Υλοποίηση Δικτυακών Υποδομών και Υπηρεσιών:
IOS Routing Configuration

Δρ. Απόστολος Γκάμας

Διδάσκων (407/80)

gkamas@uop.gr

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΛΟΠΟΝΝΗΣΟΥ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ

Dynamic Routing Configuration

- The first step in a setup is addressing the links.

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int s0
Router(config-if)#ip address 172.16.0.1 255.255.255.0
Router(config-if)#no shut
Router(config-if)#int s1
Router(config-if)#ip address 172.16.1.1 255.255.255.0
Router(config-if)#no shut
Router(config-if)#
```

Connected to networks.ecse.rpi.edu | SSH2 - 3des-cbc - hmac-md5 - none | 80x27

Dynamic Routing Configuration

Router (config) #

```
router protocol [ keyword ]
```

— Defines an IP routing protocol

Router (config-router) #

```
network network-number
```

- **The network subcommand is a mandatory configuration command for each IP routing process**

Enabling the Rip Router

- Now, we can enable the RIP process on the router, this is done by issuing the “router rip” command from (config) mode.

```
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#?
Router configuration commands:
  auto-summary            Enable automatic network number summarization
  default                 Set a command to its defaults
  default-information     Control distribution of default information
  default-metric          Set metric of redistributed routes
  distance                Define an administrative distance
  distribute-list         Filter networks in routing updates
  exit                    Exit from routing protocol configuration mode
  flash-update-threshold  Specify flash update threshold in second
  help                    Description of the interactive help system
  input-queue             Specify input queue depth
  maximum-paths           Forward packets over multiple paths
  neighbor                Specify a neighbor router
  network                 Enable routing on an IP network
  no                      Negate a command or set its defaults
  offset-list             Add or subtract offset from IGRP or RIP metrics
  output-delay            Interpacket delay for RIP updates
  passive-interface       Suppress routing updates on an interface
  redistribute            Redistribute information from another routing
                          protocol
  timers                  Adjust routing timers
  traffic-share           Algorithm for computing traffic share for alternate
 --More--
Connected to networks.ecse.rpi.edu   SSH2 - 3des-cbc - hmac-md5 - none   80x27
```

Specifying Network

- Once the router is enabled, we specify which network it should be routing for with a “network <ip_address>” command.

```
  traffic-share           Algorithm for computing traffic share for alternate
                          routes
  validate-update-source  Perform sanity checks against source address of
                          routing updates
  version                 Set routing protocol version

Router(config-router)#network 172.16.0.0
Router(config-router)#
```

Connected to networks.ecse.rpi.edu | SSH2 - 3des-cbc - hmac-md5 - none | 80x27

Viewing Setup

- To verify that the protocol is up and ready to go, we can issue a “show ip protocols” command.

```
Router#show ip proto
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 3 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface         Send  Recv   Key-chain
    Serial0           1     1 2
    Serial1           1     1 2
  Routing for Networks:
    172.16.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 120)

Router#
```

Connected to networks.ecse.rpi.edu | SSH2 - 3des-cbc - hmac-md5 - none | 80x27

OSPF Basic Configuration Commands

Router (config) #

router ospf *process-id*

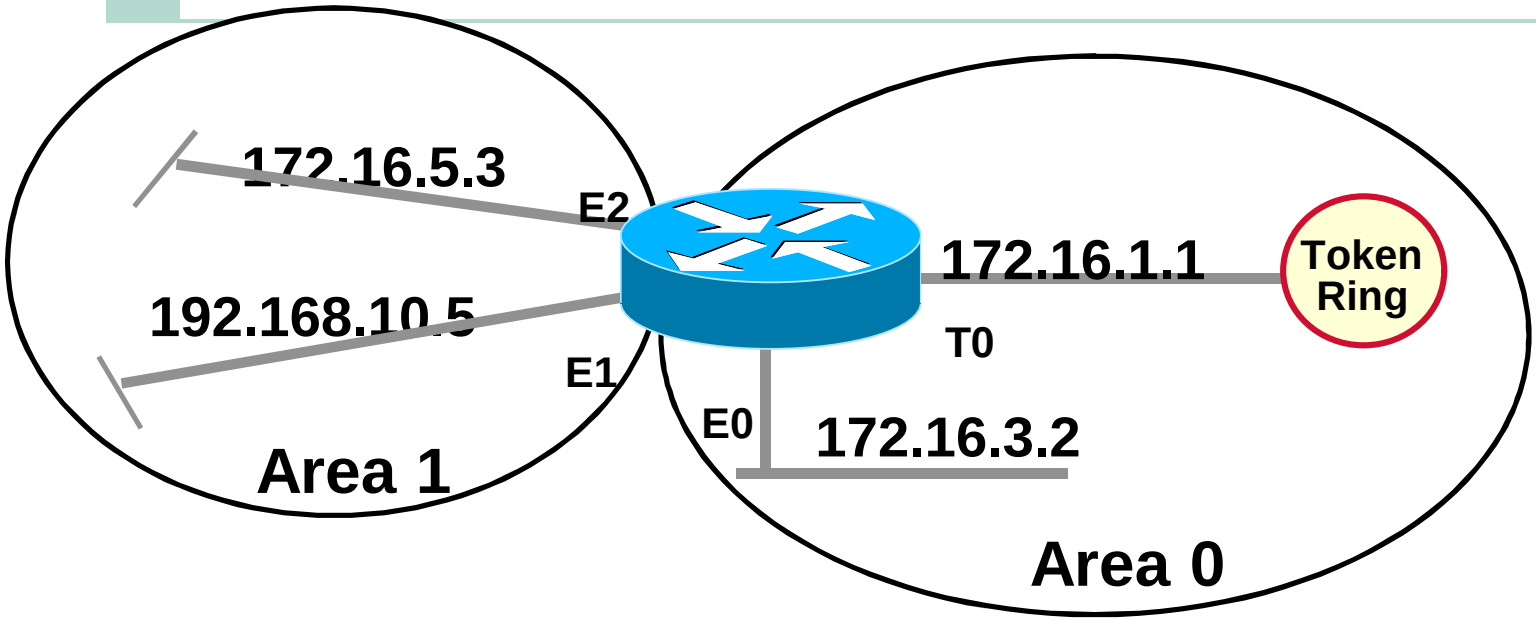
— Enables an OSPF routing process

Router (config-router) #

network *address wildcard-mask* area *area-id*

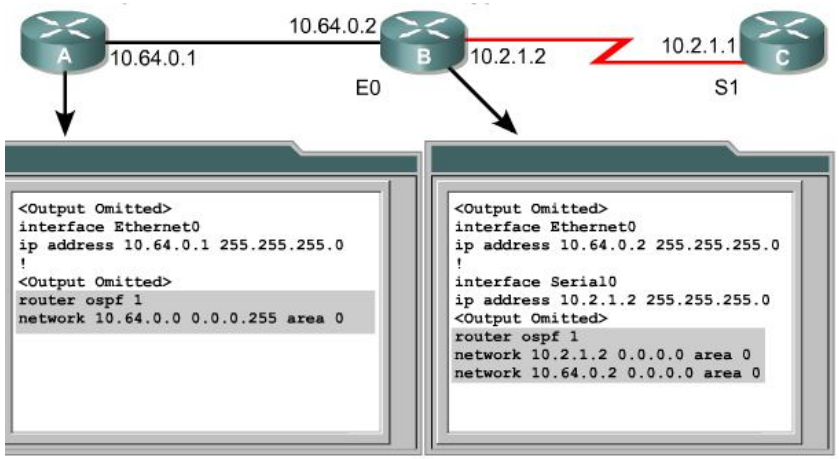
- **Selects participating interfaces**

OSPF Basic Configuration Example




```
router ospf 63
network 172.16.5.3 0.0.0.0. area 1
network 172.16.0.0 0.0.255.255 area 0
network 192.168.10.5 0.0.0.0 area 1
```

Configuring the OSPF Routing Process



Network area Command	Description
address	Can be the network address, subnet, or the address of the interface. Instructs router to know which links to advertise, which links to listen to advertisements on, and what networks to advertise.
wildcard-mask	An inverse mask used to determine how to read the address. The mask has wildcard bits where 0 is a match and 1 is "do not care"; for example, 0.0.255.255 indicates a match in the first two bytes. (the equivalent REGULAR subnet mask would be a 16 bit mask of 255.255.0.0) If specifying the interface address, use mask 0.0.0.0.
area-id	Specifies the area to be associated with the address. Can be a number or can be similar to an IP address A.B.C.D. For a backbone area, the ID must equal 0.

Configuring Router Priority

```
Sydney1(config)#interface fastethernet 0/0
Sydney1(config-if)#ip ospf priority 50
Sydney1(config-if)#end
Sydney1#
00:21:57: %SYS-5-CONFIG_I: Configured from console
by console
```

The Hello packet sent on the fastethernet interface will have the Router Priority Field set to 50.

The priorities can be set to any value from 0 to 255. A value of 0 prevents that router from being elected. A router with the highest OSPF priority will win the election for DR.

Modifying OSPF Cost Metric

Medium	Cost
56 kbps serial link	1785
T1 (1.544 Mbps serial link)	64
E1 (2.048 Mbps serial link)	48
4 Mbps Token Ring	25
Ethernet	10
16 Mbps Token Ring	6
100 Mbps Fast Ethernet, FDDI	1

```
Sydney2(config-if)#ip ospf cost ?
  <1-65535>  Cost
Sydney2(config-if)#ip ospf cost 1
```

Configuring OSPF Timers

Cisco

```
Sydney1(config-if)#ip ospf hello-interval 5
Sydney1(config-if)#ip ospf dead-interval 20
```

OSPF timers are configured on the interface.

Common OSPF Configuration Issues

No Neighbor	OSPF Routes Not Shown
Do interfaces have same OSPF timers?	Do interfaces have correct IP address and subnet mask?
Do connected interfaces have same network type?	Do network statements have correct wildcard masks?
Are authentication keys and passwords the same on interfaces?	Do network statements put links into correct area?
Do the router neighbors have duplicate IP addresses?	
Is the router interface up?	

Verifying OSPF Configuration

- show ip protocol
- show ip route
- show ip ospf interface
- shop ip ospf
- show ip ospf neighbor detail
- show ip ospf database

The debug and clear Commands for OSPF Verification

Command	Description
`clear ip route *`	Clear all routes in routing table
`clear ip route a.b.c.d`	Clear route to a.b.c.d in routing table
`debug ip ospf events`	Report all OSPF events
`debug ip ospf adj`	Report OSPF adjacency events

show ip ospf interface Command

```
Router# show ip ospf interface e0
  Ethernet0 is up, line protocol is up
  Internet Address 203.250.14.1 255.255.255.0, Area 0.0.0.0
  Process ID 10, Router ID 203.250.13.41, Network Type BROADCAST,
     Cost: 10
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 203.250.15.1, Interface address 203.250.14.2
  Backup Designated router (ID) 203.250.13.41, Interface address
     203.250.14.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
     Hello due in 0:00:02
  Neighbor Count is 3, Adjacent neighbor count is 3
    Adjacent with neighbor 203.250.15.1  (Designated Router)
Loopback0 is up, line protocol is up
  Internet Address 203.250.13.41 255.255.255.255, Area 1
  Process ID 10, Router ID 203.250.13.41, Network Type LOOPBACK, Cost: 1
  Loopback interface is treated as a stub Host
```

- Verifies interfaces are in correct areas

show ip ospf Command

```
Router # show ip ospf
     Routing Process "ospf 1" with ID 2.2.2.2
     Supports only single TOS (TOS0) routes
     SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
     Number of areas in this router is 1
          Area 23
               Number of interfaces in this area is 3
               Area has no authentication
               SPF algorithm executed 19 times
               Area ranges are
               Link State Update Interval is 0:30:00 and due in 0:04:55
               Link State Age Interval is 0:20:00 and due in 0:04:55
```

- Displays general information about the OSPF routing process

show ip ospf database Command

```
Router# show ip ospf database

       OSPF Router with ID (3.3.3.3) (Process ID 1)

                Router Link States (Area 23)

Link ID         ADV Router      Age         Seq#       Checksum  Link count
3.3.3.3         3.3.3.3         78          0x80000032 0x80B6    5
4.4.4.4         4.4.4.4         1691        0x8000002B 0xE11C    1
2.2.2.2         2.2.2.2         1693        0x80000030 0xE35E    5
1.1.1.1         1.1.1.1         1696        0x80000026 0x80A1    1

                Net Link States (Area 23)

Link ID         ADV Router      Age         Seq#       Checksum
150.100.4.2     4.4.4.4         1691        0x80000030 0x2FCE
150.100.1.2     2.2.2.2         1693        0x80000024 0xFB29
```

show ip protocol Command

```
Router>  show ip protocol
Routing Protocol is "ospf 300"
    Sending updates every 0 seconds
    Invalid after 0 seconds, hold down 0, flushed after 0
    Outgoing update filter list for all interfaces is not set
    Incoming update filter list for all interfaces is not set
    Redistributing: ospf 300
Routing for Networks:
    183.8.0.0/0.0.255.255
    144.253.100.0/0.0.0.255
Routing Information Sources:
    Gateway         Distance      Last Update
    144.253.100.0         110         6d21
    183.8.128.12          110         0:17:32
    192.3.63.192          110         0:17:33
    192.3.63.194          110         0:17:33
    183.8.128.0           110         6d21
    153.50.192.0          110         0:17:33
    153.50.193.1          110         0:17:33
    183.8.64.130          110         6d19
    183.8.64.128          110         0:17:33
    133.3.4.0             110         0:17:33
    131.108.100.3         110         0:17:33
Distance: (default is 110)
- - More - -
```

BGP cisco configuration

- Ρύθμιση γειτόνων (configuring neighbors)
- Ρύθμιση δικτύων (originating networks)
- Φιλτράρισμα route (route filtering (in/out))
- Επιλογή route (route selection)
  - με χρήση weights
  - με χρήση local preference

Ρύθμιση γειτόνων

router bgp <as-number>

neighbor <ip-address> remote-as <as-number>

neighbor <ip-address> description <neighbor description>

Ρύθμιση δικτύων

- Δήλωση δικτύων τα οποία θα ανακοινώνονται

  network <classfull-network-number>

- Χρήση redistribution από IGP

  router BGP <as-number>

  redistribute <IGP>

  distribute-list <ACL> out <IGP>

  !

  access-list <ACL> permit <network>

Ρύθμιση δικτύων 2

- Χρήση aggregation στην ανακοίνωση δικτύων

  network <ip-prefix-address> mask <subnet-mask>

Ρύθμιση δικτύων 3

- Πριν το aggregation
  - 201.222.191.0/24 201.222.10111111.0/24
  - 201.222.192.0/24 201.222.11000000.0/24
  - 201.222.193.0/24 201.222.11000001.0/24
- Μετά το aggregation
  - 201.222.191.0/24 201.222.10111111.0/24
  - 201.222.192.0/23 201.222.11000000.0/23