**ŽILINSKÁ UNIVERZITA V ŽILINE**

**Fakulta riadenia a informatiky**

**Projektovanie sietí 1**

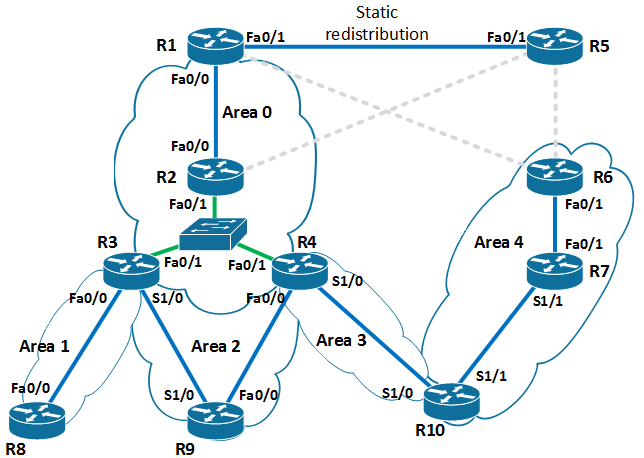
**Zadanie č. 1: OSPF**

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**Zadanie**

Úlohou bolo na smerovačoch v už vytvorenej topológii nakonfigurovať správne fungujúci smerovací protokol OSPF a overiť jeho funkčnosť a splnenie jednotlivých bodov zadania.

**Topológia**



**Adresovanie**

|  |  |  |  |
| --- | --- | --- | --- |
| **Smerovač** | **Interface** | **IP Adresa** | **Maska siete** |
| **R1** | l0 | 10.255.255.1 | 255.255.255.255 |
| fa0/0 | 10.0.12.1 | 255.255.255.0 |
| fa0/1 | 10.0.15.1 | 255.255.255.0 |
| **R2** | l0 | 10.255.255.2 | 255.255.255.255 |
| fa0/0 | 10.0.12.2 | 255.255.255.0 |
| fa0/1 | 10.0.234.1 | 255.255.255.0 |
| **R3** | l0 | 10.255.255.3 | 255.255.255.255 |
| fa0/0 | 10.1.38.1 | 255.255.255.0 |
| fa0/1 | 10.0.234.2 | 255.255.255.0 |
| s1/0 | 10.2.39.1 | 255.255.255.0 |
| **R4** | l0 | 10.255.255.4 | 255.255.255.255 |
| fa0/0 | 10.2.49.1 | 255.255.255.0 |
| fa0/1 | 10.0.234.3 | 255.255.255.0 |
| s1/0 | 10.3.40.1 | 255.255.255.0 |
| **R5** | l0 | 10.255.255.5 | 255.255.255.255 |
| fa0/1 | 10.0.15.2 | 255.255.255.0 |
| **R6** | l0 | 10.255.255.6 | 255.255.255.255 |
| fa0/1 | 10.4.67.1 | 255.255.255.0 |
| **R7** | l0 | 10.255.255.7 | 255.255.255.255 |
| fa0/1 | 10.4.67.2 | 255.255.255.0 |
| s1/1 | 10.4.70.1 | 255.255.255.0 |
| **R8** | l0 | 10.255.255.8 | 255.255.255.255 |
| fa0/0 | 10.1.38.2 | 255.255.255.0 |
| **R9** | l0 | 10.255.255.9 | 255.255.255.255 |
| fa0/0 | 10.2.49.2 | 255.255.255.0 |
| s1/0 | 10.2.39.2 | 255.255.255.0 |
| **R10** | l0 | 10.255.255.10 | 255.255.255.255 |
| s1/0 | 10.3.40.2 | 255.255.255.0 |
| s1/1 | 10.4.70.2 | 255.255.255.0 |

**Úlohy**

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Pozn.: Pre lepšiu prehľadnosť výpisov na smerovačoch sme z nich nepodstatné časti vymazali a dôležité časti zvýraznili hrubým písmom.

1. **Nakonfigurovať OSPF s viacerými oblasťami**

Na všetkých smerovačoch okrem R5 (z dôvodu, že sa nenachádza v oblastiach OSPF) sme aktivovali smerovací protokol OSPF a následne aj siete, ich masku a oblasť, do ktorých patria.

Kontrolu sme vykonali príkazom *show ip protocols* na jednotlivých smerovačoch, ktorý zobrazí typ smerovacieho protokolu a číslo procesu, ID smerovača a všetky siete a oblasti, pre ktoré vykonáva smerovanie.

**4R3#**sh ip protocols

Routing Protocol is "ospf 1"

Router ID 10.255.255.3

It is an area border router

Number of areas in this router is 3. 2 normal 1 stub 0 nssa

Routing for Networks:

**10.0.234.0 0.0.0.255 area 0**

**10.1.38.0 0.0.0.255 area 1**

**10.2.39.0 0.0.0.255 area 2**

**4R10#**sh ip protocols

Routing Protocol is "ospf 1"

Router ID 10.255.255.10

Number of areas in this router is 3. 2 normal 1 stub 0 nssa

Routing for Networks:

**10.3.40.0 0.0.0.255 area 3**

**10.4.70.0 0.0.0.255 area 4**

1. **R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača, zvyšok spojení P2P**

Na všetkých Fast Ethernet rozhraniach smerovačov z oblastí 1-4 (s výnimkou LAN siete medzi smerovačmi R2, R3, R4) sme použili príkaz *ip ospf network point-to-point*.   
Na sériových rozhraniach ho nebolo nutné použiť, pretože tie sú point-to-point defaultne.

Na výpisoch *show ip ospf interface brief* v stĺpci State vidíme typ spojenia pre jednotlivé rozhrania v daných sieťach. P2P znamená point-to-point spojenie, DR, BDR a DROTH značí, že smerovače sú v danej sieti broadcastovo prepojené L2 prepínačom a volil sa Designated Router a Backup Designated Router.

**4R1#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/0 1 0 10.0.12.1/24 10 **P2P**  1/1

**4R2#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/1 1 0 10.0.234.1/24 10 **DR**  2/2

Fa0/0 1 0 10.0.12.2/24 10 **P2P** 1/1

**4R3#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/1 1 0 10.0.234.2/24 10 **BDR**  2/2

Fa0/0 1 1 10.1.38.1/24 10 **P2P** 1/1

Se1/0 1 2 10.2.39.1/24 5 **P2P**  1/1

**4R4#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/1 1 0 10.0.234.3/24 10 **DROTH** 2/2

Fa0/0 1 2 10.2.49.1/24 10 **P2P**  1/1

Se1/0 1 3 10.3.40.1/24 64 **P2P**  1/1

**4R7#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Se1/1 1 4 10.4.70.1/24 64 **P2P**  1/1

Fa0/1 1 4 10.4.67.2/24 10 **P2P**  1/1

1. **Router-id - loopback0, passive-interface**

Na každom smerovači sme nastavili jeho ID ako IP adresu jeho loopbacku a všetky loopbacky sme nastavili v ospf konfigurácii ako passive-interface.

**4R1#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.1**

**4R2#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.2**

**4R3#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.3**

**4R4#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.4**

**4R5#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.5**

**4R6#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.6**

**4R7#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.7**

**4R8#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.8**

**4R9#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.9**

**4R10#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.10**

Passive interface:

**4R1#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R2#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R3#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R4#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R5#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R6#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R7#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R8#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R9#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**4R10#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

1. **Area 1 – Totally Stubby**

Do Totally Stubby oblasti sa nepreposielajú LSA3, LSA4 a LSA5 a neakceptuje LSA4 a LSA5. Nemá info o ASBR, externých sieťach, ani o sieťach z iných oblastí, nemôže obsahovať ASBR a má info len o intra area cestách.

Na smerovači R8 použijeme príkaz *area 1 stub* a na R3 *area 1 stub no-summary* (pretože je ABR).

**4R8#**sh ip ospf database

OSPF Router with ID (10.255.255.8) (Process ID 1)

Router Link States (Area 1)

Link ID **ADV Router** Age Seq# Checksum Link count

10.255.255.3 **10.255.255.3** 1827 0x8000002B 0x00DE79 2

10.255.255.8 10.255.255.8 1688 0x8000002C 0x0065EC 2

Summary Net Link States (Area 1)

Link ID **ADV Router**  Age Seq# Checksum

0.0.0.0 **10.255.255.3**  1828 0x80000024 0x00FE0F

1. **Area 3 – Stub**

Ako Totally Stubby, okrem toho, že má info o sieťach z iných oblastí, ale nie o ich topológii. Na všetkých smerovačoch v stub oblasti (R4 a R10) uvedieme príkaz *area 3 stub*. Nasledujúci výpis nám dá informáciu o type oblasti.

**4R10#**sh ip ospf | begin Area 3

Area 3

Number of interfaces in this area is 1

**It is a stub area**

1. **Area 4 – pripojenie pomocou virtuálnej linky**

Túto úlohu nebolo prakticky možné splniť, pretože Area 3 je stub. Ak by nebola stub, oblasť area 4 by sme virtuálne pripojili príkazom *area 3 virtual-link 10.3.40.x* na smerovačoch R4 a R10.

1. **Statická redistribúcia smerovacích záznamov z R5**

Aby mohol smerovač R5 komunikovať s ostatnými smerovačmi v topológii, bolo potrebné na R1 nastaviť statickú redistribúciu príkazom *redistribute static subnets*, ktorý zabezpečí redistribúciu všetkých staticky smerovaných sietí, teda v našom prípade sieť k smerovaču R5.

**4R1#**sh ip route 10.255.255.5

Routing entry for **10.255.255.5/32**

Known via "**static**", distance 1, metric 0

**Redistributing via ospf 1**

Advertised by ospf 1 subnets

1. **Kontrola DR prostredníctvom “ip ospf priority”**

Na smerovači R2 sme na rozhraní fa0/1 (v sieti 10.0.234.0) nastavili prioritu 100 príkazom *ip ospf priority 100*, čo z neho urobilo DR a na R3 prioritu 50, vďaka čomu sa stal BDR. Overili sme to výpisom OSPF susedov na smerovači R4.

**4R4#**sh ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

**10.255.255.2 100 FULL/DR**  00:00:19 10.0.234.1FastEthernet0/1

**10.255.255.3 50 FULL/BDR** 00:00:19 10.0.234.2FastEthernet0/1

10.255.255.9 0 FULL/ - 00:00:19 10.2.49.2FastEthernet0/0

10.255.255.10 0 FULL/ - 00:00:19 10.3.40.2 Serial1/0

1. **Kontrola OSPF databáz a smerovacích tabuliek**

Príkazmi *show ip route* a *show ip ospf database* na jednotlivých smerovačoch sme overili ich smerovacie tabuľky a OSPF databázy. Uvedieme príklad na smerovači R3.

**4R3#**sh ip route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks

O 10.0.12.0/24 [110/20] via 10.0.234.1, 00:44:55, FastEthernet0/1

O 10.2.0.0/16 is a summary, 00:45:25, Null0

C 10.255.255.3/32 is directly connected, Loopback0

O E2 10.255.255.5/32 [110/20] via 10.0.234.1, 00:44:55, FastEthernet0/1

O IA 10.3.40.0/24 [110/74] via 10.0.234.3, 00:44:55, FastEthernet0/1

C 10.1.38.0/24 is directly connected, FastEthernet0/0

C 10.2.39.0/24 is directly connected, Serial1/0

O 10.2.49.0/24 [110/15] via 10.2.39.2, 00:45:27, Serial1/0

C 10.0.234.0/24 is directly connected, FastEthernet0/1

**4R3#**sh ip ospf database

OSPF Router with ID (10.255.255.3) (Process ID 1)

Router Link States (Area 0)

Link ID ADV Router Age Seq# Checksum Link count

10.255.255.1 10.255.255.1 508 0x8000002D 0x000C87 2

10.255.255.2 10.255.255.2 821 0x800000C1 0x008E6B 3

10.255.255.3 10.255.255.3 671 0x80000003 0x008B94 1

10.255.255.4 10.255.255.4 675 0x80000095 0x006426 1

Net Link States (Area 0)

Link ID ADV Router Age Seq# Checksum

10.0.234.1 10.255.255.2 821 0x80000003 0x006AA0

Summary Net Link States (Area 0)

Link ID ADV Router Age Seq# Checksum

10.1.38.0 10.255.255.3 671 0x80000002 0x004DA6

10.2.0.0 10.255.255.3 671 0x80000002 0x00B26B

10.2.0.0 10.255.255.4 677 0x80000005 0x00D83C

10.3.40.0 10.255.255.4 677 0x80000028 0x00EAA7

Router Link States (Area 1)

Link ID ADV Router Age Seq# Checksum Link count

10.255.255.3 10.255.255.3 673 0x8000002C 0x00DC7A 2

10.255.255.8 10.255.255.8 560 0x8000002D 0x0063ED 2

Summary Net Link States (Area 1)

Link ID ADV Router Age Seq# Checksum

0.0.0.0 10.255.255.3 674 0x80000025 0x00FC10

Router Link States (Area 2)

Link ID ADV Router Age Seq# Checksum Link count

10.255.255.3 10.255.255.3 674 0x8000002A 0x001E3E 2

10.255.255.4 10.255.255.4 679 0x8000002A 0x0054E7 2

10.255.255.9 10.255.255.9 237 0x8000002C 0x00DBBB 4

Summary Net Link States (Area 2)

Link ID ADV Router Age Seq# Checksum

10.0.12.0 10.255.255.3 674 0x80000002 0x00DC28

10.0.12.0 10.255.255.4 679 0x80000002 0x00D62D

10.0.234.0 10.255.255.3 674 0x80000006 0x00DC4F

10.0.234.0 10.255.255.4 681 0x80000002 0x00DE50

10.1.38.0 10.255.255.3 676 0x80000028 0x0001CC

10.1.38.0 10.255.255.4 681 0x80000002 0x00AB3D

10.3.40.0 10.255.255.3 676 0x80000002 0x00A10E

10.3.40.0 10.255.255.4 681 0x80000002 0x003781

Summary ASB Link States (Area 2)

Link ID ADV Router Age Seq# Checksum

10.255.255.1 10.255.255.3 676 0x80000002 0x0049C5

10.255.255.1 10.255.255.4 681 0x80000002 0x0043CA

Type-5 AS External Link States

Link ID ADV Router Age Seq# Checksum Tag

10.255.255.5 10.255.255.1 1256 0x80000025 0x008AD7 0

1. **Kontrola konektivity**

Na smerovači R1 sme spustili skript, ktorý posiela pingy na všetky IP adresy rozhraní smerovačov v topológii. Odpovede sme dostali zo všetkých smerovačov okrem tých z Area 4.

R1(tcl)#foreach address {

+>(tcl)#10.0.15.1

+>(tcl)#10.0.15.2

+>(tcl)#10.0.12.1

+>(tcl)#10.0.12.2

+>(tcl)#10.0.234.1

+>(tcl)#10.0.234.2

+>(tcl)#10.0.234.3

+>(tcl)#10.1.38.1

+>(tcl)#10.1.38.2

+>(tcl)#10.2.39.1

+>(tcl)#10.2.39.2

+>(tcl)#10.2.49.1

+>(tcl)#10.2.49.2

+>(tcl)#10.3.40.1

+>(tcl)#10.3.40.2

+>(tcl)#10.4.70.1

+>(tcl)#10.4.70.2

+>(tcl)#10.4.67.1

+>(tcl)#10.4.67.2

+>(tcl)#} {

+>(tcl)#ping $address }

Sending 5, 100-byte ICMP Echos to 10.0.15.1, timeout is 2 seconds:

!!!!!

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

Sending 5, 100-byte ICMP Echos to 10.0.15.2, timeout is 2 seconds:

.!!!!

Success rate is 80 percent (4/5), round-trip min/avg/max = 16/21/24 ms

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 = 1/1/1 ms

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 = 8/16/20 ms

Sending 5, 100-byte ICMP Echos to 10.0.234.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 16/17/20 ms

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 = 20/36/44 ms

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 = 20/35/52 ms

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 = 24/37/44 ms

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 = 44/56/64 ms

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 = 24/35/44 ms

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 = 44/56/68 ms

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 = 44/57/76 ms

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 = 44/57/64 ms

Sending 5, 100-byte ICMP Echos to 10.3.40.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 20/36/44 ms

Sending 5, 100-byte ICMP Echos to 10.3.40.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 44/60/76 ms

Sending 5, 100-byte ICMP Echos to 10.4.70.1, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

Sending 5, 100-byte ICMP Echos to 10.4.70.2, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

Sending 5, 100-byte ICMP Echos to 10.4.67.1, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

Sending 5, 100-byte ICMP Echos to 10.4.67.2, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

1. **Area 2 – R3 primárny smerovač, R4 sekundárny smerovač**

Prioritu R3 pred R4 sme vyriešili nastavením ceny príslušných strán na 5 a 10 (z oboch strán, aby nedochádzalo ku konfliktom) príkazom *ip ospf cost x* na príslušnom rozhraní.

**4R9#**show ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/0 1 2 10.2.49.2/24 **10** P2P 1/1

Se1/0 1 2 10.2.39.2/24 **5**  P2P 1/1

Správnosť sme následne overili pomocou príkazu *traceroute* zo smerovača R9 na R1 - všetky pakety boli smerované cez R3.

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

Na jednotlivých rozhraniach sme na nastavenie hello intervalu použili príkaz *ip ospf hello-interval 5*, dead interval je automaticky štvornásobný.

**4R1#**sh ip ospf interface

FastEthernet0/0 is up, line protocol is up

Internet Address 10.0.12.1/24, Area 0

...

Timer intervals configured, **Hello 5**, **Dead 20**, Wait 20, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:03

...

Funkčnosť sme overili zhodením rozhrania fa0/1 na smerovači R4, po jeho zapnutí sa komunikácia obnovila do 5 sekúnd.