ŽILINSKÁ UNIVERZITA V ŽILINE

FAKULTA RIADENIA A INFORMATIKY

PROJEKTOVANIE SIETÍ 1

APLIKOVANÉ SIEŤOVÉ INŽINIERSTVO

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Dokumentácia k OSPF

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OBSAH

1. OSPF

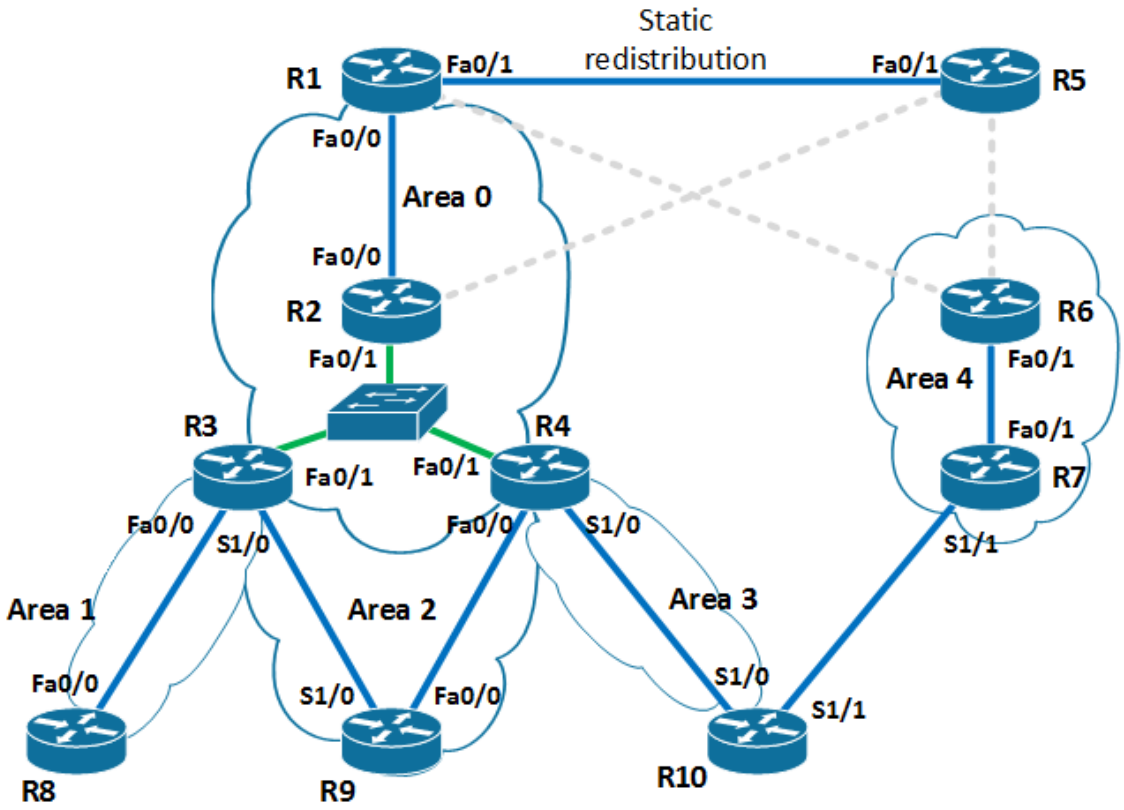
Cieľom cvičenia bolo oboznámiť sa s princípmi konfigurácie protokolu OSPF ako aj s protokolom samotným. Na cvičení sme postupovali podľa jednotlivých bodov zadania.

1.1 Zadané úlohy

- Nakonfigurovať OSPF s viacerými oblasťami
- R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača
- zvyšok spojení P2P
- Router-id - loopback0, passive-interface
- Area 1 – Totally Stubby
- Area 3 – Stub
- Area 4 – pripojenie pomocou virtuálnej linky
- Statická redistribúcia smerovacích záznamov z R5
- Kontrola DR prostredníctvom “ip ospf priority”
- Kontrola OSPF databáz a smerovacích tabuliek
- Kontrola konektivity
- Area 2 – R3 primárny smerovač, R4 sekundárny smerovač so sumarizovanými internými smerovacími záznamami do jedného sumarizačného
- Skrátenie hello a dead-interval časovačov, zistenie funkčnosti vytrhnutím jednej z liniek smerom ku L2 prepínaču
- Zdokumentovať (topo, adresácia, dizajn, úlohy)

1.2 Topológia siete

Topológia pozostávala z desiatich smerovačov a jedného L2 prepínača, pričom bolo potrebné nakonfigurovať 5 oblastí (area 0-4), podľa zadania.



1.3 Adresovanie

Na každom smerovači bol natavení loopback v tvare 10.255.255.číslo_smerovača /32. V tab. sa nachádzajú adresy, ktoré boli priradené jednotlivým rozhraniam smerovačov.

ROUTER	INTERFACE	IP ADRESA	MASKA
R1	loopback	10.255.255.1	255.255.255.255
	fa0/1	10.255.15.1	255.255.255.0
	fa0/0	10.0.12.1	255.255.255.0
R2	loopback	10.255.255.2	255.255.255.255
	fa0/0	10.0.12.2	255.255.255.0
	fa0/1	10.0.234.2	255.255.255.0
R3	loopback	10.255.255.3	255.255.255.255
	fa0/0	10.1.38.3	255.255.255.0
	fa0/1	10..0.234.3	255.255.255.0
	s1/0	10.2.39.3	255.255.255.0
R4	loopback	10.255.255.4	255.255.255.255
	fa0/0	10.2.49.4	255.255.255.0
	fa0/1	10.0.234.4	255.255.255.0
	s1/0	10.3.104.4	255.255.255.0
R5	loopback	10.255.255.5	255.255.255.255
	fa0/1	10.255.15.1	255.255.255.0
R6	loopback	10.255.255.6	255.255.255.255
	fa0/1	10.4..67.6	255.255.255.0
R7	loopback	10.255.255.7	255.255.255.255
	fa0/1	10.4.67.7	255.255.255.0
	s1/1	10.4.107.7	255.255.255.0
R8	loopback	10.255.255.8	255.255.255.255
	fa0/0	10.1.38.8	255.255.255.0
R9	loopback	10.255.255.7	255.255.255.255
	fa0/0	10.2.49.9	255.255.255.0
	s1/0	10.2.39.9	255.255.255.0
R10	loopback	10.255.255.7	255.255.255.255
	s1/0	10.3.104.10	255.255.255.0
	s1/1	10.4.107.10	255.255.255.0

1.4 Konfigurácia OSPF s viacerými oblasťami

Konfiguráciu OSPF vykonáme v sekcii *router ospf #AreaNumber*. V tejto sekcii je následne potrebné zadať *router-id*, ten sme nastavili na adresu rozhrania Lo0. Posledným krokom je vymenovanie sietí, ktoré chceme v rámci OSPF ohlasovať. Overenie úspešnej konfigurácie sme vykonali na dvoch smerovačoch (R3, R10) ktoré sú vo všetkých oblastiach.

```
3R3#sh ip protocols | begin Routing for
  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

3R10#sh ip protocols | begin Routing for
  Routing for Networks:
    10.3.104.0 0.0.0.255 area 3
    10.4.107.0 0.0.0.255 area 4
```

1.5 R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača

Smerovače R2, R3 a R4 boli prepojené pomocou L2 prepínača. Ako overenie, že sa jedná o broadcast spojenie sme použili príkaz *ip ospf neighbor*. Voľba DR a BDR smerovača sa vykonáva na broadcast spojeniach, preto by tento príkaz ako overenie mal stačiť. Voľbu DR a BDR sme ovplyvnili pomocou príkazu *ip ospf priority*, kde sme smerovaču R3 nastavili prioritu 10 (DR), R4 prioritu 1 (BDR) a na R1 sme nastavili prioritu na 0.

```
R2#sh ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
10.255.255.3     10   FULL/DR         00:00:39    10.0.234.3      FastEthernet0/1
10.255.255.4      1   FULL/BDR        00:00:33    10.0.234.4      FastEthernet0/1
10.255.255.1      0   FULL/  -        00:00:37    10.0.12.1       FastEthernet0/0
```

1.6 Zvyšok spojení P2P

Point-to-point spojenia nastavíme na konkrétnych rozhraniach pomocou príkazu *ip ospf network point-to-point*. P2P spojenie medzi R1 a R2, smerovač R1 je spojený s R2 prostredníctvom rozhrania Fa0/0.

```
R1#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        1     0               10.255.15.1/24     10    DR    0/0
Lo0          1     0               10.255.255.1/32    1     LOOP  0/0
Fa0/0        1     0               10.0.12.1/24       10    P2P   1/1
```

P2P spojenie medzi R3 a R8, smerovač R3 je spojený s R8 prostredníctvom rozhrania Fa0/0.

```
3R3(config)#do sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        1     0               10.0.234.3/24      10    DR    2/2
Fa0/0        1     1               10.1.38.3/24       10    P2P   1/1
Se1/0        1     2               10.2.39.3/24       10    P2P   1/1
```

P2P spojenia medzi smerovačom R4 a jeho susedmi R7 (rozhranie VL1) a R9 (rozhranie fa0/0).

```
R4#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
VL1          1     0               10.3.104.4/24      64    P2P   1/1
Fa0/1        1     0               10.0.234.4/24      10    BDR   2/2
Fa0/0        1     2               10.2.49.4/24       10    P2P   1/1
Se1/0        1     3               10.3.104.4/24      64    P2P   1/1
```

P2P spojenie medzi smerovačom R6 a jeho susedmi R7 (rozhranie fa0/1).

```
3R7#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        1     4               10.4.67.7/24       10    P2P   1/1
Se1/1        1     4               10.4.107.7/24      64    P2P   1/1
```

1.7 Router-id –loopback0, passive-interface

Všetky router ID boli nakonfigurované ako „loopbacky“, kde sme pri konfigurácii v *router ospf* zadali príkaz *rotuer-id #IP_adresa_Lo0*. Ako dôkaz sme použili príkaz *sh ip ospf | i with ID* (príkaz vypíše to čo požadujeme a teda iba router ID). Ako dôkaz, že všetky loopbacky na smerovačoch sú nakonfigurované ako passive interface.

```
R1#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.1
R1#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

R2#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.2
R2#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

3R3#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.3
3R3#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

R4#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.4
R4#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

3R6#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.6
3R6#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

3R7#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.7
3R7#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

3R8#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.8
3R8#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0
```

```
3R9#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.9
3R9#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0

3R10#sh ip ospf | i with ID
 Routing Process "ospf 1" with ID 10.255.255.10
3R10#sh ip protocols | sec Passive
  Passive Interface(s):
    Loopback0
```

1.8 Area 1 – Totally Stubby

Pre nakonfigurovanie oblasti totally stubby bolo potrebné na smerovači R3 zadať príkaz *area 1 stub no-summary*. Čo zabezpečí že v ospf databáze neuvidíme sumárne LSA z iných oblastí (viď *sh ip ospf database*), môžeme vidieť len default 0.0.0.0 cez R3 (ABR) smerovač. V smerovacej tabuľke vidíme že ABR generuje len default route (viď O*IA 0.0.0.0).

```
3R8#sh 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 10.255.255.8
  Number of areas in this router is 1. 0 normal 1 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.1.38.0 0.0.0.255 area 1
 Reference bandwidth unit is 100 mbps
  Passive Interface(s):
    Loopback0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.255.255.3         110      02:48:51
    10.255.255.1         110      06:21:52
  Distance: (default is 110)
```

```
3R8#sh 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 10.1.38.3 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.255.255.8/32 is directly connected, Loopback0
C       10.1.38.0/24 is directly connected, FastEthernet0/0
O*IA 0.0.0.0/0 [110/11] via 10.1.38.3, 03:09:52, FastEthernet0/0
```

1.9 Area 3 –stub

Oblasť 3 nemôže byť stub, keďže cez ňu vedie virtuálna linka, preto sme za stub zvolili oblasť 2. Ako dôkaz že oblasť 2 je stub môžeme vidieť že v ospf databáze sú sumárne LSA z iných oblastí redistribuované. Totally stubby a NSSA už neobsahujú v databázach LSA z iných oblastí (NSSA môže zobrazovať externé záznamy). Dokazuje to aj príkaz *sh ip ospf | begin Area 2*, kde môžeme vidieť že oblasť 2 je stub.

```
3R9#sh ip ospf | begin Area 2
    Area 2
        Number of interfaces in this area is 3 (1 loopback)
        It is a stub area
```

```
3R9#sh ip ospf database

            OSPF Router with ID (10.255.255.9) (Process ID 1)

                Router Link States (Area 2)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.255.255.3    10.255.255.3    1272        0x8000001A 0x0078F3 2
10.255.255.4    10.255.255.4    1445        0x80000018 0x00C08C 2
10.255.255.9    10.255.255.9    1293        0x8000001B 0x00F97E 5

                Summary Net Link States (Area 2)

Link ID         ADV Router      Age         Seq#       Checksum
0.0.0.0         10.255.255.3    1428        0x80000002 0x0043EC
0.0.0.0         10.255.255.4    1445        0x80000002 0x003DF1
10.0.12.0       10.255.255.3    1428        0x80000003 0x00F80D
10.0.12.0       10.255.255.4    1443        0x8000000A 0x00E419
10.0.234.0      10.255.255.3    1428        0x80000003 0x000130
10.0.234.0      10.255.255.4    1443        0x80000015 0x00D647
10.1.38.0       10.255.255.3    1428        0x80000003 0x00698B
10.1.38.0       10.255.255.4    1419        0x80000001 0x00CB20
10.2.0.0        10.255.255.3    1429        0x80000002 0x0067A9
10.3.104.0      10.255.255.3    1434        0x80000001 0x00FE73
10.3.104.0      10.255.255.4    1445        0x80000014 0x006EF9
10.4.67.0       10.255.255.3    1425        0x80000001 0x0072D9
10.4.67.0       10.255.255.4    1422        0x80000001 0x00084D
10.4.107.0      10.255.255.3    1425        0x80000001 0x0054D9
10.4.107.0      10.255.255.4    1422        0x80000001 0x00E94D
10.255.15.0     10.255.255.3    1430        0x80000003 0x003CBC
10.255.15.0     10.255.255.4    1446        0x80000006 0x0030C4
10.255.255.1    10.255.255.3    1430        0x80000003 0x007D92
10.255.255.1    10.255.255.4    1446        0x80000006 0x00719A
```

1.10 Area 4 – pripojenie pomocou virtuálnej linky

V topológii sme mali spraviť prepojenie oblasti 4 s chrbticovou oblasťou 0 (medzi smerovačmi R4 a R10) pomocou virtuálnej linky. Na smerovačoch R4 a R10 bolo potrebné zadať príkaz *area 3 virtual-link 10.255.255.4,* resp. *area 3 virtual-link 10.255.255.10*. V overení vidíme že sused s ID 10 (smerovač 10) je pripojený pomocou virtuálnej linky. V smerovacej tabuľke na R9 (area 2) by sa takisto mali zobraziť aj siete z oblasti 4 – napríklad sieť medzi R6 a R7 (10.4.67.0/24).

```
R4#sh ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
10.255.255.10     0   FULL/  -          -        10.3.104.10     OSPF_VL1
10.255.255.2      1   FULL/DROTHER    00:00:34    10.0.234.2      FastEthernet0/1
10.255.255.3     10   FULL/DR         00:00:36    10.0.234.3      FastEthernet0/1
10.255.255.9      0   FULL/  -        00:00:39    10.2.49.9       FastEthernet0/0
10.255.255.10     0   FULL/  -        00:00:32    10.3.104.10     Serial1/0
R4#
```

```
3R9#sh 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 10.2.39.3 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 12 subnets, 3 masks
C       10.255.255.9/32 is directly connected, Loopback0
O IA    10.0.12.0/24 [110/25] via 10.2.39.3, 00:09:55, Serial1/0
O IA    10.2.0.0/16 [110/25] via 10.2.39.3, 00:10:05, Serial1/0
O IA    10.255.255.1/32 [110/26] via 10.2.39.3, 00:09:55, Serial1/0
O IA    10.1.38.0/24 [110/15] via 10.2.39.3, 00:10:39, Serial1/0
C       10.2.39.0/24 is directly connected, Serial1/0
C       10.2.49.0/24 is directly connected, FastEthernet0/0
O IA    10.4.67.0/24 [110/148] via 10.2.49.4, 00:10:30, FastEthernet0/0
O IA    10.3.104.0/24 [110/74] via 10.2.49.4, 00:10:30, FastEthernet0/0
O IA    10.4.107.0/24 [110/138] via 10.2.49.4, 00:10:30, FastEthernet0/0
O IA    10.0.234.0/24 [110/15] via 10.2.39.3, 00:10:40, Serial1/0
O IA    10.255.15.0/24 [110/35] via 10.2.39.3, 00:09:57, Serial1/0
O*IA 0.0.0.0/0 [110/6] via 10.2.39.3, 00:10:41, Serial1/0
```

1.11 Statická redistribúcia smerovacích záznamov z R5

Na smerovači sme nastavili statickú cestu na smerovač R5 príkazom – *ip route 10.255.255.5 255.255.255.255 FastEthernet0/1 10.255.15.5*. Na smerovači R5 bolo potrebné takisto zadať statickú cestu *ip route 0.0.0.0 0.0.0.0 Fa0/1 10.255.15.1*. Na R1 sme následne v OSPF príkazom *redistribute static* distribuovali tieto cesty. Príkaz na overenie bol spustený na smerovači R1.

```
R1(config)#do 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
  Routing Descriptor Blocks:
  * 10.255.15.5, via FastEthernet0/1
      Route metric is 0, traffic share count is 1
```

1.12 Kontrola DR prostredníctvom "ip ospf priority"

Vidíme, že priorita bola nastavená (zmenená z defaultnej hodnoty 1) na hodnotu 10 na smerovači R3 a na hodnotu 0 pri R1 (postup na úpravu priority je detailne popísaný v kapitole 1.5).

```
3R3#sh run | sec ospf
 ip ospf network point-to-point
 ip ospf priority 10
 ip ospf cost 10
 ip ospf priority 10
router ospf 1
```

```
R2#sh ip ospf neighbor

Neighbor ID     Pri   State
10.255.255.3     10   FULL/DR
10.255.255.4      1   FULL/BDR
10.255.255.1      0   FULL/  -
```

1.13 Kontrola OSPF databáz a smerovacích tabuliek

```
3R9#sh 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 10.2.39.3 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 12 subnets, 3 masks
C       10.255.255.9/32 is directly connected, Loopback0
O IA    10.0.12.0/24 [110/25] via 10.2.39.3, 00:09:55, Serial1/0
O IA    10.2.0.0/16 [110/25] via 10.2.39.3, 00:10:05, Serial1/0
O IA    10.255.255.1/32 [110/26] via 10.2.39.3, 00:09:55, Serial1/0
O IA    10.1.38.0/24 [110/15] via 10.2.39.3, 00:10:39, Serial1/0
C       10.2.39.0/24 is directly connected, Serial1/0
C       10.2.49.0/24 is directly connected, FastEthernet0/0
O IA    10.4.67.0/24 [110/148] via 10.2.49.4, 00:10:30, FastEthernet0/0
O IA    10.3.104.0/24 [110/74] via 10.2.49.4, 00:10:50, FastEthernet0/0
O IA    10.4.107.0/24 [110/138] via 10.2.49.4, 00:10:30, FastEthernet0/0
O IA    10.0.234.0/24 [110/15] via 10.2.39.3, 00:10:40, Serial1/0
O IA    10.255.15.0/24 [110/35] via 10.2.39.3, 00:09:57, Serial1/0
O*IA 0.0.0.0/0 [110/6] via 10.2.39.3, 00:10:41, Serial1/0
```

```
3R9#sh ip ospf database

            OSPF Router with ID (10.255.255.9) (Process ID 1)

                Router Link States (Area 2)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.255.255.3    10.255.255.3    1272        0x8000001A 0x0078F3 2
10.255.255.4    10.255.255.4    1445        0x80000018 0x00C08C 2
10.255.255.9    10.255.255.9    1293        0x8000001B 0x00F97E 5

                Summary Net Link States (Area 2)

Link ID         ADV Router      Age         Seq#       Checksum
0.0.0.0         10.255.255.3    1428        0x80000002 0x0043EC
0.0.0.0         10.255.255.4    1445        0x80000002 0x003DF1
10.0.12.0       10.255.255.3    1428        0x80000003 0x00F80D
10.0.12.0       10.255.255.4    1443        0x8000000A 0x00E419
10.0.234.0      10.255.255.3    1428        0x80000003 0x000130
10.0.234.0      10.255.255.4    1443        0x80000015 0x00D647
10.1.38.0       10.255.255.3    1428        0x80000003 0x00698B
10.1.38.0       10.255.255.4    1419        0x80000001 0x00CB20
10.2.0.0        10.255.255.3    1429        0x80000002 0x0067A9
10.3.104.0      10.255.255.3    1434        0x80000001 0x00FE73
10.3.104.0      10.255.255.4    1445        0x80000014 0x006EF9
10.4.67.0       10.255.255.3    1425        0x80000001 0x0072D9
10.4.67.0       10.255.255.4    1422        0x80000001 0x00084D
10.4.107.0      10.255.255.3    1425        0x80000001 0x0054D9
10.4.107.0      10.255.255.4    1422        0x80000001 0x00E94D
10.255.15.0     10.255.255.3    1430        0x80000003 0x003CBC
10.255.15.0     10.255.255.4    1446        0x80000006 0x0030C4
10.255.255.1    10.255.255.3    1430        0x80000003 0x007D92
10.255.255.1    10.255.255.4    1446        0x80000006 0x00719A
```

```
R2#sh ip ospf database

            OSPF Router with ID (10.255.255.2) (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    1014        0x80000017 0x001D3D 4
10.255.255.2    10.255.255.2    506         0x80000027 0x00EFA0 3
10.255.255.3    10.255.255.3    510         0x8000000C 0x00A56D 1
10.255.255.4    10.255.255.4    515         0x80000019 0x001311 2
10.255.255.10   10.255.255.10   3     (DNA) 0x80000025 0x009482 1

                Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.234.4      10.255.255.4    507         0x80000002 0x0036D0

                Summary Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.1.38.0       10.255.255.3    515         0x80000006 0x0045AA
10.2.0.0        10.255.255.4    560         0x80000005 0x00D83C
10.2.39.0       10.255.255.3    515         0x80000007 0x00F9F7
10.2.49.0       10.255.255.3    515         0x80000006 0x00F1EC
10.3.104.0      10.255.255.4    561         0x80000005 0x006E07
10.3.104.0      10.255.255.10   9     (DNA) 0x80000001 0x0052Z1
10.4.67.0       10.255.255.10   9     (DNA) 0x80000001 0x00434A
10.4.107.0      10.255.255.10   9     (DNA) 0x80000001 0x00254A
10.255.255.9    10.255.255.3    517         0x80000006 0x00729F
10.255.255.9    10.255.255.4    565         0x80000001 0x00A868

                Type-5 AS External Link States

Link ID         ADV Router      Age         Seq#       Checksum Tag
10.255.255.5    10.255.255.1    752         0x80000010 0x002D2C 0
```

```
R2#sh 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, 14 subnets, 3 masks
O IA    10.255.255.9/32 [110/16] via 10.0.234.3, 00:09:28, FastEthernet0/1
C       10.0.12.0/24 is directly connected, FastEthernet0/0
C       10.255.255.2/32 is directly connected, Loopback0
O IA    10.2.0.0/16 [110/20] via 10.0.234.4, 00:09:28, FastEthernet0/1
O       10.255.255.1/32 [110/11] via 10.0.12.1, 00:10:07, FastEthernet0/0
O E2    10.255.255.5/32 [110/20] via 10.0.12.1, 00:10:07, FastEthernet0/0
O IA    10.1.38.0/24 [110/20] via 10.0.234.3, 00:09:29, FastEthernet0/1
O IA    10.2.39.0/24 [110/15] via 10.0.234.3, 00:09:29, FastEthernet0/1
O IA    10.2.49.0/24 [110/25] via 10.0.234.3, 00:09:29, FastEthernet0/1
O IA    10.4.67.0/24 [110/148] via 10.0.234.4, 00:09:29, FastEthernet0/1
O IA    10.3.104.0/24 [110/74] via 10.0.234.4, 00:09:29, FastEthernet0/1
O IA    10.4.107.0/24 [110/138] via 10.0.234.4, 00:09:29, FastEthernet0/1
C       10.0.234.0/24 is directly connected, FastEthernet0/1
O       10.255.15.0/24 [110/20] via 10.0.12.1, 00:10:10, FastEthernet0/0
R2#
```

1.14 Kontrola konektivity

Kontrola konektivity prebehla pomocou príkazov ping zo všetkých smerovačov, na všetky dostupné rozhrania v topológii.

```
R4#tclsh
R4(tcl)#foreach address {
+>(tcl)#10.255.255.1
+>(tcl)#10.255.255.2
+>(tcl)#10.255.255.3
+>(tcl)#10.255.255.4
+>(tcl)#10.255.255.5
+>(tcl)#10.255.255.6
+>(tcl)#10.255.255.7
+>(tcl)#10.255.255.8
+>(tcl)#10.255.255.9
+>(tcl)#10.255.255.10
+>(tcl)#} {
+>(tcl)#ping $address }
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.1, 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 10.255.255.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/21/24 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/18/24 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/56/60 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/60/76 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.7, 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 10.255.255.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/40/52 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/16/24 ms
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 = 16/18/24 ms
```

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

Ako dôkaz, že router R3 je primárnym smerovačom pre router R9 môžeme vidieť v smerovacej tabuľke smerovača R9, že do sietí ktoré sú v oblasti 1 sa dostaneme práve cez R3 smerovač čo sme zabezpečili zmenou „costy“ na interfaceoch ktorými sú spojené R3 a R9. Ako dodatočné overenie nám poslúžila aj ďalšia úloha kde vidíme, že prioritne vedie cesta cez R3 a po odpojení R3, môžeme vidieť, že sekundárna cesta (viď. príkaz traceroute po odpojení) vedie cez R4 smerovač.

```
     10.0.0.0/8 is variably subnetted, 12 subnets, 3 masks
C       10.255.255.9/32 is directly connected, Loopback0
O IA    10.0.12.0/24 [110/25] via 10.2.39.3, 00:21:07, Serial1/0
O IA    10.2.0.0/16 [110/25] via 10.2.39.3, 00:21:07, Serial1/0
O IA    10.255.255.1/32 [110/26] via 10.2.39.3, 00:21:07, Serial1/0
O IA    10.1.38.0/24 [110/15] via 10.2.39.3, 00:21:07, Serial1/0
C       10.2.39.0/24 is directly connected, Serial1/0
C       10.2.49.0/24 is directly connected, FastEthernet0/0
O IA    10.4.67.0/24 [110/148] via 10.2.49.4, 00:23:18, FastEthernet0/0
O IA    10.3.104.0/24 [110/74] via 10.2.49.4, 00:23:38, FastEthernet0/0
O IA    10.4.107.0/24 [110/138] via 10.2.49.4, 00:23:18, FastEthernet0/0
O IA    10.0.234.0/24 [110/15] via 10.2.39.3, 00:21:08, Serial1/0
O IA    10.255.15.0/24 [110/35] via 10.2.39.3, 00:21:08, Serial1/0
O*IA 0.0.0.0/0 [110/6] via 10.2.39.3, 00:21:09, Serial1/0
3R9#
```

```
R1#traceroute 10.255.255.9

Type escape sequence to abort.
Tracing the route to 10.255.255.9

  1 10.0.12.2 8 msec 24 msec 16 msec
  2 10.0.234.3 40 msec 36 msec 36 msec
  3 10.2.39.9 60 msec *  64 msec
```

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

Defaultné nastavenia Hello a Dead časovačov sú nastavené na hello 10, dead 40. My sme sa tieto hodnoty rozhodli zmeniť na 3 a 12. Konfigurácia prebehla na rozhraniach smerovačov príkazmi *ip ospf hello-interval 3*, resp *ip ospf dead-interval 12*.

Ako dôkaz sa po vytrhnutí jednej z liniek konkrétne fa0/1 na R3 smerovači mala nájsť náhradná cesta za kratší čas. Čo je dokázané pingom zo smerovača R1 na R9.

Pred zmenou:

```
R1#traceroute 10.255.255.9

Type escape sequence to abort.
Tracing the route to 10.255.255.9

  1 10.0.12.2 20 msec 16 msec 12 msec
  2 10.0.234.3 28 msec 44 msec 32 msec
  3 10.2.39.9 68 msec *  76 msec
R1#
```

```
R1#ping
Protocol [ip]:
Target IP address: 10.255.255.9
Repeat count [5]: 400
Datagram size [100]:
Timeout in seconds [2]: 1
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 400, 100-byte ICMP Echos to 10.255.255.9, timeout is 1 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!.....!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 90 percent (361/400), round-trip min/avg/max = 36/60/84 ms
R1#
```

Po zmene :

```
R1#ping
Protocol [ip]:
Target IP address: 10.255.255.9
Repeat count [5]: 400
Datagram size [100]:
Timeout in seconds [2]: 1
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 400, 100-byte ICMP Echos to 10.255.255.9, timeout is 1 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
.....!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 96 percent (384/400), round-trip min/avg/max = 40/60/84 ms
R1#tracer
R1#traceroute 10.255.255.9

Type escape sequence to abort.
Tracing the route to 10.255.255.9

  1 10.0.12.2 16 msec 16 msec 16 msec
  2 10.0.234.4 36 msec 36 msec 40 msec
  3 10.2.49.9 60 msec *  68 msec
```