ŽILINSKÁ UNIVERZITA V ŽILINE

FAKULTA RIADENIA A INFORMATIKY

Dokumentácia k zadaniu IS-IS z predmetu Projektovanie sietí 1

Tomáš Pikna, 5ZKS11
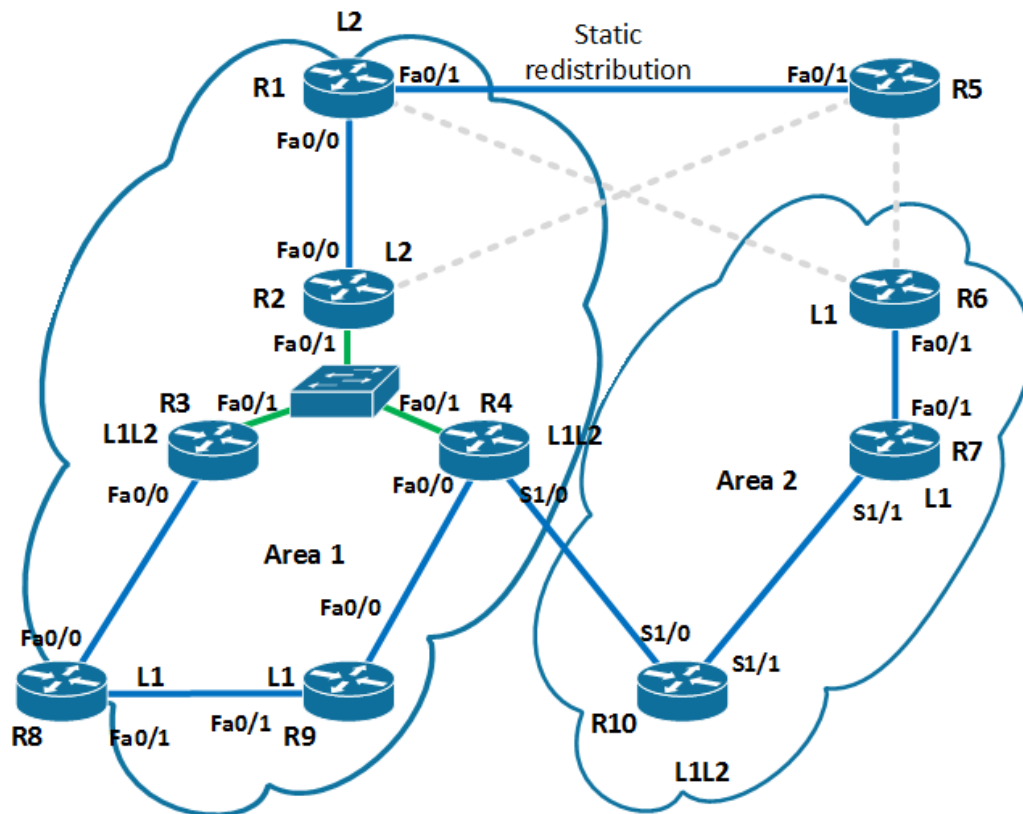
Stanislav Rusnák, 5ZKS11

Akad.rok 2016/2017

Obsah

1. Cvičenie IS-IS

Na splnenie úloh z cvičenia bolo potrebné nakonfigurovať IS-IS s dvoma oblasťami a splnenie ďalších úloh, ktoré budú popísané a zadokumentované nižšie.

1.1. Topológia

1.2. Adresovanie

Adresovanie v IS-IS je riešené odlišným spôsobom ako napríklad v OSPF. Adresujú sa uzly ako celky. Adresa uzla bez bližšej špecifikácie služby sa nazýva NET. Jej formát je :

Doména.Oblasť.SystemID.NSEL. Zo zadania sme mali zadanú doménu 49 a oblasti číslo 1 a 2. SystemID sa odvádzalo z IP adresy loopbacku. Ak mal loopback na routri R1 adresu 10.255.255.1, SystemID sa tvorilo spôsobom : 010.255.255.001 -> 0102.5525.5001. NSEL je identifikátor adresovanej služby, v našom prípade 00. Výsledná NET bude v prípade routra R1 nasledovná : 49.0001.0102.5525.5001.00. Masky sú na loopbackoch /32 na ostaných rozhraniach /24.

R1	loopback	10.255.255.1
	Fa0/0	10.1.12.1
	Fa0/1	10.255.15.1
	NET	49.0001.0102.5525.5001.00
R2	loopback	10.255.255.2
	Fa0/0	10.1.12.2
	Fa0/1	10.1.234.2
	NET	49.0001.0102.5525.5002.00
R3	loopback	10.255.255.3
	Fa0/0	10.1.38.3
	Fa0/1	10.1.234.3
	NET	49.0001.0102.5525.5003.00
R4	loopback	10.255.255.4
	Fa0/0	10.1.49.4
	Fa0/1	10.1.234.4
	S1/0	10.104.104.4
	NET	49.0001.0102.5525.5004.00
R5	loopback	10.255.255.5
	Fa0/1	10.255.15.5
	NET	--------
R6	loopback	10.255.255.6
	Fa0/1	10.2.67.6
	NET	49.0002.0102.5525.5006.00
R7	loopback	10.255.255.7
	Fa0/1	10.2.67.7
	S1/1	10.2.107.7
	NET	49.0002.0102.5525.5007.00
R8	loopback	10.255.255.8
	Fa0/0	10.1.38.8
	Fa0/1	10.1.89.8
	NET	49.0001.0102.5525.5008.00
R9	loopback	10.255.255.9
	Fa0/0	10.1.49.9
	Fa0/1	10.1.89.9
	NET	49.0001.0102.5525.5009.00
R10	loopback	10.255.255.10
	S1/0	10.104.104.10
	S1/1	10.2.107.10
	NET	49.0002.0102.5525.5010.00

1.3. Nakonfigurovať IS-IS s dvoma oblasťami

Smerovače R1,2,3,4,8,9 patria do oblasti 1, smerovače R6,7,10 do oblasti 2. Oblasť určuje druhá časť NET adresy uzla.

Oblasť 1

```
R1#sh clns proto

IS-IS Router: <Null Tag>
  System Id: 0102.5525.5001.00  IS-Type: level-2
  Manual area address(es):
        49.0001
  Routing for area address(es):
        49.0001
```

Oblasť 2

```
R6#sh clns proto

IS-IS Router: <Null Tag>
  System Id: 0102.5525.5006.00  IS-Type: level-1
  Manual area address(es):
        49.0002
  Routing for area address(es):
        49.0002
```

1.4. R2, R3, R4 broadcast spojenia prostredníctvom L2 prepínača

Prítomnosť DIS znamená že bol zvolený na základe priority, a to považujeme za dôkaz existencie broadcast spojenia medzi R2,R3 a R4. Hodnota 02-00 identifikuje DIS na danom segmente.

```
R4#sh isis data

IS-IS Level-1 Link State Database:
LSPID                   LSP Seq Num   LSP Checksum  LSP Holdtime      ATT/P/OL
R3.00-00                0x0000007D    0x57EC        668               1/0/0
R4.00-00              * 0x0000007D    0xA175        1141              1/0/0
R8.00-00                0x00000076    0x9F2C        723               0/0/0
R9.00-00                0x00000075    0xEF0A        810               0/0/0
IS-IS Level-2 Link State Database:
LSPID                   LSP Seq Num   LSP Checksum  LSP Holdtime      ATT/P/OL
R1.00-00                0x00000078    0xC080        787               0/0/0
R2.00-00                0x00000076    0xFA76        1003              0/0/0
R2.02-00                0x00000071    0x8B84        576               0/0/0
R3.00-00                0x00000081    0x06D7        467               0/0/0
R4.00-00              * 0x0000007D    0x93D0        578               0/0/0
R10.00-00               0x00000074    0x5C51        397               0/0/0
```

1.5. Zvyšok spojení P2P

P2P spojenie znamená, že sa nevolí DIS. Viď bod 1.4. Preto je potrebné sa pozrieť na L1 záznamy. Ak v nich je všade LSPID RX.00-00, znamená to, že tam nieje DIS.

R1

```
R1#sh isis data

IS-IS Level-2 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R1.00-00          *  0x0000007B   0xBA83        1084            0/0/0
R2.00-00             0x00000078   0xF678        532             0/0/0
R2.02-00             0x00000074   0x8587        664             0/0/0
R3.00-00             0x00000085   0xFDDB        1173            0/0/0
R4.00-00             0x00000080   0x8DD3        725             0/0/0
R10.00-00            0x00000077   0x5654        773             0/0/0
```

R2

```
R2#sh isis data

IS-IS Level-2 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R1.00-00             0x0000007B   0xBA83        488             0/0/0
R2.00-00          *  0x00000079   0xF479        775             0/0/0
R2.02-00          *  0x00000075   0x8388        919             0/0/0
R3.00-00             0x00000085   0xFDDB        581             0/0/0
R4.00-00             0x00000081   0x8BD4        1032            0/0/0
R10.00-00            0x00000078   0x5455        1062            0/0/0
```

R3

```
R3#sh isis data

IS-IS Level-1 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R3.00-00          *  0x00000081   0x4FF0        1177            1/0/0
R4.00-00             0x00000080   0x9B78        518             1/0/0
R8.00-00             0x0000007A   0x9730        1094            0/0/0
R9.00-00             0x00000079   0xE70E        1065            0/0/0
IS-IS Level-2 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R1.00-00             0x0000007B   0xBA83        456             0/0/0
R2.00-00             0x00000079   0xF479        742             0/0/0
R2.02-00             0x00000075   0x8388        887             0/0/0
R3.00-00          *  0x00000085   0xFDDB        552             0/0/0
R4.00-00             0x00000081   0x8BD4        1001            0/0/0
R10.00-00            0x00000078   0x5455        1032            0/0/0
```

R4

```
R4#sh isis data

IS-IS Level-1 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R3.00-00             0x00000081   0x4FF0        1117            1/0/0
R4.00-00          *  0x00000080   0x9B78        470             1/0/0
R8.00-00             0x0000007A   0x9730        1037            0/0/0
R9.00-00             0x00000079   0xE70E        1012            0/0/0
IS-IS Level-2 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R1.00-00             0x0000007B   0xBA83        401             0/0/0
R2.00-00             0x00000079   0xF479        688             0/0/0
R2.02-00             0x00000075   0x8388        832             0/0/0
R3.00-00             0x00000085   0xFDDB        496             0/0/0
R4.00-00          *  0x00000081   0x8BD4        949             0/0/0
R10.00-00            0x00000078   0x5455        979             0/0/0
```

R6

```
R6#sh isis data

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R6.00-00            * 0x00000079   0x77B0        557             0/0/0
R7.00-00              0x00000078   0xFC94        467             0/0/0
R10.00-00             0x0000007B   0x01F8        556             1/0/0
```

R7

```
R7#sh isis data

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R6.00-00              0x00000079   0x77B0        505             0/0/0
R7.00-00            * 0x00000079   0xFA95        1151            0/0/0
R10.00-00             0x0000007B   0x01F8        507             1/0/0
```

R8

```
R8#sh isis data

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R3.00-00              0x00000081   0x4FF0        915             1/0/0
R4.00-00              0x00000081   0x9979        1101            1/0/0
R8.00-00            * 0x0000007A   0x9730        835             0/0/0
R9.00-00              0x00000079   0xE70E        807             0/0/0
```

R9

```
R9#sh isis data

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R3.00-00              0x00000081   0x4FF0        891             1/0/0
R4.00-00              0x00000081   0x9979        1081            1/0/0
R8.00-00              0x0000007A   0x9730        812             0/0/0
R9.00-00            * 0x00000079   0xE70E        787             0/0/0
```

R10

```
R10#sh isis data

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R6.00-00              0x0000007A   0x75B1        1181            0/0/0
R7.00-00              0x00000079   0xFA95        1079            0/0/0
R10.00-00           * 0x0000007C   0xFEF9        1175            1/0/0
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime    ATT/P/OL
R1.00-00              0x0000007C   0xB884        1010            0/0/0
R2.00-00              0x00000079   0xF479        433             0/0/0
R2.02-00              0x00000075   0x8388        577             0/0/0
R3.00-00              0x00000086   0xFBDC        974             0/0/0
R4.00-00              0x00000081   0x8BD4        694             0/0/0
R10.00-00           * 0x00000078   0x5455        728             0/0/0
```

1.6. R3 – R4 P2P, L2 only

P2P medzi R3 a R4 je ukázaný v predchádzajúcom bode. Iba L2 spojenia medzi nimi sú na nasledujúcich screenshotoch. Na rozhraní medzi nimi sa zadal príkaz *isis circuit-type level-2-only*.

```
R3#sh clns int fa0/1 | sec Routing
  Routing Protocol: IS-IS
  Circuit Type: level-2
  Interface number 0x1, local circuit ID 0x2
  Level-2 Metric: 10, Priority: 64, Circuit ID: R2.02
  DR ID: R2.02
  Level-2 IPv6 Metric: 10
  Number of active level-2 adjacencies: 2
  Next IS-IS LAN Level-2 Hello in 1 seconds
```

```
R4#sh clns int fa0/1 | sec Routing
  Routing Protocol: IS-IS
  Circuit Type: level-2
  Interface number 0x1, local circuit ID 0x2
  Level-2 Metric: 10, Priority: 64, Circuit ID: R2.02
  DR ID: R2.02
  Level-2 IPv6 Metric: 10
  Number of active level-2 adjacencies: 2
  Next IS-IS LAN Level-2 Hello in 8 seconds
```

1.7. Router id – ISO NSAP formát odvodený z loopback0 rozhrania

Formát NSAP (NET) adresy a jeho odvodenie od loopback0 rozhrania bol popísaný v sekcii adresovanie.

```
R1#sh clns | sec NET
  NET: 49.0001.0102.5525.5001.00
```
```
R2#sh clns | sec NET
  NET: 49.0001.0102.5525.5002.00
```
```
R3#sh clns | sec NET
  NET: 49.0001.0102.5525.5003.00
```
```
R4#sh clns | sec NET
  NET: 49.0001.0102.5525.5004.00
```
```
R6#sh clns | sec NET
  NET: 49.0002.0102.5525.5006.00
```
```
R7#sh clns | sec NET
  NET: 49.0002.0102.5525.5007.00
```
```
R8#sh clns | sec NET
  NET: 49.0001.0102.5525.5008.00
```
```
R9#sh clns | sec NET
  NET: 49.0001.0102.5525.5009.00
```
```
R10#sh clns | sec NET
  NET: 49.0002.0102.5525.5010.00
```

1.8. Statická redistribúcia smerovacích záznamov z R5

Smerovač R5 sa nenachádza v žiadnej z oblastí, ani na ňom nieje iný smerovací protokol, preto bolo potrebné zabezpečiť na R5 defaultnú cestu na R1, z R1 na loopback R5 statickú cestu a na R1 príkazom *redistribute static* redistribúciu tohto záznamu do celej siete.

```
R1#sh ip proto | sec Redist
  Redistributing: static, isis
```
```
R1#sh ip route 10.255.255.5
Routing entry for 10.255.255.5/32
  Known via "static", distance 1, metric 0
  Redistributing via isis
```

1.9. Kontrola LAN DIS

Voľbu DIS sme ovplyvnili nastavením priority na rozhraní fa0/1 na routri R2 (default 64, naša priorita 100). Že router R2 je skutočne DIS sme overovali už skôr, keď sme overovali že medzi R2,R3 a R4 je broadcast spojenie.

```
R4#sh clns is-neigh

System Id      Interface  State  Type Priority  Circuit Id    Format
R3             Fa0/1      Up     L2   64         R2.02         Phase V
R10            Se1/0      Up     L2   0          00            Phase V
R2             Fa0/1      Up     L2   100        R2.02         Phase V
R9             Fa0/0      Up     L1   0          01            Phase V
```

1.10. Kontrola IS-IS databáz a smerovacích tabuliek

Databázy jednotlivých routrov sme si ukázali v kapitole 1.5, preto na nasledujúcich screenshotoch budú uvedené len smerovacie tabuľky.

R1

```
R1#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, 19 subnets, 2 masks
i L2    10.255.255.10/32 [115/30] via 10.1.12.2, FastEthernet0/0
i L2    10.255.255.8/32 [115/30] via 10.1.12.2, FastEthernet0/0
i L2    10.255.255.9/32 [115/40] via 10.1.12.2, FastEthernet0/0
C       10.1.12.0/24 is directly connected, FastEthernet0/0
i L2    10.255.255.2/32 [115/10] via 10.1.12.2, FastEthernet0/0
i L2    10.255.255.3/32 [115/20] via 10.1.12.2, FastEthernet0/0
i L2    10.104.104.0/24 [115/30] via 10.1.12.2, FastEthernet0/0
C       10.255.255.1/32 is directly connected, Loopback0
i L2    10.255.255.6/32 [115/50] via 10.1.12.2, FastEthernet0/0
i L2    10.255.255.7/32 [115/40] via 10.1.12.2, FastEthernet0/0
i L2    10.255.255.4/32 [115/20] via 10.1.12.2, FastEthernet0/0
S       10.255.255.5/32 [1/0] via 10.255.15.5
i L2    10.1.38.0/24 [115/30] via 10.1.12.2, FastEthernet0/0
i L2    10.1.49.0/24 [115/1020] via 10.1.12.2, FastEthernet0/0
i L2    10.2.67.0/24 [115/50] via 10.1.12.2, FastEthernet0/0
i L2    10.1.89.0/24 [115/40] via 10.1.12.2, FastEthernet0/0
i L2    10.2.107.0/24 [115/40] via 10.1.12.2, FastEthernet0/0
i L2    10.1.234.0/24 [115/20] via 10.1.12.2, FastEthernet0/0
C       10.255.15.0/24 is directly connected, FastEthernet0/1
```

R2

```
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, 18 subnets, 2 masks
i L2    10.255.255.10/32 [115/20] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.8/32 [115/20] via 10.1.234.3, FastEthernet0/1
i L2    10.255.255.9/32 [115/30] via 10.1.234.3, FastEthernet0/1
C       10.1.12.0/24 is directly connected, FastEthernet0/0
C       10.255.255.2/32 is directly connected, Loopback0
i L2    10.255.255.3/32 [115/10] via 10.1.234.3, FastEthernet0/1
i L2    10.104.104.0/24 [115/20] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.1/32 [115/10] via 10.1.12.1, FastEthernet0/0
i L2    10.255.255.6/32 [115/40] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.7/32 [115/30] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.4/32 [115/10] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.5/32 [115/10] via 10.1.12.1, FastEthernet0/0
i L2    10.1.38.0/24 [115/20] via 10.1.234.3, FastEthernet0/1
i L2    10.1.49.0/24 [115/1010] via 10.1.234.4, FastEthernet0/1
i L2    10.2.67.0/24 [115/40] via 10.1.234.4, FastEthernet0/1
i L2    10.1.89.0/24 [115/30] via 10.1.234.3, FastEthernet0/1
i L2    10.2.107.0/24 [115/30] via 10.1.234.4, FastEthernet0/1
C       10.1.234.0/24 is directly connected, FastEthernet0/1
```

R3

```
R3#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, 18 subnets, 2 masks
i L2    10.255.255.10/32 [115/20] via 10.1.234.4, FastEthernet0/1
i L1    10.255.255.8/32 [115/10] via 10.1.38.8, FastEthernet0/0
i L1    10.255.255.9/32 [115/20] via 10.1.38.8, FastEthernet0/0
i L2    10.1.12.0/24 [115/20] via 10.1.234.2, FastEthernet0/1
i L2    10.255.255.2/32 [115/10] via 10.1.234.2, FastEthernet0/1
C       10.255.255.3/32 is directly connected, Loopback0
i L1    10.104.104.0/24 [115/1030] via 10.1.38.8, FastEthernet0/0
i L2    10.255.255.1/32 [115/20] via 10.1.234.2, FastEthernet0/1
i L2    10.255.255.6/32 [115/40] via 10.1.234.4, FastEthernet0/1
i L2    10.255.255.7/32 [115/30] via 10.1.234.4, FastEthernet0/1
i L1    10.255.255.4/32 [115/1020] via 10.1.38.8, FastEthernet0/0
i L2    10.255.255.5/32 [115/20] via 10.1.234.2, FastEthernet0/1
C       10.1.38.0/24 is directly connected, FastEthernet0/0
i L1    10.1.49.0/24 [115/1020] via 10.1.38.8, FastEthernet0/0
i L2    10.2.67.0/24 [115/40] via 10.1.234.4, FastEthernet0/1
i L1    10.1.89.0/24 [115/20] via 10.1.38.8, FastEthernet0/0
i L2    10.2.107.0/24 [115/30] via 10.1.234.4, FastEthernet0/1
C       10.1.234.0/24 is directly connected, FastEthernet0/1
```

R4

```
R4#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, 18 subnets, 2 masks
i L2    10.255.255.10/32 [115/10] via 10.104.104.10, Serial1/0
i L1    10.255.255.8/32 [115/1010] via 10.1.49.9, FastEthernet0/0
i L1    10.255.255.9/32 [115/1000] via 10.1.49.9, FastEthernet0/0
i L2    10.1.12.0/24 [115/20] via 10.1.234.2, FastEthernet0/1
i L2    10.255.255.2/32 [115/10] via 10.1.234.2, FastEthernet0/1
i L1    10.255.255.3/32 [115/1020] via 10.1.49.9, FastEthernet0/0
C       10.104.104.0/24 is directly connected, Serial1/0
i L2    10.255.255.1/32 [115/20] via 10.1.234.2, FastEthernet0/1
i L2    10.255.255.6/32 [115/30] via 10.104.104.10, Serial1/0
i L2    10.255.255.7/32 [115/20] via 10.104.104.10, Serial1/0
C       10.255.255.4/32 is directly connected, Loopback0
i L2    10.255.255.5/32 [115/20] via 10.1.234.2, FastEthernet0/1
i L1    10.1.38.0/24 [115/1020] via 10.1.49.9, FastEthernet0/0
C       10.1.49.0/24 is directly connected, FastEthernet0/0
i L2    10.2.67.0/24 [115/30] via 10.104.104.10, Serial1/0
i L1    10.1.89.0/24 [115/1010] via 10.1.49.9, FastEthernet0/0
i L2    10.2.107.0/24 [115/20] via 10.104.104.10, Serial1/0
C       10.1.234.0/24 is directly connected, FastEthernet0/1
```

R5

```
R5#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 10.255.15.1 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.255.255.5/32 is directly connected, Loopback0
C        10.255.15.0/24 is directly connected, FastEthernet0/1
S*   0.0.0.0/0 [1/0] via 10.255.15.1
```

R6

```
R6#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 10.2.67.7 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 18 subnets, 2 masks
i L1    10.255.255.10/32 [115/20] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.8/32 [115/50] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.9/32 [115/60] via 10.2.67.7, FastEthernet0/1
i ia    10.1.12.0/24 [115/50] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.2/32 [115/40] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.3/32 [115/40] via 10.2.67.7, FastEthernet0/1
i L1    10.104.104.0/24 [115/30] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.1/32 [115/50] via 10.2.67.7, FastEthernet0/1
C       10.255.255.6/32 is directly connected, Loopback0
i L1    10.255.255.7/32 [115/10] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.4/32 [115/30] via 10.2.67.7, FastEthernet0/1
i ia    10.255.255.5/32 [115/50] via 10.2.67.7, FastEthernet0/1
i ia    10.1.38.0/24 [115/50] via 10.2.67.7, FastEthernet0/1
i ia    10.1.49.0/24 [115/1030] via 10.2.67.7, FastEthernet0/1
C       10.2.67.0/24 is directly connected, FastEthernet0/1
i ia    10.1.89.0/24 [115/60] via 10.2.67.7, FastEthernet0/1
i L1    10.2.107.0/24 [115/20] via 10.2.67.7, FastEthernet0/1
i ia    10.1.234.0/24 [115/40] via 10.2.67.7, FastEthernet0/1
i*L1 0.0.0.0/0 [115/20] via 10.2.67.7, FastEthernet0/1
```

R7

```
R7#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 10.2.107.10 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 18 subnets, 2 masks
i L1    10.255.255.10/32 [115/10] via 10.2.107.10, Serial1/1
i ia    10.255.255.8/32 [115/40] via 10.2.107.10, Serial1/1
i ia    10.255.255.9/32 [115/50] via 10.2.107.10, Serial1/1
i ia    10.1.12.0/24 [115/40] via 10.2.107.10, Serial1/1
i ia    10.255.255.2/32 [115/30] via 10.2.107.10, Serial1/1
i ia    10.255.255.3/32 [115/30] via 10.2.107.10, Serial1/1
i L1    10.104.104.0/24 [115/20] via 10.2.107.10, Serial1/1
i ia    10.255.255.1/32 [115/40] via 10.2.107.10, Serial1/1
i L1    10.255.255.6/32 [115/10] via 10.2.67.6, FastEthernet0/1
C       10.255.255.7/32 is directly connected, Loopback0
i ia    10.255.255.4/32 [115/20] via 10.2.107.10, Serial1/1
i ia    10.255.255.5/32 [115/40] via 10.2.107.10, Serial1/1
i ia    10.1.38.0/24 [115/40] via 10.2.107.10, Serial1/1
i ia    10.1.49.0/24 [115/1020] via 10.2.107.10, Serial1/1
C       10.2.67.0/24 is directly connected, FastEthernet0/1
i ia    10.1.89.0/24 [115/50] via 10.2.107.10, Serial1/1
C       10.2.107.0/24 is directly connected, Serial1/1
i ia    10.1.234.0/24 [115/30] via 10.2.107.10, Serial1/1
i*L1 0.0.0.0/0 [115/10] via 10.2.107.10, Serial1/1
```

R8

```
R8#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, 9 subnets, 2 masks
C       10.255.255.8/32 is directly connected, Loopback0
i L1    10.255.255.9/32 [115/10] via 10.1.89.9, FastEthernet0/1
i L1    10.255.255.3/32 [115/10] via 10.1.38.3, FastEthernet0/0
i L1    10.104.104.0/24 [115/1020] via 10.1.89.9, FastEthernet0/1
i L1    10.255.255.4/32 [115/1010] via 10.1.89.9, FastEthernet0/1
i ia    10.255.255.5/32 [115/1030] via 10.1.89.9, FastEthernet0/1
C       10.1.38.0/24 is directly connected, FastEthernet0/0
i L1    10.1.49.0/24 [115/1010] via 10.1.89.9, FastEthernet0/1
C       10.1.89.0/24 is directly connected, FastEthernet0/1
i*L1 0.0.0.0/0 [115/10] via 10.1.38.3, FastEthernet0/0
```

R9

```
R9#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 10.1.89.8 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks
i L1    10.255.255.8/32 [115/10] via 10.1.89.8, FastEthernet0/1
C       10.255.255.9/32 is directly connected, Loopback0
i L1    10.255.255.3/32 [115/20] via 10.1.89.8, FastEthernet0/1
i L1    10.104.104.0/24 [115/1010] via 10.1.49.4, FastEthernet0/0
i L1    10.255.255.4/32 [115/1000] via 10.1.49.4, FastEthernet0/0
i ia    10.255.255.5/32 [115/1020] via 10.1.49.4, FastEthernet0/0
i L1    10.1.38.0/24 [115/20] via 10.1.89.8, FastEthernet0/1
C       10.1.49.0/24 is directly connected, FastEthernet0/0
C       10.1.89.0/24 is directly connected, FastEthernet0/1
i*L1 0.0.0.0/0 [115/20] via 10.1.89.8, FastEthernet0/1
```

R10

```
R10#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, 18 subnets, 2 masks
C        10.255.255.10/32 is directly connected, Loopback0
i L2     10.255.255.8/32 [115/30] via 10.104.104.4, Serial1/0
i L2     10.255.255.9/32 [115/40] via 10.104.104.4, Serial1/0
i L2     10.1.12.0/24 [115/30] via 10.104.104.4, Serial1/0
i L2     10.255.255.2/32 [115/20] via 10.104.104.4, Serial1/0
i L2     10.255.255.3/32 [115/20] via 10.104.104.4, Serial1/0
C        10.104.104.0/24 is directly connected, Serial1/0
i L2     10.255.255.1/32 [115/30] via 10.104.104.4, Serial1/0
i L1     10.255.255.6/32 [115/20] via 10.2.107.7, Serial1/1
i L1     10.255.255.7/32 [115/10] via 10.2.107.7, Serial1/1
i L2     10.255.255.4/32 [115/10] via 10.104.104.4, Serial1/0
i L2     10.255.255.5/32 [115/30] via 10.104.104.4, Serial1/0
i L2     10.1.38.0/24 [115/30] via 10.104.104.4, Serial1/0
i L2     10.1.49.0/24 [115/1010] via 10.104.104.4, Serial1/0
i L1     10.2.67.0/24 [115/20] via 10.2.107.7, Serial1/1
i L2     10.1.89.0/24 [115/40] via 10.104.104.4, Serial1/0
C        10.2.107.0/24 is directly connected, Serial1/1
i L2     10.1.234.0/24 [115/20] via 10.104.104.4, Serial1/0
```

1.11.   Kontrola konektivity

Na kontrolu konektivity sme použili tcl skript na routri č. 6 v tvare :

```
R6#tclsh
R6(tcl)#foreach myaddresses {
+>(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)#} {ping $myaddresses}
```

```
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 = 96/100/108 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 = 60/78/96 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 = 92/101/108 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 = 40/66/88 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 = 116/121/124 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 = 1/1/4 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 = 12/21/32 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 = 80/94/104 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 = 88/100/108 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 = 40/40/44 ms
```

1.12.   Area 2 – redistribúcia L2 do L1

Aby sme mohli využiť redistribúciu z L2 záznamov do L1 záznamov, bolo najprv potrebné vytvoriť Access-list. V našom prípade bol v tvare :

access-list 101 permit ip any any

následne sme v konfiguračnom móde pre isis (configure terminal -> router isis) nastavili :

redistribute isis ip level-2 into level-1 distribute-list 101

Ako dôkaz, že redistribúcia funguje, sa môžeme presvedčiť v routovacej tabuľke routrov R6 a R7, kde sú prítomné *ia* záznamy (screenshoty v kapitole 1.10)

1.13. R8, R9 - R3 primárny smerovač pre všetky vnútorné adresy, R4 primárny smerovač len pre R5 smerovacie záznamy

Aby sa router R3 stal primárnym smerovačom pre všetky vnútorné adresy smerovačov R8 a R9, znehodnotili sme cost na linke medzi R9 a R4. Na screenshotoch vidíme, že oba routre idú cez router R3.

```
R9#sh isis topo

IS-IS paths to level-1 routers
System Id          Metric     Next-Hop          Interface   SNPA
R3                 20         R8                Fa0/1       c007.6127.0001
R4                 1000       R4                Fa0/0       c003.6127.0000
R8                 10         R8                Fa0/1       c007.6127.0001
R9                 --
```

```
R8#traceroute 10.255.255.1

Type escape sequence to abort.
Tracing the route to 10.255.255.1

  1 10.1.38.3 28 msec 12 msec 16 msec
  2 10.1.234.2 44 msec 40 msec 36 msec
  3 10.1.12.1 56 msec *  68 msec
```

```
R9#traceroute 10.255.255.1

Type escape sequence to abort.
Tracing the route to 10.255.255.1

  1 10.1.89.8 8 msec 20 msec 12 msec
  2 10.1.38.3 40 msec 44 msec 36 msec
  3 10.1.234.2 60 msec 36 msec 84 msec
  4 10.1.12.1 56 msec *  72 msec
```

Aby sa R4 stal primárnym smerovačom len pre R5 smerovacie záznamy, bolo potrebné vytvoriť Access-list v tvare :

access-list 100 permit ip 0.0.0.0 10.255.255.5 0.0.0.0 255.255.255.255

a následne v konfiguračnom móde isis

redistribute isis ip level-2 into level-1 distribute-list 100

čo zabezpečilo, že záznamy pre smerovanie na R5 budú v smerovacej tabuľke pred default route.

```
R8#traceroute 10.255.255.5

Type escape sequence to abort.
Tracing the route to 10.255.255.5

  1 10.1.89.9 16 msec 16 msec 16 msec
  2 10.1.49.4 40 msec 40 msec 36 msec
  3 10.1.234.2 32 msec 72 msec 28 msec
  4 10.1.12.1 84 msec 76 msec 68 msec
  5 10.255.15.5 96 msec *  100 msec
```

```
R9#traceroute 10.255.255.5

Type escape sequence to abort.
Tracing the route to 10.255.255.5

  1 10.1.49.4 8 msec 20 msec 12 msec
  2 10.1.234.2 40 msec 40 msec 44 msec
  3 10.1.12.1 56 msec 36 msec 88 msec
  4 10.255.15.5 60 msec *  72 msec
```

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

Skrátenie hello intervalu sme predviedli na routri R4. Z defaultných 10 sekúnd sme ho skrátili na 2 sekundy a výsledok sme odsledovali vo výpise, ktorý nám poskytol príkaz

debug isis adj-packets fastEthernet 0/1

PRED :

```
IS-IS Adjacency related packets debugging is on
R4#
*Mar  5 02:28:11.575: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
*Mar  5 02:28:11.603: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 14
97
*Mar  5 02:28:11.627: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:14.899: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:16.103: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:17.635: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:20.771: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
*Mar  5 02:28:20.827: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
*Mar  5 02:28:21.367: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 14
97
R4#
*Mar  5 02:28:23.815: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:25.243: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#debug isis adj-packets fastEthernet 0/1
*Mar  5 02:28:26.791: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#no debug isis adj-packets fastEthernet 0/1
IS-IS Adjacency related packets debugging is off
R4#
*Mar  5 02:28:29.179: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
*Mar  5 02:28:29.519: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1)
, cir type L2, cir id 0102.5525.5002.02, length 1497
R4#
*Mar  5 02:28:30.503: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 14
97
```

PO :

```
R4#debug isis adj-packets fastEthernet 0/1
IS-IS Adjacency related packets debugging is on
R4#debug isis adj-packets fastEthernet 0/1
*Mar  5 02:30:25.415: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar  5 02:30:25.623: ISIS-Adj: Rec L2 IIH from c001.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.02, length 1497
R4#debug isis adj-packets fastEthernet 0/1
*Mar  5 02:30:27.219: ISIS-Adj: Rec L2 IIH from c002.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.02, length 1497
*Mar  5 02:30:27.331: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
```

1.15. Status linky R4 – R10 ? L1L2 ?

Status linky R4-R10 sa dá overiť príkazom

sh clns int s1/0

To, že status linky je level-1-2 je možné overiť aj tým, že v smerovacích záznamoch routrov R6 a R7 sú záznamy aj z inej oblasti (screenshoty v kapitole 1.10).