

Multi-area OSPF

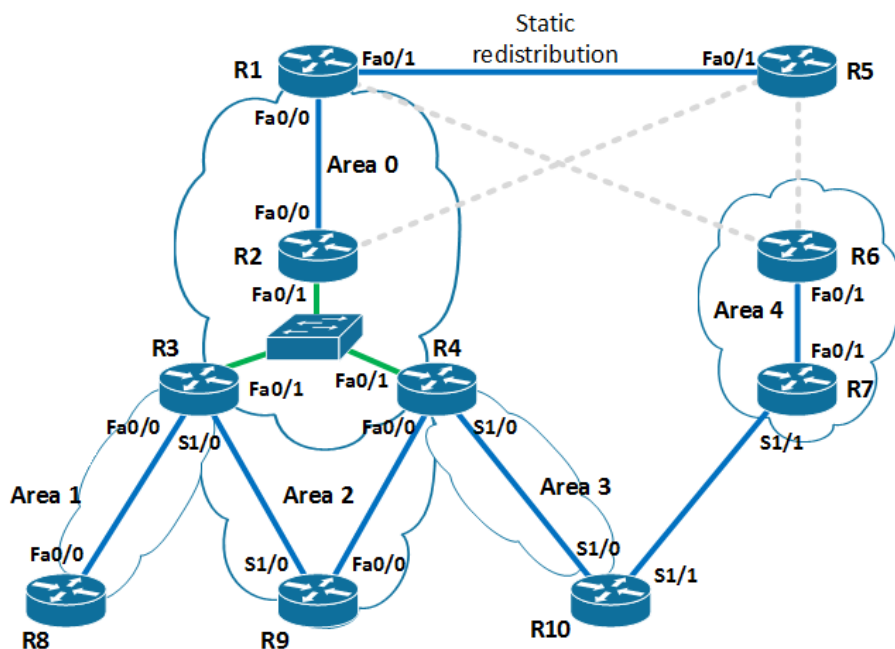
Andrej Šišila, Marián Vachalík

Obsah

| | | |
|--------|--|----|
| 1.1 | Topológia | 3 |
| 1.2 | Úlohy a ich konfigurácia | 4 |
| 1.2.1 | Základná konfigurácia | 4 |
| 1.2.2 | Nakonfigurovať OSPF s viacerými oblasťami | 10 |
| 1.2.3 | R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača, zvyšok spojení P2P | 14 |
| 1.2.4 | Router-id – loopback0, passive-interface | 15 |
| 1.2.5 | Area 1 – Totally Stubby | 16 |
| 1.2.6 | Area 3 – Stub | 17 |
| 1.2.7 | Area 4 – pripojenie pomocou virtuálnej linky | 19 |
| 1.2.8 | Statická redistribúcia smerovacích záznamov z R5 | 20 |
| 1.2.9 | Kontrola DR prostredníctvom “ip ospf priority” | 21 |
| 1.2.10 | Area 2 – R3 primárny smerovač, R4 sekundárny smerovač so sumarizovanými internými smerovacími záznamami do jedného sumarizačného | 21 |
| 1.2.11 | Skrátenie hello a dead-interval časovačov, zistenie funkčnosti vytrhnutím jednej z liniek smerom ku L2 prepínaču | 23 |
| 1.2.12 | Kontrola OSPF databáz a smerovacích tabuliek | 26 |
| 1.2.13 | Kontrola konektivity | 28 |

1.1 Topológia

Budeme konfigurovať Multi-area OSPF, ktorá je znázornená na obrázku 1. Smerovač R10 patrí tiež do oblasti 4. IP adresácia je uvedená v tabuľke 1 a dopĺňa grafické znázornenie topológie na obrázku 1.



Obr. 1: Topológia Multi-area OSPF

Tabuľka 1: IP adresácia

| Smerovač | Funkcia | Rozhranie | IP adresa | Maska |
|----------|------------------------|-----------|---------------|-----------------|
| R1 | ASBR | Fa0/0 | 10.0.12.1 | 255.255.255.0 |
| | | Fa0/1 | 10.100.15.1 | 255.255.255.0 |
| | | Lo0 | 10.255.255.1 | 255.255.255.255 |
| R2 | Štandardný | Fa0/0 | 10.0.12.1 | 255.255.255.0 |
| | | Fa0/1 | 10.100.15.1 | 255.255.255.0 |
| | | Lo0 | 10.255.255.2 | 255.255.255.255 |
| R3 | ABR | Fa0/0 | 10.1.38.1 | 255.255.255.0 |
| | | Fa0/1 | 10.0.234.3 | 255.255.255.0 |
| | | S1/0 | 10.2.39.1 | 255.255.255.252 |
| | | Lo0 | 10.255.255.3 | 255.255.255.255 |
| R4 | ABR | Fa0/0 | 10.2.49.1 | 255.255.255.0 |
| | | Fa0/1 | 10.0.234.4 | 255.255.255.0 |
| | | S1/0 | 10.3.104.1 | 255.255.255.252 |
| | | Lo0 | 10.255.255.4 | 255.255.255.255 |
| R5 | Smerovač iného systému | Fa0/1 | 10.100.15.2 | 255.255.255.0 |
| | | Lo0 | 10.255.255.5 | 255.255.255.255 |
| R6 | Štandardný | Fa0/0 | 10.4.67.1 | 255.255.255.0 |
| | | Lo0 | 10.255.255.6 | 255.255.255.255 |
| R7 | Štandardný | Fa0/1 | 10.4.67.2 | 255.255.255.0 |
| | | S1/1 | 10.4.107.1 | 255.255.255.0 |
| | | Lo0 | 10.255.255.7 | 255.255.255.255 |
| R8 | Štandardný | Fa0/0 | 10.1.38.2 | 255.255.255.0 |
| | | Lo0 | 10.255.255.8 | 255.255.255.255 |
| R9 | Štandardný | Fa0/0 | 10.2.49.2 | 255.255.255.0 |
| | | S1/0 | 10.2.39.2 | 255.255.255.0 |
| | | Lo0 | 10.255.255.9 | 255.255.255.255 |
| R10 | ABR | S1/0 | 10.3.104.2 | 255.255.255.0 |
| | | S1/1 | 10.4.107.2 | 255.255.255.0 |
| | | Lo0 | 10.255.255.10 | 255.255.255.255 |

1.2 Úlohy a ich konfigurácia

1.2.1 Základná konfigurácia

Popis

Ako za základnú konfiguráciu považujeme nastavenie adresácie, vzdialeného prístupu a vypisovania konzoly. IP adresy sme vytvárali tak, že prvý oktet bola 10, druhý oktet bolo číslo oblasti, tretí oktet bolo číslo, ktoré vzniklo ako spojenie čísel dvojíc smerovačov, medzi ktorými sa sieť nachádzala; napr. sieť medzi smerovačmi 4 a 10 by bol tretí oktet 104, medzi smerovačmi R1 a R2 by to bolo 12 atď. Každý smerovač má aj svoje loopback rozhranie, ktoré bližšie opisujeme v kapitole "Router-id - loopback0, passive-interface".

Konfigurácia

```
!!!!!!! R1 !!!!!!!!
hostname R1
no ip domain-lookup
username admin privilege 15 secret admin
line con 0
login local
logging synchronous
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip address 10.255.255.1 255.255.255.255
no shutdown
int f0/1
ip address 10.100.15.1 255.255.255.0
no shutdown
int f0/0
ip address 10.0.12.1 255.255.255.0
no shutdown

do show ip interface brief
```

```
!!!!!!! R2 !!!!!!!!
hostname R2
no ip domain-lookup
username admin privilege 15 secret admin
line con 0
login local
logging synchronous
! Predĺženie intervalu na odpojenie používateľa od konzoly
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip address 10.255.255.2 255.255.255.255
no shutdown
int f0/1
ip address 10.0.234.2 255.255.255.0
no shutdown
int f0/0
ip address 10.0.12.2 255.255.255.0
no shutdown

do show ip interface brief
```

```

!!!!!!!!!!!! R3 !!!!!!!!!!!!!
hostname R3
no ip domain-lookup
username admin privilege 15 secret admin
line con 0
login local
logging synchronous
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip address 10.255.255.3 255.255.255.255
no shutdown
int f0/1
ip address 10.0.234.3 255.255.255.0
no shutdown
int f0/0
ip address 10.1.38.1 255.255.255.0
no shutdown
int s1/0
ip address 10.2.39.1 255.255.255.252
no shutdown

do show ip interface brief

```

```

!!!!!!!!!!!! R4 !!!!!!!!!!!!!
hostname R4
no ip domain-lookup
username admin privilege 15 secret admin
line con 0
login local
logging synchronous
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip address 10.255.255.4 255.255.255.255
no shutdown
int f0/1
ip address 10.0.234.4 255.255.255.0
no shutdown
int f0/0
ip address 10.2.49.1 255.255.255.0
no shutdown
int s1/0
ip address 10.3.104.1 255.255.255.252
no shutdown

```

```
do show ip interface brief
```

```
!!!!!!!!!!!! R5  !!!!!!!!!!!!!
hostname R5
no ip domain-lookup
username admin privilege 15 secret admin
line con 0
login local
logging synchronous
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip address 10.255.255.5 255.255.255.255
no shutdown
int f0/1
ip address 10.100.15.2 255.255.255.0
no shutdown
```

```
do show ip interface brief
```

```
!!!!!!!!!!!! R6  !!!!!!!!!!!!!
hostname R6
no ip domain lookup
username admin privil 15 secret admin
line con 0
login local
logging synchro
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip add 10.255.255.6 255.255.255.255
no sh
int fa0/1
ip add 10.4.67.1 255.255.255.0
no sh
```

```
!!!!!!!!!!!! R7  !!!!!!!!!!!!!
hostname R7
no ip domain lookup
username admin privil 15 secret admin
line con 0
login local
logging synchro
exec-timeout 120
line vty 0 15
privilege level 15
```

```

no login
int lo1
ip add 10.255.255.7 255.255.255.255
no sh
int fa0/1
ip add 10.4.67.2 255.255.255.0
no sh
int s1/1
ip add 10.4.107.1 255.255.255.0
no sh

```

```

!!!!!!!!!!!! R8 !!!!!!!!!!!!!
hostname R8
no ip domain lookup
username admin privil 15 secret admin
line con 0
login local
logging synchro
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip add 10.255.255.8 255.255.255.255
no sh
int fa0/0
ip add 10.1.38.2 255.255.255.0
no sh

```

```

!!!!!!!!!!!! R9 !!!!!!!!!!!!!
hostname R9
no ip domain lookup
username admin privil 15 secret admin
line con 0
login local
logging synchro
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip add 10.255.255.9 255.255.255.255
no sh
int fa0/0
ip add 10.2.49.2 255.255.255.0
no sh
int s1/0
ip add 10.2.39.2 255.255.255.0
no sh

```

```

!!!!!!!!!!!! R10 !!!!!!!!!!!!!

```



```

hostname R10
no ip domain lookup
username admin privil 15 secret admin
line con 0
login local
logging synchro
exec-timeout 120
line vty 0 15
privilege level 15
no login
int lo1
ip add 10.255.255.10 255.255.255.255
no sh
int s1/1
ip add 10.4.107.2 255.255.255.0
no sh
int s1/0
ip add 10.3.104.2 255.255.255.0
no sh

```

Overenie

Základnú konfiguráciu sme overili príkazmi “show ip interface brief”, “show cdp neighbors”. Nižšie sú uvedené výpisy zo smerovača R3.

```
R3#show ip interface brief
```

| Interface | IP-Address | OK? | Method | Status | Protocol |
|-----------------|--------------|-----|--------|--------|----------|
| FastEthernet0/0 | 10.1.38.1 | YES | TFTP | up | up |
| FastEthernet0/1 | 10.0.234.3 | YES | TFTP | up | up |
| Serial1/0 | 10.2.39.1 | YES | TFTP | up | up |
| Serial1/1 | unassigned | YES | TFTP | up | down |
| Serial1/2 | unassigned | YES | TFTP | up | down |
| Serial1/3 | unassigned | YES | TFTP | up | down |
| Loopback1 | 10.255.255.3 | YES | TFTP | up | up |

```
R3#show cdp neighbors
```

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater

| Device ID | Local Intrfce | Holdtme | Capability | Platform | Port ID |
|-----------|---------------|---------|------------|----------|---------|
| R2 | Fas 0/1 | 125 | R S I | 2691 | Fas 0/1 |
| R4 | Fas 0/1 | 137 | R S I | 2691 | Fas 0/1 |
| R8 | Fas 0/0 | 155 | R S I | 2691 | Fas 0/0 |
| R9 | Ser 1/0 | 147 | R S I | 2691 | Ser 1/0 |

Z výpisov vyplýva, že smerovač R3 susedí so štyrmi ďalšími smerovačmi: R2, R4, R8 a R9. Má vlastný aktívny loopback (viď kapitolu “Router-id - loopback0, passive-interface”). R3 na rozhraní “Fas 0/1” susedí s dvoma smerovačmi R2

a R4, pretože sú pripojené ku prepínaču, čím R2, R3 a R4 tvoria broadcastovú doménu.

1.2.2 Nakonfigurovať OSPF s viacerými oblasťami

Popis

Jednotlivé smerovače sme priradili do oblastí podľa obrázku 1.

Konfigurácia

```
!KONFIGURACIA R1
router ospf 1
  network 10.255.255.1 0.0.0.0 area 0
  exit
int f0/0
  ip ospf 1 area 0
  !treba zapnúť interface, keď nám padne router/server
  no shutdown

!KONFIGURACIA R2
router ospf 1
  network 10.255.255.2 0.0.0.0 area 0
  exit
int f0/0
  ip ospf 1 area 0
  no shutdown
int f0/1
  ip ospf 1 area 0
  no shutdown

!KONFIGURACIA R3
router ospf 1
  network 10.255.255.3 0.0.0.0 area 1
  exit
int f0/1
  ip ospf 1 area 0
  no shutdown
int f0/0
  ip ospf 1 area 1
  no shutdown
int s1/0
  ip ospf 1 area 2
  no shutdown

!KONFIGURACIA R4
router ospf 1
  network 10.255.255.4 0.0.0.0 area 3
  exit
int f0/1
```

```

        ip ospf 1 area 0
        no shutdown
int f0/0
        ip ospf 1 area 2
        no shutdown
int s1/0
        ip ospf 1 area 3
        no shutdown

!KONFIGURACIA R5
ip route 0.0.0.0 0.0.0.0 f0/1 10.100.15.1

!KONFIGURACIA R6
router ospf 1
    network 10.255.255.6 0.0.0.0 area 4
    exit
int f0/1
    ip ospf 1 area 4
    no sh

!KONFIGURACIA R7
router ospf 1
    network 10.255.255.7 0.0.0.0 area 4
    exit
int f0/1
    ip ospf 1 area 4
    no sh
int s1/1
    ip ospf 1 area 4
    no sh

!KONFIGURACIA R8
router ospf 1
    network 10.255.255.8 0.0.0.0 area 1
    exit
int f0/0
    ip ospf 1 area 1
    no sh

!KONFIGURACIA R9
router ospf 1
    network 10.255.255.9 0.0.0.0 area 2
    exit
int f0/0
    ip ospf 1 area 2
    no sh
int s1/0
    ip ospf 1 area 2
    no sh

```

```
!KONFIGURACIA R10
router ospf 1
    network 10.255.255.10 0.0.0.0 area 3
    exit
int s1/0
    ip ospf 1 area 3
    no sh
int s1/1
    ip ospf 1 area 4
    no sh
```

Overenie

Príslušnosť smerovačov do oblastí sme testovali týmito príkazmi “show ip ospf interface brief”, “show ip ospf neighbors”, “show ip ospf database”. Nižšie uvádzame výpis uvedených príkazov zo smerovača R1.

```
R1#show ip ospf interface f0/0
FastEthernet0/0 is up, line protocol is up
Internet Address 10.0.12.1/24, Area 0
...
```

```
R1#show ip ospf database
```

```
OSPF Router with ID (10.255.255.1) (Process ID 1)
```

```
Router Link States (Area 0)
```

| Link ID | ADV Router | Age | Seq# | Checksum | Link count |
|---------------|---------------|-----|------------------|----------|------------|
| 10.255.255.1 | 10.255.255.1 | 748 | 0x800000A8 | 0x00D192 | 4 |
| 10.255.255.2 | 10.255.255.2 | 835 | 0x800000A7 | 0x0046AC | 4 |
| 10.255.255.3 | 10.255.255.3 | 707 | 0x800000A4 | 0x00D1B1 | 1 |
| 10.255.255.4 | 10.255.255.4 | 811 | 0x800000A5 | 0x00CFCA | 2 |
| 10.255.255.10 | 10.255.255.10 | 3 | (DNA) 0x80000002 | 0x006AD7 | 1 |

```
Net Link States (Area 0)
```

| Link ID | ADV Router | Age | Seq# | Checksum |
|------------|--------------|-----|------------|----------|
| 10.0.234.4 | 10.255.255.4 | 811 | 0x800000A4 | 0x00F073 |

```
Summary Net Link States (Area 0)
```

| Link ID | ADV Router | Age | Seq# | Checksum |
|-----------|--------------|-----|------------|----------|
| 10.1.38.0 | 10.255.255.3 | 707 | 0x800000A3 | 0x000A48 |
| 10.2.39.0 | 10.255.255.3 | 707 | 0x8000009F | 0x009B42 |
| 10.2.39.0 | 10.255.255.4 | 811 | 0x8000009F | 0x00110C |
| 10.2.39.3 | 10.255.255.3 | 707 | 0x8000009F | 0x00E835 |
| 10.2.39.3 | 10.255.255.4 | 813 | 0x8000009F | 0x006379 |
| 10.2.49.0 | 10.255.255.3 | 709 | 0x8000009F | 0x000FFA |

| | | | | | |
|---------------|---------------|-----|-------|------------|----------|
| 10.2.49.0 | 10.255.255.4 | 813 | | 0x8000009F | 0x002231 |
| 10.3.104.0 | 10.255.255.4 | 813 | | 0x8000009F | 0x00BBDE |
| 10.3.104.0 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x005221 |
| 10.3.104.3 | 10.255.255.4 | 813 | | 0x8000009F | 0x0009D1 |
| 10.3.104.3 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x00A48E |
| 10.4.67.0 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x00434A |
| 10.4.107.0 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x00254A |
| 10.255.255.3 | 10.255.255.3 | 709 | | 0x800000A3 | 0x00413E |
| 10.255.255.4 | 10.255.255.4 | 813 | | 0x800000A3 | 0x00314C |
| 10.255.255.4 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x00D405 |
| 10.255.255.6 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x0025A8 |
| 10.255.255.7 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x00B620 |
| 10.255.255.8 | 10.255.255.3 | 709 | | 0x80000021 | 0x00787A |
| 10.255.255.9 | 10.255.255.3 | 710 | | 0x8000009F | 0x008FAD |
| 10.255.255.9 | 10.255.255.4 | 814 | | 0x8000009F | 0x000577 |
| 10.255.255.10 | 10.255.255.4 | 814 | | 0x8000009F | 0x007FBB |
| 10.255.255.10 | 10.255.255.10 | 7 | (DNA) | 0x80000001 | 0x0016FD |

Router Link States (Area 3)

| Link ID | ADV Router | Age | Seq# | Checksum | Link count |
|--------------|--------------|-----|------------|----------|------------|
| 10.255.255.1 | 10.255.255.1 | 245 | 0x800000A4 | 0x006F18 | 0 |

Type-5 AS External Link States

| Link ID | ADV Router | Age | Seq# | Checksum | Tag |
|--------------|--------------|------|------------|----------|-----|
| 10.255.255.5 | 10.255.255.1 | 1515 | 0x8000009E | 0x009ACE | 0 |

Z výpisu “show ip ospf interface f0/0” smerovača R1 vyplýva, že rozhranie “f0/0” patrí do oblasti 0, čo je chrbticová oblasť. V OSPF topológií majú smerovače v rovnakej oblasti totožnú LSDB (Link State databázu). Na začiatku výpisu LSDB vidíme “Router ID” smerovača, ktorého databázu sledujeme. V časti “Router Link States (Area 0)” vidíme priamo pripojené siete ku chrbticovej oblasti. Šíria sa ako LSA 1 a generuje ich každý smerovač v OSPF topológií. Je medzi nimi aj loopback rozhranie R10, pretože sme museli vytvoriť virtuálne pripojenie oblasti 4 cez oblasť 3 (viď kapitola “Area 3 – Stub”). R10 sa preto tvári ako ABR a šíri svoje siete správami LSA 3. V časti “Net Link States (Area 0)” vidíme DR smerovač (R4). Šíria sa ako LSA 2 a generuje ich DR smerovač. V časti “Summary Net Link States (Area 0)” vidíme ohlasované siete od ABR smerovačov. Niektoré záznamy sú zdvojené, pretože aj R3, aj R4 sú ABR smerovačmi do oblasti 2. Šíria sa ako LSA 3 a generujú ich ABR smerovače. V časti “Type-5 AS External Link States” vidíme siete ohlasované z iných autonómnych systémov (AS). V našom prípade sme ohlasovali cestu ku smerovaču R5. R5 bol pripojený ku R1, preto sa stal R1 ASBR smerovačom. Tieto siete sa šíria ako LSA 5 a generuje ich ASBR smerovač.

1.2.3 R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača, zvyšok spojení P2P

Popis

V "broadcastovej" a "non-broadcastovej" doméne smerovače v rámci OSPF topológie komunikujú pomocou LSA 2 správ, ktorými si volia DR/BDR smerovač. DR (Designated Router) je smerovač, ktorý slúži ako centrálny bod pre výmenu smerovacích informácií v "broadcast" doméne v rámci OSPF. BDR (Backup DR) je záložný smerovač v prípade, že by DR smerovač prestal fungovať.

Konfigurácia

```
!KONFIGURACIA R1
int f0/0
    ip ospf network point-to-point

!KONFIGURACIA R2
int f0/0
    ip ospf network point-to-point

!KONFIGURACIA R3
int f0/0
    ip ospf network point-to-point
int s1/0
    ip ospf network point-to-point

!KONFIGURACIA R4
int f0/0
    ip ospf network point-to-point
int s1/0
    ip ospf network point-to-point

!KONFIGURACIA R6
int f0/1
    ip ospf network point-to-point

!KONFIGURACIA R7
int f0/1
    ip ospf network point-to-point
int s1/1
    ip ospf network point-to-point

!KONFIGURACIA R8
int f0/0
    ip ospf network point-to-point

!KONFIGURACIA R9
int f0/0
    ip ospf network point-to-point
    ip ospf 1 area 2
```

```

int s1/0
    ip ospf network point-to-point

!KONFIGURACIA R10
int s1/0
    ip ospf network point-to-point
int s1/1
    ip ospf network point-to-point

```

Overenie

Typ siete (resp. rozhrania) sme overovali príkazom "show ip ospf interface <názov_rozhrania >". Napríklad smerovač R3 na Fa0/0:

```

FastEthernet0/0 is up, line protocol is up
  Internet Address 10.1.38.1/24, Area 1
  Process ID 1, Router ID 10.255.255.3, Network Type POINT_TO_POINT, Cost: 10

```

Z uvedeného show príkazu vyplýva, že rozhranie "Fa0/0" na smerovači R3 patrí do siete typu "point-to-point".

1.2.4 Router-id – loopback0, passive-interface

Popis

IP adresa loopback rozhrania sa nastavila ako Router ID a zároveň sme loopback rozhranie "lo1" nastavili ako pasívne.

Konfigurácia

Na každom routri sme vykonali tieto príkazy:

```

router ospf 1
    router-id 10.255.255.X
    passive-interface lo1

```

'X' symbolizuje číslo smerovača (napr. pre R1: 10.255.255.1)

Overenie

Router ID sme overovali príkazom "show ip ospf 1".

```

R3#show ip ospf 1
Routing Process "ospf 1" with ID 10.255.255.3

```

Pasívne rozhranie sme overovali príkazom “show ip ospf interface brief”.

```
R3#show ip ospf interface brief
Interface      PID      Area      IP Address/Mask      Cost      State      Nbrs      F/C
Fa0/1          1        0         10.0.234.3/24        1         DR         2/2
Lo1           1       1       10.255.255.3/32    1       LOOP     0/0
Fa0/0          1        1         10.1.38.1/24         10        P2P        1/1
Se1/0          1        2         10.2.39.1/30         64        P2P        1/1
```

Z výpisu vyplýva, že loopback rozhranie “Lo1” je v pasívnom móde (LOOP) a teda sa cezeň nemôže vytvoriť susedstvo.

1.2.5 Area 1 – Totally Stubby

Popis

“Totally Stubby” oblasť je taký druh oblasti, v ktorej sa nešíria žiadne LSA 3, LSA 4, LSA 5 a predvolená cesta sa šíri ako LSA 3.

Konfigurácia

Oblasť 1 nastavíme na typ “Totally Stubby” na smerovačoch R3 a R8.

```
!R3 - R3 je ABR, preto použijeme dodatočný príkaz "no-summary", aby sme
!definovali Totally Stubby oblasť
R3(config)#router ospf 1
R3(config-router)#area 1 stub no-summary
```

```
!R8
R8(config)#router ospf 1
R8(config-router)#area 1 stub
```

Overenie

Na overenie sme použili príkaz “show ip ospf database”.

```
R3#show ip ospf database
```

...

Router Link States (Area 1)

| Link ID | ADV Router | Age | Seq# | Checksum | Link count |
|--------------|--------------|-----|------------|----------|------------|
| 10.255.255.3 | 10.255.255.3 | 23 | 0x80000088 | 0x008854 | 3 |
| 10.255.255.8 | 10.255.255.8 | 24 | 0x80000081 | 0x0021B8 | 3 |

Summary Net Link States (Area 1)

| Link ID | ADV Router | Age | Seq# | Checksum |
|---------|--------------|-----|------------|----------|
| 0.0.0.0 | 10.255.255.3 | 68 | 0x80000001 | 0x0045EB |
| ... | | | | |

Z príkazu “show ip ospf database” na R3 vyplýva, že predvolená cesta sa v oblasti 1 šíri ako predvolená cesta ako LSA 3 (Link ID t.j. Router ID v časti “Summary Net Link States” pre oblasť 1 je 0.0.0.0).

1.2.6 Area 3 – Stub

Popis

Oblasť 3 nemôže byť “Stub” oblasťou, pretože sa ňou nešíria správy LSA 4 a 5, ktoré potrebuje virtuálne spojenie. Preto sme po úvahe oblasť 3 zmenili zo “Stub” na štandardnú oblasť a namiesto toho sme oblasť 2 nastavili ako “Stub”.

Konfigurácia

Konfigurovali sme smerovače R3, R4 a R9. Konfigurácia bola zhodná pre všetky spomenuté smerovače.

```
R3(config)#router ospf 1
R3(config-router)#area 2 stub
```

Overenie

Stub sieť sme overili príkazom “show ip ospf database router” zo smerovača R3 a R4.

```
R3#show ip ospf database router
...
Router Link States (Area 2)
...

LS age: 2012
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.255.255.3
Advertising Router: 10.255.255.3
LS Seq Number: 80000008
Checksum: 0x2FDB
Length: 48
Area Border Router
Number of Links: 2
```

```
Link connected to: another Router (point-to-point)
(Link ID) Neighboring Router ID: 10.255.255.9
```

```

(Link Data) Router Interface address: 10.2.39.1
Number of TOS metrics: 0
TOS 0 Metrics: 64

Link connected to: a Stub Network
(Link ID) Network/subnet number: 10.2.39.0
(Link Data) Network Mask: 255.255.255.252
Number of TOS metrics: 0
TOS 0 Metrics: 64

...

R4#show ip ospf database router
...
Router Link States (Area 2)
...

LS age: 510
Options: (No TOS-capability, DC)
LS Type: Router Links
Link State ID: 10.255.255.4
Advertising Router: 10.255.255.4
LS Seq Number: 80000008
Checksum: 0xB6BB
Length: 48
Area Border Router
Number of Links: 2

Link connected to: another Router (point-to-point)
(Link ID) Neighboring Router ID: 10.255.255.9
(Link Data) Router Interface address: 10.2.49.1
Number of TOS metrics: 0
TOS 0 Metrics: 65535

Link connected to: a Stub Network
(Link ID) Network/subnet number: 10.2.49.0
(Link Data) Network Mask: 255.255.255.0
Number of TOS metrics: 0
TOS 0 Metrics: 65535

...

```

Z uvedeých výpisov vyplýva, že smerovače R3 a R4 patria k oblasti 2, čo je oblasť typu "Stub".

1.2.7 Area 4 – pripojenie pomocou virtuálnej linky

Popis

Oblasť 4 sme potrebovali pripojiť ku existujúcej OSPF topológii. Pripojenie sa dalo uskutočniť iba cez oblasť 3, čo nie je chrbticová oblasť. Keďže každá oblasť v OSPF topológii musí byť pripojená ku chrbticovej oblasti. Preto sme museli oblasť 4 pripojiť ku chrbticovej oblasti tak, že sme vytvorili vzájomné virtuálne spojenie medzi smerovačmi R4 a R10.

Konfigurácia

Nižšie je uvedená konfigurácia smerovačov R4 a R10.

```
!R4
router ospf 1
  area 3 virtual-link 10.255.255.10
```

```
!R10
router ospf 1
  area 3 virtual-link 10.255.255.4
```

Overenie

Virtuálne pripojenie sme overovali príkazom “show ip ospf interface brief” na smerovačoch R4 a R10 a príkazom “show ip ospf database” na R4 (pretože pokiaľ virtuálne pripojenie funguje, záznamy o sieťach v oblasti 4 by mali byť vidieť v chrbticovej oblasti).

```
R4#show ip ospf interface brief
```

| Interface | PID | Area | IP Address/Mask | Cost | State | Nbrs | F/C |
|------------|----------|----------|----------------------|-----------|------------|------------|-----|
| VL0 | 1 | 0 | 10.3.104.1/30 | 64 | P2P | 1/1 | |
| Fa0/1 | 1 | 0 | 10.0.234.4/24 | 10 | DROTH | 2/2 | |
| Fa0/0 | 1 | 2 | 10.2.49.1/24 | 65535 | P2P | 1/1 | |
| Lo1 | 1 | 3 | 10.255.255.4/32 | 1 | LOOP | 0/0 | |
| Se1/0 | 1 | 3 | 10.3.104.1/30 | 64 | P2P | 1/1 | |

```
R10#show ip ospf interface brief
```

| Interface | PID | Area | IP Address/Mask | Cost | State | Nbrs | F/C |
|------------|----------|----------|----------------------|-----------|------------|------------|-----|
| VL0 | 1 | 0 | 10.3.104.2/24 | 64 | P2P | 1/1 | |
| Lo1 | 1 | 3 | 10.255.255.10/32 | 1 | LOOP | 0/0 | |
| Se1/0 | 1 | 3 | 10.3.104.2/24 | 64 | P2P | 1/1 | |
| Se1/1 | 1 | 4 | 10.4.107.2/24 | 64 | P2P | 1/1 | |

```
R4#show ip ospf database
```

```
...
```

```
Summary Net Link States (Area 0)
```

| Link ID | ADV Router | Age | Seq# | Checksum |
|--------------|---------------|-----|------------------|----------|
| ... | | | | |
| 10.4.67.0 | 10.255.255.10 | 5 | (DNA) 0x80000001 | 0x00434A |
| 10.4.107.0 | 10.255.255.10 | 5 | (DNA) 0x80000001 | 0x00254A |
| ... | | | | |
| 10.255.255.6 | 10.255.255.10 | 5 | (DNA) 0x80000001 | 0x0025A8 |
| 10.255.255.7 | 10.255.255.10 | 5 | (DNA) 0x80000001 | 0x00B620 |
| ... | | | | |

Z výpisov od oboch smerovačov vyplýva, že virtuálne pripojenie bolo úspešne vytvorené a malo názov "VL0". Záznamy sietí z oblasti 4 sú vidieť v LSDB databáze na R4 šírené ako LSA 3, čo znamená, že sa oblasť 4 tvári ako priamo pripojená ku chrbticovej oblasti.

1.2.8 Statická redistribúcia smerovacích záznamov z R5

Popis

Na smerovači R5 sme nastavili predvolenú cestu, aby sme prepojili smerovač externej oblasti, R5, s OSPF topológiou.

Konfigurácia

```
R5(config)#ip route 0.0.0.0 0.0.0.0 f0/1 10.100.15.1
```

Potom sme na smerovači R1 namapovali cestu k "lo1" na R5, ktorú sme ohlásili v rámci OSPF topológie príkazmi "redistribute":

```
R1(config)#ip route 10.255.255.5 255.255.255.255 f0/1 10.100.15.2
R1(config)#router ospf 1
R1(config-router)#redistribute static subnets
R1(config-router)#redistribute connected subnets
```

Overenie

Prítomnosť statickej cesty sme overovali príkazom "show ip route" na smerovačoch R1 a R2.

```
R1#show ip route
...
S      10.255.255.5/32 [1/0] via 10.100.15.2, FastEthernet0/1
...
```

```
R2#show ip route
...
O E2      10.255.255.5/32 [110/20] via 10.0.12.1, 00:03:07, FastEthernet0/0
...
```

Ako vyplýva z výpisov, statická cesta na R1 sa objavila aj na smerovači R2 ako "E2". Cena (Cost) externej cesty typu "E2" v celej OSPF topológii bude mať konštantnú hodnotu 20, nariadenú od typu "E1", pri ktorej sa jej cena zvyšuje každým prechodom na každý ďalší smerovač v OSPF topológii.

1.2.9 Kontrola DR prostredníctvom "ip ospf priority"

Popis

Smerovač R4 sme manuálne nastavili ako DR.

Konfigurácia

```
int f0/1
 ip ospf priority 100
```

Overenie

Prioritu sme overovali zo smerovača R2 príkazom "show ip ospf neighbor".

```
R2(config-if)#do show ip ospf neighbor
```

| Neighbor ID | Pri | State | Dead Time | Address | Interface |
|--------------|-----|----------|-----------|------------|-----------|
| 10.255.255.3 | 1 | FULL/BDR | 00:00:01 | 10.0.234.3 | Fa0/1 |
| 10.255.255.4 | 100 | FULL/DR | 00:00:01 | 10.0.234.4 | Fa0/1 |

```
R2(config-if)#do show ip ospf neighbor
```

| Neighbor ID | Pri | State | Dead Time | Address | Interface |
|--------------|-----|----------|-----------|------------|-----------|
| 10.255.255.3 | 1 | FULL/BDR | 00:00:01 | 10.0.234.3 | Fa0/1 |
| 10.255.255.4 | 100 | FULL/DR | 00:00:01 | 10.0.234.4 | Fa0/1 |

1.2.10 Area 2 – R3 primárny smerovač, R4 sekundárny smerovač so sumarizovanými internými smerovacími záznamami do jedného sumarizačného

Popis

Smerovač R3 sme nastavili ako primárny a R4 ako sekundárny smerovač. To môžeme doceliť aj zmenou formálnej prenosovej rýchlosti (Bandwidth) na rozhraní F0/0 na smerovači R4.

Konfigurácia

```
!R4
int f0/0
    bandwidth 1

!R3 aj R4 - sumarizácia
router ospf 1
    area 2 range 10.2.0.0 255.255.0.0 1
```

Hoci príkaz uvádzame príkaz na sumarizáciu sietí v oblasti 2, nepoužili sme ho na žiadnom zo smerovačov, pretože riadenie toku z R5 do R9 fungovalo správne aj bez sumarizácie.

Tým, že znížime bandwidth na tomto rozhraní, zvýšime jeho "Cost". Zmena sa potom ohlásí všetkým smerovačom v sieti. Následkom toho bude rozhranie f0/1 na R3 preferované pre ďalšie smerovanie.

Overenie

Na overenie sme použili príkaz traceroute v smeroch R5 -> R9, R9 -> R5 a R10 -> R5.

Kontrola smerovania z R5 na R9:

```
R5#traceroute 10.255.255.9

Type escape sequence to abort.
Tracing the route to 10.255.255.9

 0 10.100.15.1 12 msec 16 msec 20 msec
 1 10.0.12.2 36 msec 36 msec 36 msec
 2 10.0.234.3 60 msec 36 msec 76 msec
 3 10.2.39.2 56 msec * 80 msec
```

Kontrola smerovania z R9 na R5:

```
R9#traceroute 10.255.255.5

Type escape sequence to abort.
Tracing the route to 10.255.255.5

 0 10.2.49.1 16 msec 16 msec 20 msec
 1 10.0.234.2 36 msec 36 msec 36 msec
 2 10.0.12.1 60 msec 36 msec 80 msec
 3 10.100.15.2 60 msec * 64 msec
```

Kontrola smerovania z R10 na R5:

```
R10#traceroute 10.255.255.5
```

```
Type escape sequence to abort.  
Tracing the route to 10.255.255.5
```

```
 1 10.3.104.1 8 msec 20 msec 12 msec  
 2 10.0.234.2 40 msec 36 msec 36 msec  
 3 10.0.12.1 48 msec 44 msec 76 msec  
 4 10.100.15.2 80 msec * 72 msec
```

Z výpisov vyplýva, že smerovanie z R5 ku R9 prechádza prioritne cez R3. Smerovanie od R9 do R5 prechádza ale cez R4, rovnako ako z R10 na R5.

1.2.11 Skrátenie hello a dead-interval časovačov, zistenie funkčnosti vytrhnutím jednej z liniek smerom ku L2 prepínaču

Popis

Smerovačom R2, R3 a R4 sme na rozhraní "Fa0/1" znížili "hello" a "dead" intervaly na rozhraniach pripojených k prepínaču. Význam "hello" intervalu je ten, že oznamuje ostatným smerovačom v oblasti, že jeho priamo pripojená sieť je živá. "dead" interval hovorí o tom, ako dlho budeme čakať, kým sieť vyhlásime za odpojenú. Čím sú tieto intervaly kratšie, tým rýchlejšia je konvergencia siete, v prípade, že nastane zmena v topológii. Pokiaľ však nastavíme "hello" a "dead" intervaly v milisekundách (hodnota menšia ako 1), hrozí, že úplne vyťažíme procesor v smerovači.

Konfigurácia

Skrátenie "hello" a "dead" intervalov na smerovačoch R2, R3 a R4 na rozhraní "Fa0/1".

```
!R3  
int f0/1  
    ip ospf hello-interval 1  
    ip ospf dead-interval 2
```

Odpojenie linky Fa0/1 na R3:

```
R3(config)#int f0/1  
R3(config-if)#shutdown
```

Overenie

Zisťovali sme, či sa "hello" a "dead" intervaly zmenili príkazom "show ip ospf interface fa0/1". Testovali sme čas konverencie a konektivitu pri výpadku rozhrania "Fa0/1" na smerovači R3 v smeroch R5 -> R9, R5 -> R8, R5 -> R10 a R8 -> R6 príkazmi "ping" a "traceroute".

Ukážka časovačov na rozhraní "f0/1" na smerovači R3.

```
R3#show ip ospf interface fa0/1
FastEthernet0/1 is administratively down, line protocol is down
  Internet Address 10.0.234.3/24, Area 0
  Process ID 1, Router ID 10.255.255.3, Network Type BROADCAST, Cost: 1
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State DOWN, Priority 1
  No designated router on this network
  No backup designated router on this network
Timer intervals configured, Hello 1, Dead 2, Wait 2, Retransmit 5
  oob-resync timeout 40
```

Priebeh "ping-u" v smere R5 -> R9:

```
R5#ping
Protocol [ip]:
Target IP address: 10.255.255.9
Repeat count [5]: 100000
Datagram size [100]: 100
Timeout in seconds [2]: 1
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
...
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
...
Success rate is 99 percent (11853/11870), round-trip min/avg/max = 52/79/148
```

```
R5#traceroute 10.255.255.9

Type escape sequence to abort.
Tracing the route to 10.255.255.9

 0 10.100.15.1 24 msec 16 msec 16 msec
 1 10.0.12.2 36 msec 40 msec 36 msec
 2 10.0.234.4 56 msec 36 msec 80 msec
 3 10.2.49.2 56 msec * 80 msec
```


Priebeh "ping-u" v smere R5 -> R8:

```
R5#ping 10.255.255.8
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 10.255.255.8, timeout is 2 seconds:
```

```
U.U.U
```

```
Success rate is 0 percent (0/5)
```

```
R5#traceroute 10.255.255.8
```

```
Type escape sequence to abort.
```

```
Tracing the route to 10.255.255.8
```

```
 1 10.100.15.1 8 msec 20 msec 16 msec
```

```
 2 10.100.15.1 !H * !H
```

Priebeh "ping-u" v smere R5 -> R10:

```
R5#ping 10.255.255.10
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 10.255.255.10, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/72/84 ms
```

Priebeh "ping-u" v smere R8 -> R6:

```
R8#ping 10.255.255.6
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 10.255.255.6, timeout is 2 seconds:
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
R8#traceroute 10.255.255.6
```

```
Type escape sequence to abort.
```

```
Tracing the route to 10.255.255.6
```

| | | | |
|---|---|---|---|
| 1 | * | * | * |
| 2 | * | * | * |
| 3 | * | * | * |
| 4 | * | * | * |
| 5 | * | * | * |
| 6 | * | * | |

Mali sme rôzne spôsoby, ako overiť toto nastavenie: použitím nepretržitého ping-u, pričom sledujeme čas konverencie; debugging smerovacej tabuľky a OSPF procesu. Avšak použili sme len príkaz “show ip ospf názov_rozhrania”, pretože pri vypnutí rozhrania “Fa0/1” vznikali nasledujúce problémy:

- Oblasť 1 stratí konektivitu s chrbticovou oblasťou, pretože už nebude priamo pripojená ku chrbticovej oblasti. Riešením by bolo vytvorenie virtuálneho pripojenia cez oblasť 2. Rovnaký problém vznikne aj s oblasťami 3 a 4 pri odpojení linky f0/1 na smerovači R4.
- Vznikne smerovacia slučka medzi smerovačmi R3 a R9. Keď sme vypli rozhranie “f0/1” medzi prepínačom a R3, tak sa smerovač odrezal od chrbticovej oblasti 0. Ale keďže jeho loopback bol stále v oblasti 0, tak sám seba stále považoval za ABR do oblasti 0, a preto generoval LSA 3. Tým pádom R9 dostalo predvolenú cestu od R3 aj od R4. Vybralo si tú od R3, lebo mala menšiu cenu (Cost). A keď prišiel ping z R9 na R3 (pomocou predvolenej cesty), tak tam sa zase cez predvolenú cestu poslal späť na R9. A tak sa to posielalo dookola. Riešením je presunúť loopback na R3 do oblasti 1, tak R3 prestala generovať LSA 3. Na R9 prišla následne len jedna predvolená cesta (z R4) a smerovanie sa upravilo. Táto zmena sa prejavila aj v základnej konfigurácii, ktorú uvádzame na začiatku dokumentácie.

Po vypnutí rozhrania “Fa0/1” na smerovači R3 sieť skonvergovala za 8 sekúnd (8 neúspešných pingov). Po skonvergovaní bolo možné dostať sa zo smerovača R5 na R9, R10, ale nie na R8, pretože R8 už nebol pripojený priamo na chrbticovú oblasť cez R3, ale na oblasť 2 cez smerovače R3 a R9 (problém nastal na linke medzi R3 a R9). Výpadok konektivity v smeroch R5 -> R8 a R8 -> R6 sme nevedeli vyriešiť. Možno by pomohlo vytvorenie virtuálneho pripojenia resp. tunela ku chrbticovej oblasti, ale tieto možnosti sme nepreskúmali.

1.2.12 Kontrola OSPF databáz a smerovacích tabuliek

Popis

OSPF databáza (LSDB - Link State DataBase) je sumárny výstup, v ktorom môžeme sledovať, od ktorých smerovačov získavame ktoré LSA správy. Smerovacia tabuľka je výstup, ktorý obsahuje informácie o topológii siete.

Overenie

Použili sme tieto príkazy:

```
show ip ospf database
show ip ospf neighbors
show ip ospf interface brief
show ip protocols
show ip route
```

Výpis příkazu "show ip protocols" zo smerovača R4.

```
R4#show ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.255.255.4
  It is an area border router
  Number of areas in this router is 3. 3 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.255.255.4 0.0.0.0 area 3
  Routing on Interfaces Configured Explicitly (Area 0):
    FastEthernet0/1
  Routing on Interfaces Configured Explicitly (Area 2):
    FastEthernet0/0
  Routing on Interfaces Configured Explicitly (Area 3):
    Serial1/0
  Reference bandwidth unit is 100 mbps
  Passive Interface(s):
    Loopback1
  Routing Information Sources:
    Gateway          Distance      Last Update
    10.255.255.10     110          03:28:28
    10.255.255.9      110          04:08:59
    10.255.255.2      110          03:44:16
    Gateway          Distance      Last Update
    10.255.255.3      110          03:44:18
    10.255.255.1      110          03:44:08
  Distance: (default is 110)
```

Výpis příkazu "show ip route" zo smerovača R4.

```
R4#show ip route
Codes: 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
       i - IS-IS, su - IS-IS summary, 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

```
10.0.0.0/8 is variably subnetted, 21 subnets, 3 masks
O      10.255.255.10/32 [110/65] via 10.3.104.2, 03:31:18, Serial1/0
O IA   10.255.255.8/32 [110/21] via 10.0.234.3, 03:46:56, FastEthernet0/1
O      10.255.255.9/32 [110/65536] via 10.2.49.2, 04:11:39, FastEthernet0/0
O      10.0.12.0/24 [110/20] via 10.0.234.2, 03:46:56, FastEthernet0/1
O      10.255.255.2/32 [110/11] via 10.0.234.2, 03:46:56, FastEthernet0/1
O IA   10.255.255.3/32 [110/11] via 10.0.234.3, 03:46:56, FastEthernet0/1
O      10.255.255.1/32 [110/21] via 10.0.234.2, 03:46:57, FastEthernet0/1
O IA   10.255.255.6/32 [110/139] via 10.3.104.2, 03:31:09, Serial1/0
O IA   10.255.255.7/32 [110/129] via 10.3.104.2, 03:31:09, Serial1/0
C      10.255.255.4/32 is directly connected, Loopback1
O E2   10.255.255.5/32 [110/20] via 10.0.234.2, 03:46:47, FastEthernet0/1
O IA   10.1.38.0/24 [110/20] via 10.0.234.3, 03:46:57, FastEthernet0/1
O      10.2.39.0/30 [110/65663] via 10.2.49.2, 04:11:41, FastEthernet0/0
O      10.2.39.0/24 [110/65599] via 10.2.49.2, 04:11:41, FastEthernet0/0
C      10.2.49.0/24 is directly connected, FastEthernet0/0
O IA   10.4.67.0/24 [110/138] via 10.3.104.2, 03:31:10, Serial1/0
O      10.100.15.0/24 [110/30] via 10.0.234.2, 03:46:58, FastEthernet0/1
C      10.3.104.0/30 is directly connected, Serial1/0
O      10.3.104.0/24 [110/128] via 10.3.104.2, 03:31:20, Serial1/0
O IA   10.4.107.0/24 [110/128] via 10.3.104.2, 03:31:10, Serial1/0
C      10.0.234.0/24 is directly connected, FastEthernet0/1
```

Výpis uvedených príkazov uvádzame v týchto kapitolách:

- show ip ospf database
 - Nakonfigurovať OSPF s viacerými oblasťami
 - Area 1 – Totally Stubby
 - Area 3 – Stub
 - Area 4 – pripojenie pomocou virtuálnej linky
- show ip ospf neighbors
 - Nakonfigurovať OSPF s viacerými oblasťami
- show ip ospf interface brief
 - Router-id - loopback0, passive-interface
 - Area 4 – pripojenie pomocou virtuálnej linky

1.2.13 Kontrola konektivity

Popis

Konektivitu sme testovali pomocou tclsh skriptu, ktorý “opíngal” každý smerovač v topológii.

Konfigurácia

```
R1#tclsh
# Celý foreach cyklus skopírujeme do terminálu

foreach address {
#R1
10.100.15.2
10.0.12.1

#R2
10.0.12.2
10.0.234.2

#R3
10.0.234.3
10.1.38.1
10.2.39.1

#R4
10.0.234.4
10.2.49.1
10.3.104.1

#R5
10.100.15.1

#R6
10.4.67.1

#R7
10.4.67.2
10.4.107.1

#R8
10.1.38.2

#R9
10.2.39.2
10.2.49.2

#R10
10.4.107.2
10.3.104.2
} {
ping $address}
```

Overenie

Po skopírovaní skriptu do terminálu sa začne okamžite vykonávať (ak nie, stlačíme Enter). Otestuje sa konektivita ku každému smerovaču. Výstup pochádza zo smerovača R10, ale rovnaký výsledok dostaneme aj na všetkých ostatných smerovačoch.

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.100.15.2, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/74/80 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.12.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 44/56/60 ms% Unre

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.12.2, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 24/35/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.2, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 24/36/44 ms% Unre

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.3, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 24/35/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.1.38.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 24/36/44 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.39.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 40/48/60 ms% Unre

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.4, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 12/17/24 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.49.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 16/18/20 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.3.104.1, timeout is 2 seconds:

!!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 12/17/20 ms% Unre

Type escape sequence to abort.

```

Sending 5, 100-byte ICMP Echos to 10.100.15.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/58/64 ms% Unreco

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.67.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/37/40 ms% Unreco

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.67.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/20/28 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.107.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/17/20 ms% Unreco

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.38.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/56/60 ms% Unreco

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.39.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/54/60 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.49.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/36/40 ms% Unreco

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.107.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/36/40 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.104.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/38/40 ms

```