


# OSPF protocol's configuration


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## Description

The OSPF configuration is performed only via CLI. A separate command shell with several modes is used to configure the OSPF protocol (Figure 1). The transition to each mode is performed using commands having the same name as the mode. A detailed description of the commands is available in the [Technical documentation](#).

 **NOTE**  
An configuration example is given for the InfiLINK 2x2, InfiMAN 2x2 families devices, pay attention to the name of the radio interface on your devices during the scheme implementation.

Mode name	Description
Basic	<p>The basic OSPF mode is used to analyze the output of the diagnostic commands and to switch to the configuration mode.</p> <p>Switching to the basic mode is performed from the WANFleX command shell using the "ospf" command.</p> <pre>BS_1#1&gt; ospf OSPF&gt;</pre>
OSPF configuration	<p>The configuration mode allows to manage the OSPF service running on the device and to proceed to the additional configuration modes: router, interfaces or route-maps.</p> <p>The switching to the OSPF configuration mode is performed from the basic mode using the "config" command.</p> <pre>OSPF&gt; config OSPF(config)#</pre>

OSPF router configuration	<p>In the router configuration mode, the basic OSPF settings can be performed. This mode allows to configure the networks, the areas, the router ID, etc.</p> <p>The switching to the OSPF router configuration mode is performed from the configuration mode using the "router" command.</p> <pre>OSPF(config)# router OSPF(config-router)#</pre>
OSPF interface configuration	<p>The OSPF interface configuration mode allows to configure the protocol settings related to a specific interface.</p> <p>The switching to the OSPF interface configuration mode is performed from the configuration mode using the "interface IFNAME" command.</p> <pre>OSPF(config)# interface rf5.0 OSPF(config-if)#</pre>
Route-maps configuration	<p>The route-maps configuration mode allows to configure the rules that should be applied to the announced or received OSPF routes.</p> <p>The switching to the OSPF route-map configuration mode is performed from the configuration mode using the rule creation command "route-map WORD (deny permit) &lt;1-65535&gt;".</p> <pre>OSPF(config)# route-map MAP permit 10 OSPF(config-route-map)#</pre>

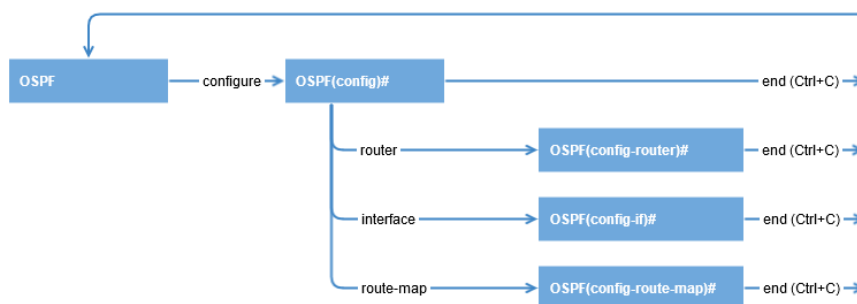


Figure 1 - Switching between the OSPF command shell modes

Each OSPF shell mode provides help by displaying the full list of supported commands. To display the list use the "help" command.

The routing table can be displayed using one of the following commands:

```

From WANFlex command shell:
BS_1#1> netstat -r

From OSPF command shell:
OSPF> show route

From ARDA command shell:
ARDA> show route

```

## Network scheme with one OSPF area

In order to demonstrate how to configure the OSPF protocol and analyze the output of the diagnostic commands, let's take a look at the example in (Figure 2):

- The network consists of three wireless devices BS1, CPE2 and CPE3 configured as routers.
- The wireless devices are part of the OSPF backbone area 0 (only one OSPF area is present in this setup).
- BS1 has an external link for connecting to the LAN-1 network.
- The CPE3 router is connected to the external router R1. To make R1's router networks available, static routes to the networks 192.168.5.0/28 and 192.168.6.0/28 have been added to CPE3.
- Routers BS1, CPE2 and CPE3 use as identifiers the addresses assigned to the loopback interface: 192.168.0.1/32, 192.168.0.2/32 and 192.168.0.3/32.

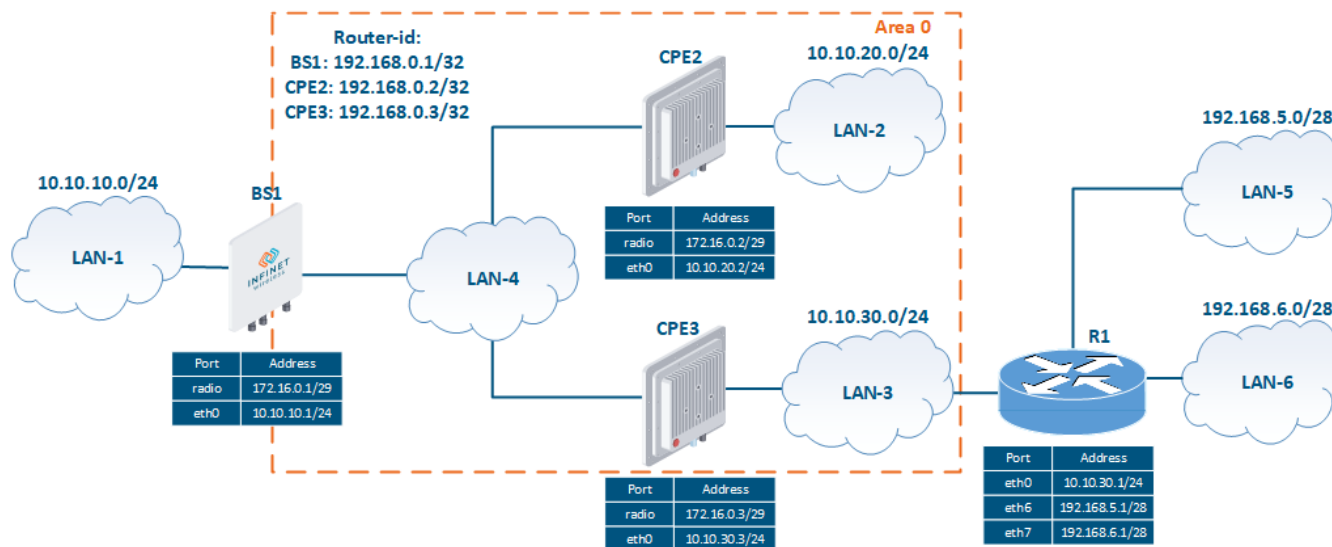


Figure 2 - Network scheme with one OSPF area

## Pre-configuration

<b>Description</b>	<p>Perform a preliminary configuration of the wireless devices, consisting of the following steps:</p> <ul style="list-style-type: none"> <li>• Configure the device IDs.</li> <li>• Remove the svil interface.</li> <li>• Assign IP addresses to network interfaces, according to the scheme.</li> <li>• Add static entries to the routing table.</li> <li>• Disable switching.</li> <li>• Establish the wireless links.</li> </ul>
<b>BS1</b>	<pre> Set the device ID system prompt BS_1  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.10.1/24 ifc rf5.0 172.16.0.1/29 ifc lo0 192.168.0.1/32  Disable switching switch stop  Establish wireless links rf rf5.0 band 20 rf rf5.0 freq 5000  mint rf5.0 -name "BS_1" mint rf5.0 -type master </pre>

<b>CPE2</b>	<pre> Set the device ID system prompt CPE_2  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.20.2/24 ifc rf5.0 172.16.0.2/29 ifc lo0 192.168.0.2/32  Disable switching switch stop  Establish the wireless link mint rf5.0 -name "CPE_2" mint rf5.0 -type slave mint rf5.0 prof 1 -band 20 -freq 5000 -type slave </pre>
<b>CPE3</b>	<pre> Set the device ID system prompt CPE_3  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.30.3/24 ifc rf5.0 172.16.0.3/29 ifc lo0 192.168.0.3/32  Add static routes route add 192.168.5.0/28 10.10.30.1 route add 192.168.6.0/28 10.10.30.1  Disable switching switch stop  Establish the wireless link mint rf5.0 -name "CPE_3" mint rf5.0 -type slave mint rf5.0 prof 1 -band 20 -freq 5000 -type slave </pre>

## OSPF configuration

<b>Description</b>	<p>Configure the OSPF protocol according to the scheme.</p> <p><b>Step 1:</b> start OSPF.</p> <p><b>Step 2:</b> set the router IDs. The identifiers will be equal to the IP addresses assigned to the loopback interface.</p> <p><b>Step 3:</b> define the interfaces where OSPF should be started. All the interfaces are connected to the backbone area according to the scheme. On the BS1 and CPE3 routers, define the networks assigned to the device's interfaces that should take part in OSPF.</p> <p>On the CPE2 router, set all the networks using only one entry 0.0.0.0/0. This entry includes all networks and enables the OSPF support on all router's interfaces; when a device's interface is connected to a new network, this network will be immediately announced via OSPF. This approach doesn't require additional OSPF configuration, but decreases the control over the announcements. In addition, this command advertises the address 127.0.0.1/32 that is assigned to the loopback interface and does not announce the address 192.168.0.2/32, therefore, this network must be additionally specified.</p> <p><b>Step 4:</b> perform the redistribution of the directly connected networks to the BS1 router and of the static routes on the CPE3 router.</p> <p><b>Step 5:</b> configure passive interfaces. The eth0 interface of CPE3 is connected to the external router R1, so no neighboring relation should be established on this interface. Network 10.10.30.0/24 associated with the eth0 interface must be announced via OSPF, so the eth0 interface must be set as passive.</p>
<b>BS1</b>	<pre> Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.1  Start OSPF on the interfaces ospf config router network 172.16.0.0/29 area 0.0.0.0 network 192.168.0.1/32 area 0.0.0.0  Redistribution of the connected routes ospf config router redistribute connected </pre>
<b>CPE2</b>	<pre> Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.2  Start OSPF on the interfaces ospf config router network 0.0.0.0/0 area 0.0.0.0 network 192.168.0.2/32 area 0.0.0.0 </pre>

<b>CPE3</b>	<pre> Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.3  Start OSPF on the interfaces ospf config router network 10.10.30.0/24 area 0.0.0.0 network 172.16.0.0/29 area 0.0.0.0 network 192.168.0.3/32 area 0.0.0.0  Redistribute the static routes ospf config router redistribute kernel  Configure the passive interfaces passive-interface eth0 </pre>
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### Command output analysis

#### Neighbors list

<b>Description</b>	<p>Analyze the neighbors. The routers are connected through the 172.16.0.0/29 network, which is a broadcast segment (using the MINT protocol), so:</p> <ul style="list-style-type: none"> <li>• CPE3 is elected as DR, its router-id being the highest.</li> <li>• CPE2 is elected as BDR, its router-id being the highest after CPE3.</li> <li>• BS1 becomes DROther.</li> <li>• The routers have established Full relations.</li> </ul>
<b>BS1</b>	<pre> OSPF&gt; show neighbor  Neighbor ID      Pri   State           Dead Time   Address        Interface       RXmtL RqstL DBsmL 192.168.0.2      1     Full/Backup     00:00:38   172.16.0.2    rf5.0:172.16.0.1 0      0      0 192.168.0.3      1     Full/DR         00:00:38   172.16.0.3    rf5.0:172.16.0.1 0      0      0 </pre>
<b>CPE2</b>	<pre> OSPF&gt; show neighbor  Neighbor ID      Pri   State           Dead Time   Address        Interface       RXmtL RqstL DBsmL 192.168.0.1      1     Full/DROther    00:00:33   172.16.0.1    rf5.0:172.16.0.2 0      0      0 192.168.0.3      1     Full/DR         00:00:35   172.16.0.3    rf5.0:172.16.0.2 0      0      0 </pre>

CPE3

OSPF> show neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL
RqstL DBsmL						
192.168.0.1	1	Full/DROther	00:00:31	172.16.0.1	rf5.0:172.16.0.3	
0 0 0						
192.168.0.2	1	Full/Backup	00:00:37	172.16.0.2	rf5.0:172.16.0.3	
0 0 0						

## LSDB content

<b>Description</b>	<p>Analyze the LSDB. Since the scheme contains one area, the LSDB output on all the routers will be identical:</p> <ul style="list-style-type: none"> <li>• <b>LSA type 1</b> (Router Link States): the LSDB contains three LSAs type 1, one from each of the area routers. Note that each LSA can contain a lot of information. For example, the LSA type 1 generated by CPE2 contains information about the neighbors, about the 172.16.0.0/29 and 10.10.20.0/24 networks and its own identifier.</li> <li>• <b>LSA type 2</b> (Net Link States): CPE3 as DR has generated one LSA type 2.</li> <li>• <b>LSA type 5</b> (AS External Link States): by default, one LSA type 5 is generated for each external route, therefore the LSDB contains three LSAs type 5, one for each external network: the routes to the networks 192.168.5.0/28 and 192.168.6.0/28 were generated during the redistribution of the CPE3's static routes and the route to network 10.10.10.0/24 is generated by BS1 during the redistribution as a directly connected network.</li> </ul>
<b>BS1, CPE2, CPE3</b>	<pre>OSPF&gt; show database</pre> <pre>       OSPF Router with ID (192.168.0.1)(192.168.0.1)        Router Link States (Area 0.0.0.0)  Link ID        ADV Router    Age  Seq#           LS-Age Link count 192.168.0.1    192.168.0.1    202  0x80000008     7442   2 192.168.0.2    192.168.0.2    201  0x80000008     7405   3 192.168.0.3    192.168.0.3    204  0x8000000a     7407   3        Net Link States (Area 0.0.0.0)  Link ID        ADV Router    Age  Seq#           LS-Age Routers 172.16.0.3/29  192.168.0.3    204  0x80000006     7407   3        AS External Link States  Link ID        ADV Router    Age  Seq#           LS-Age Route 10.10.10.0     192.168.0.1    122  0x80000007     7442  E2 10.10.10.0/24    [0x0] 192.168.5.0    192.168.0.3    169  0x80000007     7407  E2 192.168.5.0/28   [0x0] 192.168.6.0    192.168.0.3    299  0x80000007     7407  E2 192.168.6.0/28   [0x0] </pre>

## Routing table

<b>Description</b>	<p>The routing tables of the wireless devices contain entries for each subnet shown in the scheme. This means that the devices have successfully exchanged the routing information and added it to the FIB.</p> <p>Note that the addresses of the loopback interfaces do not depend on the link state, therefore they can be used to manage the devices in redundant networks.</p>
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BS1	BS_1#1> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	10.10.10.0/24	link#2	UC	0	0	eth0
	10.10.20.0/24	172.16.0.2	UG3	0	0	rf5.0
	10.10.30.0/24	172.16.0.3	UG3	0	0	rf5.0
	127.0.0.1	127.0.0.1	UH	3	141	lo0
	172.16.0.0/29	link#3	UC	0	0	rf5.0
	192.168.0.1	192.168.0.1	UH	0	0	lo0
	192.168.0.2	172.16.0.2	UGH3	0	0	rf5.0
	192.168.0.3	172.16.0.3	UGH3	0	0	rf5.0
	192.168.5.0/28	172.16.0.3	UG3	0	0	rf5.0
	192.168.6.0/28	172.16.0.3	UG3	0	0	rf5.0
	224.0.0.0/8	127.0.0.1	UGS	1	1561	lo0
CPE2	AS_2#2> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	10.10.10.0/24	172.16.0.1	UG3	0	0	rf5.0
	10.10.20.0/24	link#2	UC	0	0	eth0
	10.10.30.0/24	172.16.0.3	UG3	0	0	rf5.0
	127.0.0.1	127.0.0.1	UH	3	50	lo0
	172.16.0.0/29	link#3	UC	0	0	rf5.0
	192.168.0.1	172.16.0.1	UGH3	0	0	rf5.0
	192.168.0.2	192.168.0.2	UH	0	0	lo0
	192.168.0.3	172.16.0.3	UGH3	0	0	rf5.0
	192.168.5.0/28	172.16.0.3	UG3	0	0	rf5.0
	192.168.6.0/28	172.16.0.3	UG3	0	0	rf5.0
	224.0.0.0/8	127.0.0.1	UGS	1	2037	lo0
CPE3	AS_3#1> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	10.10.10.0/24	172.16.0.1	UG3	0	0	rf5.0
	10.10.20.0/24	172.16.0.2	UG3	0	0	rf5.0
	10.10.30.0/24	link#2	UC	0	0	eth0
	127.0.0.1	127.0.0.1	UH	3	155	lo0
	172.16.0.0/29	link#3	UC	0	0	rf5.0
	192.168.0.1	172.16.0.1	UGH3	0	0	rf5.0
	192.168.0.2	172.16.0.2	UGH3	0	0	rf5.0
	192.168.0.3	192.168.0.3	UH	0	0	lo0
	192.168.5.0/28	10.10.30.1	UGS	0	0	eth0
	192.168.6.0/28	10.10.30.1	UGS	0	0	eth0
	224.0.0.0/8	127.0.0.1	UGS	1	1745	lo0

## Network scheme with several OSPF areas

Let's look at the example of a network scheme using several OSPF areas (Figure 3):

- The network consists of four wireless devices BS1, CPE2, CPE3 and CPE4, configured in the router mode.
- The wireless devices are part of three OSPF areas:
  - area 0: routers BS1 and CPE2 are connected to this area. The BS1 router has an external network connection;
  - area 3: routers BS1 and CPE3 are connected to this area, the area's type is NSSA. The CPE3 router has an external link with router R1 and two static routes to the networks 192.168.5.0/28 and 192.168.6.0/28;
  - area 4: routers BS1 and CPE4 are connected to this area, the area's type is Stub.
- Routers BS1, CPE2, CPE3 and CPE4 use the addresses assigned to the loopback interface as identifiers: 192.168.0.1/32, 192.168.0.2/32, 192.168.0.3/32 and 192.168.0.4/32.



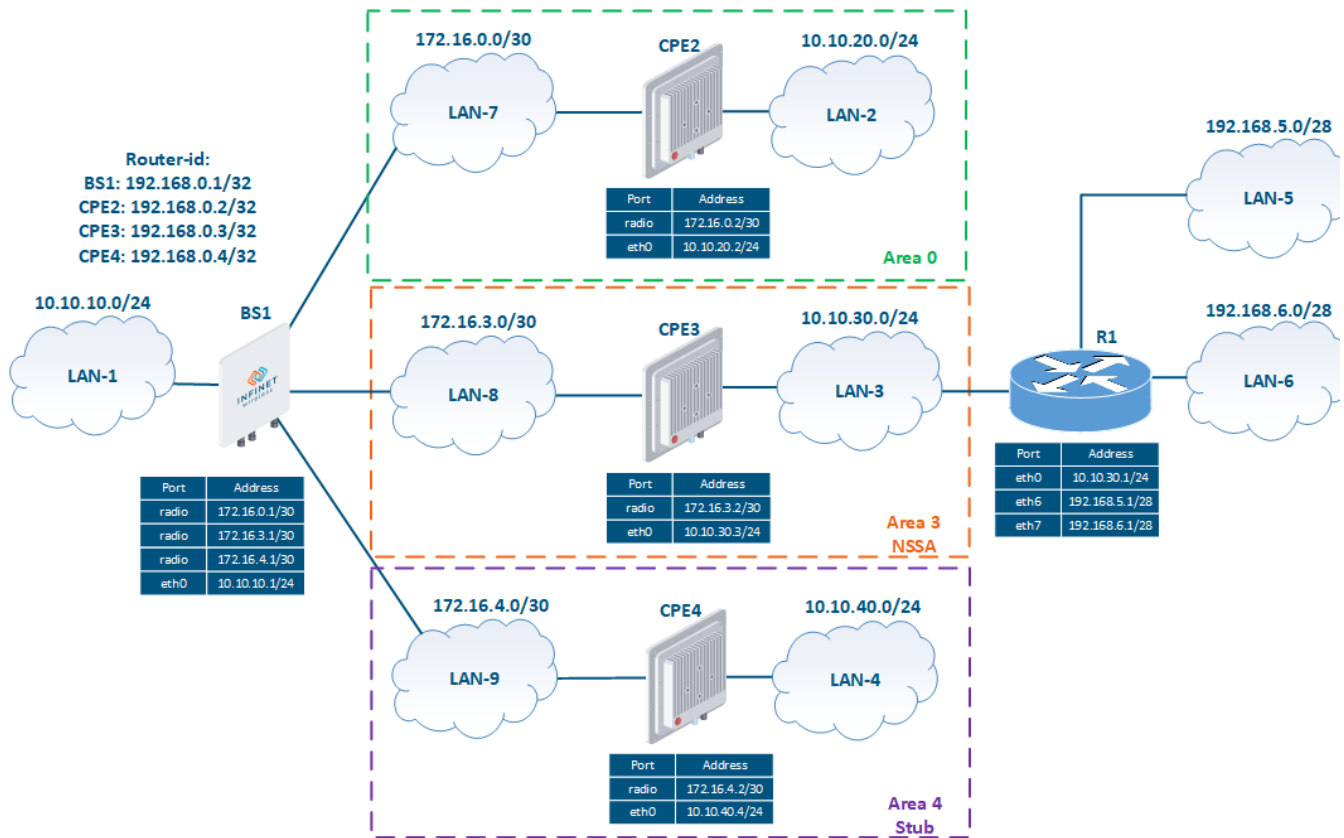


Figure 3 - Network scheme with several OSPF areas

### Pre-configuration

Description	<p>Perform a preliminary configuration of the wireless devices consisting of the following steps:</p> <ul style="list-style-type: none"> <li>• Configure the router IDs.</li> <li>• Remove the svi1 interface.</li> <li>• Assign IP addresses to network interfaces, according to the scheme.</li> <li>• Add static entries to the routing table.</li> <li>• Disable switching.</li> <li>• Establish the wireless links.</li> </ul>
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<b>BS1</b>	<pre> Set the device ID system prompt BS_1  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.10.1/24 ifc rf5.0 172.16.0.1/30 ifc rf5.0 172.16.3.1/30 ifc rf5.0 172.16.4.1/30 ifc lo0 192.168.0.1/32  Disable switching switch stop  Establish the radio link rf rf5.0 band 20 rf rf5.0 freq 5000  mint rf5.0 -name "BS_1" mint rf5.0 -type master </pre>
<b>CPE2</b>	<pre> Set the device ID system prompt CPE_2  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.20.2/24 ifc rf5.0 172.16.0.2/30 ifc lo0 192.168.0.2/32  Disable switching switch stop  Establish the radio link mint rf5.0 -name "CPE_2" mint rf5.0 -type slave mint rf5.0 prof 1 -band 20 -freq 5000 -type slave </pre>

CPE3	<pre> Set the device ID system prompt CPE_3  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.30.3/24 ifc rf5.0 172.16.3.2/30 ifc lo0 192.168.0.3/32  Add static routes route add 192.168.5.0/28 10.10.30.1 route add 192.168.6.0/28 10.10.30.1  Disable switching switch stop  Establish the radio link mint rf5.0 -name "CPE_3" mint rf5.0 -type slave mint rf5.0 prof 1 -band 20 -freq 5000 -type slave </pre>
CPE4	<pre> Set the device ID system prompt CPE_4  Remove the svil interface ifc svil destroy  Assign IP addresses ifc eth0 10.10.40.4/24 ifc rf5.0 172.16.4.2/30 ifc lo0 192.168.0.4/32  Disable switching switch stop  Establish the radio link mint rf5.0 -name "CPE_4" mint rf5.0 -type slave mint rf5.0 prof 1 -band 20 -freq 5000 -type slave </pre>

## OSPF configuration

Description	<p>Let's configure the OSPF protocol according to the scheme.</p> <p><b>Step 1:</b> start OSPF.</p> <p><b>Step 2:</b> configure the router IDs. The identifiers will be equal to the IP addresses assigned to the loopback interface.</p> <p><b>Step 3:</b> define the interfaces where OSPF should be started. All the interfaces are connected to the backbone area according to the scheme.</p> <p><b>Step 4:</b> define the area types: area 3 - NSSA, area 4 - Stub. Note that the area type must be configured on all the routers connected to that area, otherwise they will not establish neighboring relations.</p> <p><b>Step 5:</b> perform the redistribution of the directly connected networks on the BS1 router and of the static routes on the CPE3 router.</p> <p><b>Step 6:</b> configure passive interfaces.</p>
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<b>BS1</b>	<pre>Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.1  Start OSPF on the interfaces ospf config router network 172.16.0.0/30 area 0.0.0.0 network 172.16.3.0/30 area 0.0.0.3 network 172.16.4.0/30 area 0.0.0.4 network 192.168.0.1/32 area 0.0.0.0  Set the area types ospf config router area 0.0.0.3 nssa area 0.0.0.4 stub  Redistribute the connected routes ospf config router redistribute connected</pre>
<b>CPE2</b>	<pre>Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.2  Start OSPF on the interfaces ospf config router network 10.10.20.0/24 area 0.0.0.0 network 172.16.0.0/30 area 0.0.0.0 network 192.168.0.2/32 area 0.0.0.0</pre>

<b>CPE3</b>	<pre>Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.3  Start OSPF on the interfaces ospf config router network 10.10.30.0/24 area 0.0.0.3 network 172.16.3.0/30 area 0.0.0.3 network 192.168.0.3/32 area 0.0.0.3  Set the area types ospf config router area 0.0.0.3 nssa  Redistribute the static routes ospf config router redistribute kernel  Set the passive interfaces passive-interface eth0</pre>
<b>CPE4</b>	<pre>Start OSPF ospf start  Set the router-id ospf config router router-id 192.168.0.4  Start OSPF on the interfaces ospf config router network 10.10.40.0/24 area 0.0.0.4 network 172.16.4.0/30 area 0.0.0.4 network 192.168.0.4/32 area 0.0.0.4  Set the area types ospf config router area 0.0.0.4 stub  Redistribute the static routes ospf config router redistribute kernel</pre>

## Neighbors list

Description	Let's analyze the neighbors list. The routers are connected by the MINT network, but each wireless connection has its own subnet.  Routers CPE2, CPE3 and CPE4 have established a neighboring relation only with BS1, which means that a neighboring relation can be established only within one area.  Routers CPE2, CPE3 and CPE4 are selected as DR, BS1 - BDR, as BS1's router ID is the lowest.																																																														
BS1	<div>OSPF&gt; show neighbor</div> <table><thead><tr><th>Neighbor ID</th><th>Pri</th><th>State</th><th>Dead Time</th><th>Address</th><th>Interface</th><th>RXmtL</th></tr></thead><tbody><tr><td>RqstL DBsmL</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.2</td><td>1</td><td>Full/DR</td><td>00:00:32</td><td>172.16.0.2</td><td>rf5.0:172.16.0.1</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.3</td><td>1</td><td>Full/DR</td><td>00:00:34</td><td>172.16.3.2</td><td>rf5.0:172.16.3.1</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.4</td><td>1</td><td>Full/DR</td><td>00:00:32</td><td>172.16.4.2</td><td>rf5.0:172.16.4.1</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>							Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL	RqstL DBsmL							192.168.0.2	1	Full/DR	00:00:32	172.16.0.2	rf5.0:172.16.0.1		0 0 0							192.168.0.3	1	Full/DR	00:00:34	172.16.3.2	rf5.0:172.16.3.1		0 0 0							192.168.0.4	1	Full/DR	00:00:32	172.16.4.2	rf5.0:172.16.4.1		0 0 0						
Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL																																																									
RqstL DBsmL																																																															
192.168.0.2	1	Full/DR	00:00:32	172.16.0.2	rf5.0:172.16.0.1																																																										
0 0 0																																																															
192.168.0.3	1	Full/DR	00:00:34	172.16.3.2	rf5.0:172.16.3.1																																																										
0 0 0																																																															
192.168.0.4	1	Full/DR	00:00:32	172.16.4.2	rf5.0:172.16.4.1																																																										
0 0 0																																																															
CPE2	<div>OSPF&gt; show neighbor</div> <table><thead><tr><th>Neighbor ID</th><th>Pri</th><th>State</th><th>Dead Time</th><th>Address</th><th>Interface</th><th>RXmtL</th></tr></thead><tbody><tr><td>RqstL DBsmL</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.1</td><td>1</td><td>Full/Backup</td><td>00:00:32</td><td>172.16.0.1</td><td>rf5.0:172.16.0.2</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>							Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL	RqstL DBsmL							192.168.0.1	1	Full/Backup	00:00:32	172.16.0.1	rf5.0:172.16.0.2		0 0 0																																		
Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL																																																									
RqstL DBsmL																																																															
192.168.0.1	1	Full/Backup	00:00:32	172.16.0.1	rf5.0:172.16.0.2																																																										
0 0 0																																																															
CPE3	<div>OSPF&gt; show neighbor</div> <table><thead><tr><th>Neighbor ID</th><th>Pri</th><th>State</th><th>Dead Time</th><th>Address</th><th>Interface</th><th>RXmtL</th></tr></thead><tbody><tr><td>RqstL DBsmL</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.1</td><td>1</td><td>Full/Backup</td><td>00:00:31</td><td>172.16.3.1</td><td>rf5.0:172.16.3.2</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>							Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL	RqstL DBsmL							192.168.0.1	1	Full/Backup	00:00:31	172.16.3.1	rf5.0:172.16.3.2		0 0 0																																		
Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL																																																									
RqstL DBsmL																																																															
192.168.0.1	1	Full/Backup	00:00:31	172.16.3.1	rf5.0:172.16.3.2																																																										
0 0 0																																																															
CPE4	<div>OSPF&gt; show neighbor</div> <table><thead><tr><th>Neighbor ID</th><th>Pri</th><th>State</th><th>Dead Time</th><th>Address</th><th>Interface</th><th>RXmtL</th></tr></thead><tbody><tr><td>RqstL DBsmL</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>192.168.0.1</td><td>1</td><td>Full/Backup</td><td>00:00:37</td><td>172.16.4.1</td><td>rf5.0:172.16.4.2</td><td></td></tr><tr><td>0 0 0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>							Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL	RqstL DBsmL							192.168.0.1	1	Full/Backup	00:00:37	172.16.4.1	rf5.0:172.16.4.2		0 0 0																																		
Neighbor ID	Pri	State	Dead Time	Address	Interface	RXmtL																																																									
RqstL DBsmL																																																															
192.168.0.1	1	Full/Backup	00:00:37	172.16.4.1	rf5.0:172.16.4.2																																																										
0 0 0																																																															

## LSDB content

Description	<p>Let's analyze the LSDB. Unlike in the case of the scheme with one area, in this example the set of LSAs for each area will be different.</p> <p><b>Area 0:</b></p> <ul style="list-style-type: none"> <li>• <b>LSA type 1</b> (Router Link States): The LSDB contains two LSAs type 1, from each area router.</li> <li>• <b>LSA type 2</b> (Net Link States): CPE2 as DR, has generated one LSA type 2.</li> <li>• <b>LSA type 3</b> (Summary Link States): the LSDB contains 6 LSAs type 3 about the networks in different areas.</li> <li>• <b>LSA type 4</b> (ASBR-Summary Link States): CPE3 is ASBR and it is located in area 3, so it redistributes the static routes. BS1 generates an LSA type 4 for area 0 with information about the location of the ASBR (CPE3).</li> <li>• <b>LSA type 5</b> (AS External Link States): By default, one LSA type 5 is generated for each external route, therefore the LSDB contains three LSAs type 5 containing the routes to the external networks: the routes to the networks 192.168.5.0/28 and 192.168.6.0/28 were generated during the redistribution of CPE3's static routes, while the route to network 10.10.10.0/24 is generated by BS1 during the redistribution as a directly connected network. Since area 3 is an NSSA, LSAs type 5 about the networks 192.168.5.0/28 and 192.168.6.0/28 for area 0 are generated by the BS1 to replace the LSA type 7 from CPE3.</li> </ul> <p><b>Area 3:</b></p> <ul style="list-style-type: none"> <li>• <b>LSA type 1</b> (Router Link States): The LSDB contains two LSAs type 1, from each area router.</li> <li>• <b>LSA type 2</b> (Net Link States): CPE3 as DR generates one LSA type 2.</li> <li>• <b>LSA type 3</b> (Summary Link States): the LSDB contains 7 LSAs type 3 about the networks in different areas, similar to area 0. The difference is in the LSA with a default route generated by BS1 for area 3.</li> <li>• <b>LSA type 5</b> (AS External Link States): the CPE3 router generates 2 LSAs type 5 with information about the static routes (redistribution). The presence of these LSAs in the LSDB is formal, since CPE3 converts them to LSA type 7 and forwards them to the neighbors.</li> <li>• <b>LSA type 7</b> (NSSA-external Link States): the external routes are transmitted using LSA type 7 in NSSA type areas, so the LSDB includes three LSAs of this type.</li> </ul> <p><b>Area 4:</b></p> <ul style="list-style-type: none"> <li>• <b>LSA type 1</b> (Router Link States): The LSDB contains two LSAs type 1, one from each area router.</li> <li>• <b>LSA type 2</b> (Net Link States): CPE4 as DR generates one LSA type 2.</li> <li>• <b>LSA type 3</b> (Summary Link States): the LSDB contains 7 LSAs type 3 about the networks in different areas and one LSA type 3, with a default route. Stub areas do not support the distribution of the routes towards the external networks, which are replaced by the default route distribution in LSA type 3.</li> </ul> <p>Note: routers CPE2, CPE3 and CPE4 use only LSAs generated for areas 0, 3, and 4. BS1's LSDB includes LSAs for all areas, since BS1 is ABR and it is set at the border of all three areas.</p>
BS1	<pre> OSPF&gt; show database        OSPF Router with ID (192.168.0.1)(192.168.0.1)            Router Link States (Area 0.0.0.0)  Link ID        ADV Router      Age  Seq#           LS-Age Link count 192.168.0.1    192.168.0.1     235  0x80000003     246    2 192.168.0.2    192.168.0.2     232  0x80000005     243    3            Net Link States (Area 0.0.0.0)  Link ID        ADV Router      Age  Seq#           LS-Age Routers 172.16.0.2/30  192.168.0.2     244  0x80000001     243    2            Summary Link States (Area 0.0.0.0)  Link ID        ADV Router      Age  Seq#           LS-Age Route 10.10.30.0     192.168.0.1     237  0x80000001     237    10.10.30.0/24 10.10.40.0     192.168.0.1     237  0x80000001     237    10.10.40.0/24 172.16.3.0     192.168.0.1     245  0x80000001     245    172.16.3.0/30 172.16.4.0     192.168.0.1     245  0x80000001     245    172.16.4.0/30 192.168.0.3    192.168.0.1     237  0x80000001     237    192.168.0.3/32 192.168.0.4    192.168.0.1     237  0x80000001     237    192.168.0.4/32            ASBR-Summary Link States (Area 0.0.0.0)  Link ID        ADV Router      Age  Seq#           LS-Age 192.168.0.3    192.168.0.1     237  0x80000001     237            Router Link States (Area 0.0.0.3 [NSSA]) </pre>

```

Link ID      ADV Router    Age  Seq#      LS-Age Link count
192.168.0.1  192.168.0.1    236 0x80000003  246 1
192.168.0.3  192.168.0.3    224 0x80000005  243 3

Net Link States (Area 0.0.0.3 [NSSA])

Link ID      ADV Router    Age  Seq#      LS-Age Routers
172.16.3.2/30 192.168.0.3    244 0x80000001  243 2

Summary Link States (Area 0.0.0.3 [NSSA])

Link ID      ADV Router    Age  Seq#      LS-Age Route
0.0.0.0      192.168.0.1    245 0x80000001  245 0.0.0.0/0
10.10.20.0   192.168.0.1    237 0x80000001  237 10.10.20.0/24
10.10.40.0   192.168.0.1    237 0x80000001  237 10.10.40.0/24
172.16.0.0   192.168.0.1    245 0x80000001  245 172.16.0.0/30
172.16.4.0   192.168.0.1    245 0x80000001  245 172.16.4.0/30
192.168.0.1  192.168.0.1    240 0x80000001  240 192.168.0.1/32
192.168.0.2  192.168.0.1    237 0x80000001  237 192.168.0.2/32
192.168.0.4  192.168.0.1    237 0x80000001  237 192.168.0.4/32

NSSA-external Link States (Area 0.0.0.3 [NSSA])

Link ID      ADV Router    Age  Seq#      LS-Age Route
10.10.10.0   192.168.0.1    243 0x80000004  246 E2 10.10.10.0/24 [0x0]
192.168.5.0  192.168.0.3    244 0x80000002  243 E2 192.168.5.0/28 [0x0]
192.168.6.0  192.168.0.3    244 0x80000002  243 E2 192.168.6.0/28 [0x0]

Router Link States (Area 0.0.0.4 [Stub])

Link ID      ADV Router    Age  Seq#      LS-Age Link count
192.168.0.1  192.168.0.1    231 0x80000003  246 1
192.168.0.4  192.168.0.4    215 0x80000005  243 3

Net Link States (Area 0.0.0.4 [Stub])

Link ID      ADV Router    Age  Seq#      LS-Age Routers
172.16.4.2/30 192.168.0.4    244 0x80000001  243 2

Summary Link States (Area 0.0.0.4 [Stub])

Link ID      ADV Router    Age  Seq#      LS-Age Route
0.0.0.0      192.168.0.1    245 0x80000001  245 0.0.0.0/0
10.10.20.0   192.168.0.1    237 0x80000001  237 10.10.20.0/24
10.10.30.0   192.168.0.1    237 0x80000001  237 10.10.30.0/24
172.16.0.0   192.168.0.1    245 0x80000001  245 172.16.0.0/30
172.16.3.0   192.168.0.1    245 0x80000001  245 172.16.3.0/30
192.168.0.1  192.168.0.1    240 0x80000001  240 192.168.0.1/32
192.168.0.2  192.168.0.1    237 0x80000001  237 192.168.0.2/32
192.168.0.3  192.168.0.1    237 0x80000001  237 192.168.0.3/32

AS External Link States

Link ID      ADV Router    Age  Seq#      LS-Age Route
10.10.10.0   192.168.0.1    243 0x80000004  246 E2 10.10.10.0/24 [0x0]
192.168.5.0  192.168.0.1    207 0x80000002  239 E2 192.168.5.0/28 [0x0]
192.168.6.0  192.168.0.1    207 0x80000002  239 E2 192.168.6.0/28 [0x0]

```



CPE2

OSPF&gt; show database

OSPF Router with ID (192.168.0.2)(192.168.0.2)

Router Link States (Area 0.0.0.0)

Link ID	ADV Router	Age	Seq#	LS-Age	Link count
192.168.0.1	192.168.0.1	61	0x80000003	68	2
192.168.0.2	192.168.0.2	56	0x80000005	96	3

Net Link States (Area 0.0.0.0)

Link ID	ADV Router	Age	Seq#	LS-Age	Routers
172.16.0.2/30	192.168.0.2	68	0x80000001	68	2

Summary Link States (Area 0.0.0.0)

Link ID	ADV Router	Age	Seq#	LS-Age	Route
10.10.30.0	192.168.0.1	63	0x80000001	62	10.10.30.0/24
10.10.40.0	192.168.0.1	63	0x80000001	62	10.10.40.0/24
172.16.3.0	192.168.0.1	71	0x80000001	68	172.16.3.0/30
172.16.4.0	192.168.0.1	71	0x80000001	68	172.16.4.0/30
192.168.0.3	192.168.0.1	63	0x80000001	62	192.168.0.3/32
192.168.0.4	192.168.0.1	63	0x80000001	62	192.168.0.4/32

ASBR-Summary Link States (Area 0.0.0.0)

Link ID	ADV Router	Age	Seq#	LS-Age
192.168.0.3	192.168.0.1	63	0x80000001	62

AS External Link States

Link ID	ADV Router	Age	Seq#	LS-Age	Route	
10.10.10.0	192.168.0.1	69	0x80000004	68	E2 10.10.10.0/24	[0x0]
192.168.5.0	192.168.0.1	65	0x80000002	64	E2 192.168.5.0/28	[0x0]
192.168.6.0	192.168.0.1	65	0x80000002	64	E2 192.168.6.0/28	[0x0]

## CPE3

```
OSPF> show database
```

```
OSPF Router with ID (192.168.0.3)(192.168.0.3)
```

```
Router Link States (Area 0.0.0.3 [NSSA])
```

Link ID	ADV Router	Age	Seq#	LS-Age	Link count
192.168.0.1	192.168.0.1	157	0x80000003	163	1
192.168.0.3	192.168.0.3	142	0x80000005	182	3

```
Net Link States (Area 0.0.0.3 [NSSA])
```

Link ID	ADV Router	Age	Seq#	LS-Age	Routers
172.16.3.2/30	192.168.0.3	163	0x80000001	163	2

```
Summary Link States (Area 0.0.0.3 [NSSA])
```

Link ID	ADV Router	Age	Seq#	LS-Age	Route
0.0.0.0	192.168.0.1	166	0x80000001	163	0.0.0.0/0
10.10.20.0	192.168.0.1	158	0x80000001	157	10.10.20.0/24
10.10.40.0	192.168.0.1	158	0x80000001	157	10.10.40.0/24
172.16.0.0	192.168.0.1	166	0x80000001	163	172.16.0.0/30
172.16.4.0	192.168.0.1	166	0x80000001	163	172.16.4.0/30
192.168.0.1	192.168.0.1	161	0x80000001	160	192.168.0.1/32
192.168.0.2	192.168.0.1	158	0x80000001	157	192.168.0.2/32
192.168.0.4	192.168.0.1	158	0x80000001	157	192.168.0.4/32

```
NSSA-external Link States (Area 0.0.0.3 [NSSA])
```

Link ID	ADV Router	Age	Seq#	LS-Age	Route	
10.10.10.0	192.168.0.1	164	0x80000004	163	E2 10.10.10.0/24	[0x0]
192.168.5.0	192.168.0.3	163	0x80000002	182	E2 192.168.5.0/28	[0x0]
192.168.6.0	192.168.0.3	163	0x80000002	182	E2 192.168.6.0/28	[0x0]

```
AS External Link States
```

Link ID	ADV Router	Age	Seq#	LS-Age	Route	
192.168.5.0	192.168.0.3	163	0x80000002	182	E2 192.168.5.0/28	[0x0]
192.168.6.0	192.168.0.3	163	0x80000002	182	E2 192.168.6.0/28	[0x0]

<b>CPE4</b>	<pre> OSPF&gt; show database        OSPF Router with ID (192.168.0.4)(192.168.0.4)        Router Link States (Area 0.0.0.4 [Stub])  Link ID      ADV Router      Age  Seq#           LS-Age Link count 192.168.0.1  192.168.0.1      194  0x80000003     205  1 192.168.0.4  192.168.0.4      176  0x80000005     216  3        Net Link States (Area 0.0.0.4 [Stub])  Link ID      ADV Router      Age  Seq#           LS-Age Routers 172.16.4.2/30 192.168.0.4     205  0x80000001     205  2        Summary Link States (Area 0.0.0.4 [Stub])  Link ID      ADV Router      Age  Seq#           LS-Age Route 0.0.0.0      192.168.0.1     208  0x80000001     205  0.0.0.0/0 10.10.20.0   192.168.0.1     200  0x80000001     199  10.10.20.0/24 10.10.30.0   192.168.0.1     200  0x80000001     199  10.10.30.0/24 172.16.0.0   192.168.0.1     208  0x80000001     205  172.16.0.0/30 172.16.3.0   192.168.0.1     208  0x80000001     205  172.16.3.0/30 192.168.0.1  192.168.0.1     203  0x80000001     202  192.168.0.1/32 192.168.0.2  192.168.0.1     200  0x80000001     199  192.168.0.2/32 192.168.0.3  192.168.0.1     200  0x80000001     199  192.168.0.3/32 </pre>
-------------	---

## Routing table

<b>Description</b>	<p>The routing tables of the wireless devices contain entries about each subnet shown in the scheme. This means that the devices have successfully exchanged the routing information and added it to the FIB.</p> <p>The main difference between the routing tables of the devices are the routes to the external networks: on some routers there is a direct route to the network, and on others a default route.</p> <p>Note: the addresses of the loopback interfaces do not depend on the link state, therefore they can be used to manage the devices in redundant networks.</p>
<b>BS1</b>	<pre> BS_1#1&gt; netstat -r Routing tables Destination      Gateway            Flags      Refs      Use  Interface 10.10.10.0/24     link#2             UC          0          0    eth0 10.10.20.0/24     172.16.0.2         UG3         0          0    rf5.0 10.10.30.0/24     172.16.3.2         UG3         0          0    rf5.0 10.10.40.0/24     172.16.4.2         UG3         0          0    rf5.0 127.0.0.1         127.0.0.1          UH          3         465    lo0 172.16.0.0/30     link#3             UC          0          0    rf5.0 172.16.3.0/30     link#3             UC          0          0    rf5.0 172.16.4.0/30     link#3             UC          0          0    rf5.0 192.168.0.1       192.168.0.1        UH          0          0    lo0 192.168.0.2       172.16.0.2         UGH3        0          0    rf5.0 192.168.0.3       172.16.3.2         UGH3        0          0    rf5.0 192.168.0.4       172.16.4.2         UGH3        0          0    rf5.0 192.168.5.0/28    172.16.3.2         UG3         0          0    rf5.0 192.168.6.0/28    172.16.3.2         UG3         0          0    rf5.0 224.0.0.0/8       127.0.0.1          UGS         1        11852    lo0 </pre>

CPE2	AS_2#2> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	10.10.10.0/24	172.16.0.1	UG3	0	0	rf5.0
	10.10.20.0/24	link#2	UC	0	0	eth0
	10.10.30.0/24	172.16.0.1	UG3	0	0	rf5.0
	10.10.40.0/24	172.16.0.1	UG3	0	0	rf5.0
	127.0.0.1	127.0.0.1	UH	3	396	lo0
	172.16.0.0/30	link#3	UC	0	0	rf5.0
	172.16.3.0/30	172.16.0.1	UG3	0	0	rf5.0
	172.16.4.0/30	172.16.0.1	UG3	0	0	rf5.0
	192.168.0.1	172.16.0.1	UGH3	0	0	rf5.0
	192.168.0.2	192.168.0.2	UH	0	0	lo0
	192.168.0.3	172.16.0.1	UGH3	0	0	rf5.0
	192.168.0.4	172.16.0.1	UGH3	0	0	rf5.0
	192.168.5.0/28	172.16.0.1	UG3	0	0	rf5.0
	192.168.6.0/28	172.16.0.1	UG3	0	0	rf5.0
	224.0.0.0/8	127.0.0.1	UGS	1	15881	lo0
CPE3	AS_3#1> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	default	172.16.3.1	UG3	0	0	rf5.0
	10.10.10.0/24	172.16.3.1	UG3	0	0	rf5.0
	10.10.20.0/24	172.16.3.1	UG3	0	0	rf5.0
	10.10.30.0/24	link#2	UC	0	0	eth0
	10.10.40.0/24	172.16.3.1	UG3	0	0	rf5.0
	127.0.0.1	127.0.0.1	UH	3	534	lo0
	172.16.0.0/30	172.16.3.1	UG3	0	0	rf5.0
	172.16.3.0/30	link#3	UC	0	0	rf5.0
	172.16.4.0/30	172.16.3.1	UG3	0	0	rf5.0
	192.168.0.1	172.16.3.1	UGH3	0	0	rf5.0
	192.168.0.2	172.16.3.1	UGH3	0	0	rf5.0
	192.168.0.3	192.168.0.3	UH	0	0	lo0
	192.168.0.4	172.16.3.1	UGH3	0	0	rf5.0
	192.168.5.0/28	10.10.30.1	UGS	0	0	eth0
	192.168.6.0/28	10.10.30.1	UGS	0	0	eth0
	224.0.0.0/8	127.0.0.1	UGS	1	9339	lo0
CPE4	AS_4#1> netstat -r					
	Routing tables					
	Destination	Gateway	Flags	Refs	Use	Interface
	default	172.16.4.1	UG3	0	0	rf5.0
	10.10.20.0/24	172.16.4.1	UG3	0	0	rf5.0
	10.10.30.0/24	172.16.4.1	UG3	0	0	rf5.0
	10.10.40.0/24	link#2	UC	0	0	eth0
	127.0.0.1	127.0.0.1	UH	3	271	lo0
	172.16.0.0/30	172.16.4.1	UG3	0	0	rf5.0
	172.16.3.0/30	172.16.4.1	UG3	0	0	rf5.0
	172.16.4.0/30	link#3	UC	0	0	rf5.0
	192.168.0.1	172.16.4.1	UGH3	0	0	rf5.0
	192.168.0.2	172.16.4.1	UGH3	0	0	rf5.0
	192.168.0.3	172.16.4.1	UGH3	0	0	rf5.0
	192.168.0.4	192.168.0.4	UH	0	0	lo0
	224.0.0.0/8	127.0.0.1	UGS	1	3138	lo0

## Additional materials

## Webinars

# Title

1. Typical scenario of routing setting using Infinet Wireless devices. Part II

## Other

1. `ifconfig` command (interfaces configuration)
2. ARDA (Aqua Router Daemon)
3. OSPF command
4. `netstat` command