via 192.168.250.13, 00:45:15, Serial0/0/0
     192.168.80.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.80.0/24 is directly connected, GigabitEthernet0/0
L       192.168.80.1/32 is directly connected, GigabitEthernet0/0
O    192.168.90.0/24 [110/65] via 192.168.250.22, 00:45:15, Serial0/1/0
O E2 192.168.100.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
O E2 192.168.110.0/24 [110/20] via 192.168.250.18, 00:45:15, Serial0/0/1
O E2 192.168.120.0/24 [110/20] via 192.168.250.18, 00:14:34, Serial0/0/1
O E2 192.168.130.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
O E2 192.168.140.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
O E2 192.168.200.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
O E2 192.168.210.0/24 [110/20] via 192.168.250.18, 00:45:15, Serial0/0/1
O E2 192.168.220.0/24 [110/20] via 192.168.250.18, 00:14:34, Serial0/0/1
O E2 192.168.230.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
O E2 192.168.240.0/24 [110/20] via 192.168.250.18, 00:44:40, Serial0/0/1
     192.168.250.0/24 is variably subnetted, 11 subnets, 2 masks
O       192.168.250.0/30 [110/128] via 192.168.250.18, 00:45:15, Serial0/0/1
                         [110/128] via 192.168.250.22, 00:45:15, Serial0/1/0
O       192.168.250.4/30 [110/128] via 192.168.250.22, 00:45:15, Serial0/1/0
                         [110/128] via 192.168.250.26, 00:45:15, Serial0/1/1
O       192.168.250.8/30 [110/128] via 192.168.250.26, 00:45:15, Serial0/1/1
                         [110/128] via 192.168.250.13, 00:45:15, Serial0/0/0
C       192.168.250.12/30 is directly connected, Serial0/0/0
L       192.168.250.14/32 is directly connected, Serial0/0/0
C       192.168.250.16/30 is directly connected, Serial0/0/1
L       192.168.250.17/32 is directly connected, Serial0/0/1
```

C 192.168.250.20/30 is directly connected, Serial0/1/0
L 192.168.250.21/32 is directly connected, Serial0/1/0
C 192.168.250.24/30 is directly connected, Serial0/1/1
L 192.168.250.25/32 is directly connected, Serial0/1/1

Router Area I Router Table

Router I#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

O 192.168.60.0/24 [110/65] via 192.168.250.6, 00:46:10, Serial0/0/1
O 192.168.70.0/24 [110/129] via 192.168.250.21, 00:46:00, Serial0/1/0
[110/129] via 192.168.250.6, 00:46:00, Serial0/0/1
O 192.168.80.0/24 [110/65] via 192.168.250.21, 00:46:00, Serial0/1/0
192.168.90.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.90.0/24 is directly connected, GigabitEthernet0/0
L 192.168.90.1/32 is directly connected, GigabitEthernet0/0
O E2 192.168.100.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
O E2 192.168.110.0/24 [110/20] via 192.168.250.1, 00:46:10, Serial0/0/0
O E2 192.168.120.0/24 [110/20] via 192.168.250.1, 00:15:21, Serial0/0/0
O E2 192.168.130.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
O E2 192.168.140.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
O E2 192.168.200.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
O E2 192.168.210.0/24 [110/20] via 192.168.250.1, 00:46:10, Serial0/0/0
O E2 192.168.220.0/24 [110/20] via 192.168.250.1, 00:15:21, Serial0/0/0
O E2 192.168.230.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
O E2 192.168.240.0/24 [110/20] via 192.168.250.1, 00:45:29, Serial0/0/0
192.168.250.0/24 is variably subnetted, 10 subnets, 2 masks
C 192.168.250.0/30 is directly connected, Serial0/0/0
L 192.168.250.2/32 is directly connected, Serial0/0/0
C 192.168.250.4/30 is directly connected, Serial0/0/1
L 192.168.250.5/32 is directly connected, Serial0/0/1
O 192.168.250.8/30 [110/128] via 192.168.250.6, 00:46:10, Serial0/0/1
O 192.168.250.12/30 [110/128] via 192.168.250.21, 00:46:00, Serial0/1/0
O 192.168.250.16/30 [110/128] via 192.168.250.1, 00:46:00, Serial0/0/0
[110/128] via 192.168.250.21, 00:46:00, Serial0/1/0

C 192.168.250.20/30 is directly connected, Serial0/1/0
L 192.168.250.22/32 is directly connected, Serial0/1/0
O 192.168.250.24/30 [110/128] via 192.168.250.21, 00:46:00, Serial0/1/0
[110/128] via 192.168.250.6, 00:46:00, Serial0/0/1