

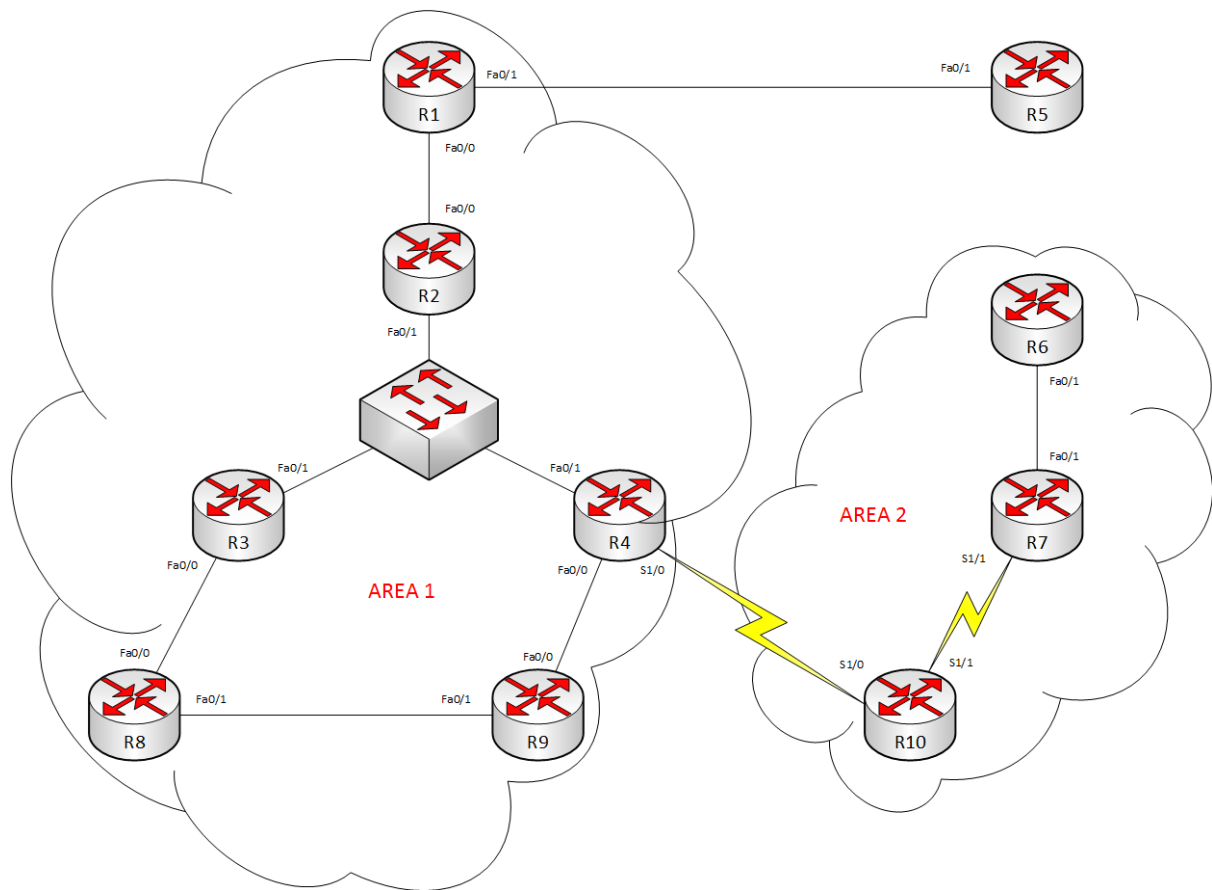
**ŽILINSKÁ UNIVERZITA V ŽILINE**  
**FAKULTA RIADENIA A INFORMATIKY**

**Projektovanie sietí 1**  
**IS - IS**

## Obsah

1. Fyzická topológia .....	3
2. Adresný plán .....	4
3. Nakonfigurovať IS-IS s dvoma oblasťami.....	5
4. R2,R3,R4 broadcast spojenia prostredníctvom L2 prepínača .....	6
5. Zvyšok spojení P2P .....	8
6. R3 – R4 point-to-point, L2 only .....	9
7. Router ID – ISO NSAP formát odvodený z Lo0 rozhrania .....	9
8. Statická redistribúcia smerovacích záznamov z R5.....	10
9. Kontrola IS-IS databáz a smerovacích tabuliek .....	11
10. Kontrola konektivity .....	12
11. Area 2 – redistribúcia L2 do L1 .....	13
12. R8, R9 – R3 primárny smerovač pre všetky vnútorné adresy, R4 primárny smerovač len pre R5 záznamy .....	14
13. Skrátene hello a dead-intervalov časovačov, zistenie funkčnosti vytrhnutím jednej z liniek smerom k L2 prepínaču .....	15

# 1. Fyzická topológia



## 2. Adresný plán

ROUTER	INTERFACE	ADRESA	MASKA
R1	Fa0/0	10.1.12.1	255.255.255.0
	Fa0/1	10.255.15.1	255.255.255.0
	Loopback0	10.255.255.1	255.255.255.255
R2	Fa0/0	10.1.12.2	255.255.255.0
	Fa0/1	10.1.234.2	255.255.255.0
	Loopback0	10.255.255.2	255.255.255.255
R3	Fa0/0	10.1.38.3	255.255.255.0
	Fa0/1	10.1.234.3	255.255.255.0
	Loopback0	10.255.255.3	255.255.255.255
R4	Fa0/0	10.1.49.4	255.255.255.0
	Fa0/1	10.1.234.4	255.255.255.0
	S1/0	10.12.104.4	255.255.255.0
	Loopback0	10.255.255.4	255.255.255.255
R5	Fa0/1	10.255.15.5	255.255.255.0
	Loopback0	10.255.255.5	255.255.255.255
R6	Fa0/1	10.2.67.6	255.255.255.0
	Loopback0	10.255.255.6	255.255.255.255
R7	Fa0/1	10.2.67.7	255.255.255.0
	S1/1	10.2.107.7	255.255.255.0
	Loopback0	10.255.255.7	255.255.255.255
R8	Fa0/0	10.1.38.8	255.255.255.0
	Fa0/1	10.1.89.8	255.255.255.0
	Loopback0	10.255.255.8	255.255.255.255
R9	Fa0/0	10.1.49.9	255.255.255.0
	Fa0/1	10.1.89.9	255.255.255.0
	Loopback0	10.255.255.9	255.255.255.255
R10	S1/0	10.12.104.10	255.255.255.0
	S1/1	10.2.107.10	255.255.255.0
	Loopback0	10.255.255.10	255.255.255.255

### 3. Nakonfigurovať IS-IS s dvoma oblasťami

Úlohou bolo nakonfigurovať smerovače tak, aby R1 – R4, R8 a R9 ležali v oblasti Area 1 a smerovače R6, R7 a R10 v oblasti Area 2. Každá oblasť v IS-IS je určená hodnotou NET a v našom prípade začína vždy bajtom s hodnotou 49, ktorá reprezentuje privátne OSI domény. Za touto hodnotou nasleduje číslo oblasti, ku ktorej daný smerovač patrí. Z výpisu môžeme vidieť, že smerovače R2, R4 a R9 patria do oblasti Area 1, a smerovače R7, R10 do oblasti Area 2.

```
R10#show clns neighbors detail
```

System Id	Interface	SNPA	State	Holdtime	Type	Protocol
R4	Se1/0	*HDLC*	Up	20	L2	IS-IS
Area Address(es): 49.0001						
IP Address(es): 10.12.104.4*						
Uptime: 07:06:42						
NSF capable						
R7	Se1/1	*HDLC*	Up	21	L1	IS-IS
Area Address(es): 49.0002						
IP Address(es): 10.2.107.7*						
Uptime: 07:25:57						
NSF capable						

```
R4#show clns neighbors detail
```

System Id	Interface	SNPA	State	Holdtime	Type	Protocol
R10	Se1/0	*HDLC*	Up	23	L2	IS-IS
Area Address(es): 49.0002						
IP Address(es): 10.12.104.10*						
Uptime: 07:07:11						
NSF capable						
R2	Fa0/1	c015.6127.0001	Up	14	L2	IS-IS
Area Address(es): 49.0001						
IP Address(es): 10.1.234.2*						
Uptime: 07:59:26						
NSF capable						
R9	Fa0/0	c01c.6127.0000	Up	25	L1	IS-IS
Area Address(es): 49.0001						
IP Address(es): 10.1.49.9*						
Uptime: 08:01:08						
NSF capable						

#### 4. R2,R3,R4 broadcast spojenia prostredníctvom L2 prepínača

Na tomto segmente musela prebehnúť voľba Designated IS (DIS), keďže linka nebola typu point-to-point. Všetky smerovače majú štandardne nastavenú prioritu na hodnotu 64, a pokiaľ ju nezmeníme, voľba padne na smerovač s najvyšším SNPA. V našom prípade sme si zvolili ako DIS smerovač R4 a nastavili sme mu najvyššiu prioritu – 127. Overenie, či sa smerovač R4 naozaj stal DIS, vykonáme pomocou príkazu *show isis database*. V tomto výpise je dôležité sledovať, pri ktorom smerovači sa v stĺpci LSPID objaví hodnota 01-00 – tá totiž identifikuje DIS na danom segmente.

```
R2#sh clns int fa0/1
FastEthernet0/1 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 1 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x1
    Level-2 Metric: 10, Priority: 64, Circuit ID: R4.01
    DR ID: R4.01
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 4
    Next IS-IS LAN Level-2 Hello in 519 milliseconds
```

```
R3#sh clns int fa0/1
FastEthernet0/1 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 27 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-2
    Interface number 0x0, local circuit ID 0x1
    Level-2 Metric: 10, Priority: 60, Circuit ID: R4.01
    DR ID: R4.01
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 2
    Next IS-IS LAN Level-2 Hello in 591 milliseconds
```

```

R4#sh clns int fa0/1
FastEthernet0/1 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 4 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-2
    Interface number 0x0, local circuit ID 0x1
    Level-2 Metric: 10, Priority: 127, Circuit ID: R4.01
    DR ID: R4.01
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 2
    Next IS-IS LAN Level-2 Hello in 471 milliseconds

```

```

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       0x00000034   0x215A        497           0/0/0
R2.00-00       * 0x0000003C   0x217F        819           0/0/0
R3.00-00       0x00000049   0x7BD7        1029          0/0/0
R4.00-00       0x00000040   0xE9F4        1105          0/0/0
R4.01-00       0x00000037   0xCA7E        1030          0/0/0
R10.00-00      0x00000028   0xBF82        560           0/0/0

```

```

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       * 0x0000003F   0x294F        1070          1/0/0
R4.00-00       0x00000045   0xB8F2        1162          1/0/0
R8.00-00       0x0000002C   0xD932        736           0/0/0
R9.00-00       0x00000034   0x8FA1        937           0/0/0

IS-IS Level-2 Link State Database:
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
R1.00-00       0x00000034   0x215A        527           0/0/0
R2.00-00       0x0000003C   0x217F        849           0/0/0
R3.00-00       * 0x00000049   0x7BD7        1064          0/0/0
R4.00-00       0x00000040   0xE9F4        1139          0/0/0
R4.01-00       0x00000037   0xCA7E        1063          0/0/0
R10.00-00      0x00000028   0xBF82        594           0/0/0

```

```
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	0x0000003F	0x294F	1051	1/0/0
R4.00-00	* 0x00000045	0xB8F2	1155	1/0/0
R8.00-00	0x0000002C	0xD932	721	0/0/0
R9.00-00	0x00000034	0x8FA1	926	0/0/0

IS-IS Level-2 Link State Database:

LSPID	LSP Seq Num	LSP Checksum	LSP Holdtime	ATT/P/OL
R1.00-00	0x00000034	0x215A	515	0/0/0
R2.00-00	0x0000003C	0x217F	838	0/0/0
R3.00-00	0x00000049	0x7BD7	1049	0/0/0
R4.00-00	* 0x00000040	0xE9F4	1128	0/0/0
R4.01-00	* 0x00000037	0xCA7E	1052	0/0/0
R10.00-00	0x00000028	0xBF82	583	0/0/0

## 5. Zvyšok spojení P2P

Na linkách sme nastavili spojenia point-to-point, čo prinieslo zvýšenie výkonu a skrátili sa tak časy konvergencie danej siete. Systém totiž nie je zaťažovaný voľbou DIS smerovača, zjednodušili sa tak výpočty najkratšej cesty a predchádza sa floodovaniu pre synchronizáciu databáz.

```
R1#sh run | sec interface FastEthernet0/0
interface FastEthernet0/0
 ip address 10.1.12.1 255.255.255.0
 ip router isis
 duplex auto
 speed auto
 isis network point-to-point
```

```
R3#sh run | sec interface FastEthernet0/0
interface FastEthernet0/0
 ip address 10.1.38.3 255.255.255.0
 ip router isis
 duplex auto
 speed auto
 isis circuit-type level-1
 isis network point-to-point
```

```
R4#sh run | sec interface FastEthernet0/0
interface FastEthernet0/0
 ip address 10.1.49.4 255.255.255.0
 ip router isis
 duplex auto
 speed auto
 isis circuit-type level-1
 isis network point-to-point
 isis metric 1000
```

```
R6#sh run | sec interface FastEthernet0/1
interface FastEthernet0/1
 ip address 10.2.67.6 255.255.255.0
 ip router isis
 duplex auto
 speed auto
 isis network point-to-point
```



## 6. R3 – R4 point-to-point, L2 only

V tomto kroku zadania bolo potrebné nastaviť smerovače R3 a R4 tak, aby na vzájomnej linke pracovali ako level-2 only. Pri konfigurácii bolo potrebné zadať na rozhraní Fa0/1 príkaz *isis circuit-type level-2-only*, čím sme dosiahli požadované správanie. Správnosť konfigurácie overíme pomocou príkazu *show clns neighbors | i R4* (resp. *R3*), a vo výpise v predposlednom stĺpci je vidieť, že smerovače sú na danej linke L2 only.

R3#sh clns neighbors   i R4						
R4	Fa0/1	c017.6127.0001	Up	4	L2	IS-IS
R4#sh clns neighbors   i R3						
R3	Fa0/1	c016.6127.0001	Up	10	L2	IS-IS

## 7. Router ID – ISO NSAP formát odvodený z Lo0 rozhrania

Router ID bolo potrebné odvodiť z IP adresy na rozhraní Loopback0. Pri vytváraní Router ID sme postupovali nasledovne (príklad pre R1):

1. IP adresa Loopback0: 10.255.255.1
2. Úprava na tvar: 010.255.255.001
3. Výsledný tvar Router ID: 0102.5525.5001

Pri zvyšných smerovačoch sa menila iba hodnota posledného čísla, v závislosti od toho, aký smerovač bol konfigurovaný.

R1#sh ip int b   inc Loopback						
Loopback0	10.255.255.1	YES manual up				up
R1#sh clns pro   inc Id						
System Id: 0102.5525.5001.00 IS-Type: level-2						
R2#sh ip int b   inc Loopback						
Loopback0	10.255.255.2	YES manual up				up
R2#sh clns pro   inc Id						
System Id: 0102.5525.5002.00 IS-Type: level-2						
R3#sh ip int b   inc Loopback						
Loopback0	10.255.255.3	YES manual up				up
R3#sh clns pro   inc Id						
System Id: 0102.5525.5003.00 IS-Type: level-1-2						
R4#sh ip int b   inc Loopback						
Loopback0	10.255.255.4	YES manual up				up
R4#sh clns pro   inc Id						
System Id: 0102.5525.5004.00 IS-Type: level-1-2						
R6#sh ip int b   inc Loopback						
Loopback0	10.255.255.6	YES manual up				up
R6#sh clns pro   inc Id						
System Id: 0102.5525.5006.00 IS-Type: level-1						
R7#sh ip int b   inc Loopback						
Loopback0	10.255.255.7	YES manual up				up
R7#sh clns pro   inc Id						
System Id: 0102.5525.5007.00 IS-Type: level-1						

```

R8#sh ip int b | inc Loopback
Loopback0          10.255.255.8    YES manual up

R8#sh clns pro | inc Id
System Id: 0102.5525.5008.00 IS-Type: level-1

R9#sh ip int b | inc Loopback
Loopback0          10.255.255.9    YES manual up

R9#sh clns pro | inc Id
System Id: 0102.5525.5009.00 IS-Type: level-1

R10#sh ip int b | inc Loopback
Loopback0          10.255.255.10   YES manual up

R10#sh clns pro | inc Id
System Id: 0102.5525.5010.00 IS-Type: level-1-2

```

## 8. Statická redistribúcia smerovacích záznamov z R5

Keďže smerovač R5 nepatrí do žiadnej oblasti v rámci protokolu IS-IS, ani na ňom nebol spustený iný smerovací protokol, bolo potrebné nakonfigurovať statickú redistribúciu, aby sme zabezpečili plnú konektivitu v celej topológii. Zo smerovača R5 sme nastavili default route na smerovač R1. V opačnom smere bolo potrebné takisto nastaviť statickú cestu na loopback R5. V poslednom kroku sme nastavili príkazom *redistribute static ip* na smerovači R1, aby preposielal túto informáciu do celej siete a bola zabezpečená plná konektivita.

```

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, FastEthernet0/1

R1#sh ip route static
    10.0.0.0/8 is variably subnetted, 19 subnets, 2 masks
S       10.255.255.5/32 [1/0] via 10.255.15.5

```

## 9. Kontrola IS-IS databáz a smerovacích tabuliek

Pomocou príkazov *show isis database*, *show ip route* sme overili, či majú smerovače všetky potrebné informácie o dostupných sieťach a smerovačoch v celej topológii.

```
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       0x000000042  0xCDB1        777           1/0/0
R4.00-00       * 0x000000047  0xB4F4        783           1/0/0
R8.00-00       0x00000002E  0xD534        612           0/0/0
R9.00-00       0x000000036  0x8BA3        620           0/0/0

IS-IS Level-2 Link State Database:
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
R1.00-00       0x000000037  0x433F        663           0/0/0
R2.00-00       0x00000003F  0x8423        565           0/0/0
R3.00-00       0x00000004B  0x4A11        781           0/0/0
R4.00-00       * 0x000000042  0x4B9B        785           0/0/0
R4.01-00       * 0x000000039  0xC680        699           0/0/0
R10.00-00      0x00000002B  0xB985        1043          0/0/0

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 [115/20] via 10.12.104.10, Serial1/0
i L1   10.255.255.8/32 [115/1020] via 10.1.49.9, FastEthernet0/0
i L1   10.255.255.9/32 [115/1010] 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
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 10.12.104.10, Serial1/0
i L2   10.255.255.7/32 [115/30] via 10.12.104.10, 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 10.12.104.10, 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 10.12.104.10, Serial1/0
C       10.12.104.0/24 is directly connected, Serial1/0
C       10.1.234.0/24 is directly connected, FastEthernet0/1
```

```

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       0x0000002A  0x1661        566           0/0/0
R7.00-00       0x00000031  0x319D        1058          0/0/0
R10.00-00      * 0x0000002D  0xFA6D        713           1/0/0
IS-IS Level-2 Link State Database:
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
R1.00-00       0x00000037  0x433F        596           0/0/0
R2.00-00       0x0000003F  0x8423        498           0/0/0
R3.00-00       0x0000004B  0x4A11        714           0/0/0
R4.00-00       0x00000042  0x4B9B        718           0/0/0
R4.01-00       0x00000039  0xC680        632           0/0/0
R10.00-00      * 0x0000002B  0xB985        980           0/0/0

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 [115/40] via 10.12.104.4, Serial1/0
i L2    10.255.255.9/32 [115/50] via 10.12.104.4, Serial1/0
i L2    10.1.12.0/24 [115/30] via 10.12.104.4, Serial1/0
i L2    10.255.255.2/32 [115/20] via 10.12.104.4, Serial1/0
i L2    10.255.255.3/32 [115/20] via 10.12.104.4, Serial1/0
i L2    10.255.255.1/32 [115/30] via 10.12.104.4, 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 [115/20] via 10.2.107.7, Serial1/1
i L2    10.255.255.4/32 [115/10] via 10.12.104.4, Serial1/0
i L2    10.255.255.5/32 [115/30] via 10.12.104.4, Serial1/0
i L2    10.1.38.0/24 [115/30] via 10.12.104.4, Serial1/0
i L2    10.1.49.0/24 [115/1010] via 10.12.104.4, 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 10.12.104.4, Serial1/0
C       10.2.107.0/24 is directly connected, Serial1/1
C       10.12.104.0/24 is directly connected, Serial1/0
i L2    10.1.234.0/24 [115/20] via 10.12.104.4, Serial1/0

```

## 10. Kontrola konektivity

Kontrola konektivity prebehla pomocou príkazov ping zo všetkých smerovačov, na všetky dostupné rozhrania v topológii. Úspešný výsledok z každého smerovača je uložený v textovom súbore a priložený k dokumentácii.

## 11. Area 2 – redistribúcia L2 do L1

V tomto bode úlohy bolo potrebné na smerovači R10 nastaviť, aby prepúšťal informácie z Area 1 do oblasti Area 2, kde sa nachádzajú smerovače R6 a R7 pracujúce ako L1. Najprv sme vytvorili *access-list 100 permit ip any any*, aby smerovač vedel, aké záznamy má preposielať. Následne sme príkazom *redistribute isis ip level-2 into level-1 distribute-list 100* zabezpečili redistribúciu L2 do L1. Po zadaní príkazu *show ip route* na R7 sa nám vo výpise objavila okrem L1 aj redistribuované záznamy (ia – inter area) z R10.

```
R10(tcl)#sh run | sec isis
ip router isis
ip router isis
ip router isis
isis circuit-type level-1
router isis
net 49.0002.0102.5525.5010.00
metric-style wide
redistribute isis ip level-2 into level-1 distribute-list 100
```

```
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 [115/20] via 10.2.107.10, Serial1/1
i ia    10.255.255.8/32 [115/50] via 10.2.107.10, Serial1/1
i ia    10.255.255.9/32 [115/40] 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 [115/40] via 10.2.107.10, Serial1/1
i ia    10.255.255.3/32 [115/40] via 10.2.107.10, Serial1/1
i ia    10.255.255.1/32 [115/50] 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 [115/30] 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 [115/40] via 10.2.107.10, Serial1/1
C       10.2.107.0/24 is directly connected, Serial1/1
i L1    10.12.104.0/24 [115/20] via 10.2.107.10, Serial1/1
i ia    10.1.234.0/24 [115/30] via 10.2.107.10, Serial1/1
```

## 12. R8, R9 – R3 primárny smerovač pre všetky vnútorné adresy, R4 primárny smerovač len pre R5 záznamy

V tomto kroku bolo potrebné nastaviť, aby všetky požiadavky pre vnútorné adresy zo smerovačov R8 a R9 prechádzali primárne cez smerovač R3. Aby sme docielili takéto správanie, museli sme znevýhodniť trasu cez R3. Upravili sme tak metriku na rozhraniach medzi smerovačmi R9 a R3. Overenie želaného správania sme vykonali pomocou príkazu traceroute na niektorú z vnútorných adries.

```
R8#traceroute 10.255.255.1 source 10.255.255.8
Type escape sequence to abort.
Tracing the route to 10.255.255.1

 1 10.1.38.3 16 msec 28 msec 16 msec
 2 10.1.234.2 32 msec 32 msec 32 msec
 3 10.1.12.1 68 msec 52 msec *
```

```
R9#traceroute 10.255.255.1 source 10.255.255.9
Type escape sequence to abort.
Tracing the route to 10.255.255.1

 1 10.1.89.8 28 msec 16 msec 24 msec
 2 10.1.38.3 24 msec 28 msec 40 msec
 3 10.1.234.2 64 msec 40 msec 72 msec
 4 10.1.12.1 56 msec 76 msec *
```

V druhej časti zadania sme povolili cez R4 prepúšťať L2 záznamy do L1, čím sme zabezpečili, aby smerovače vedeli o R5. Tým pádom vedia R8 a R9, že na cestu k R5 musia použiť prepínač R4. Overenie prebieha príkazom traceroute na adresu 10.255.255.5.

```
R8#traceroute 10.255.255.5 source 10.255.255.8
Type escape sequence to abort.
Tracing the route to 10.255.255.5

 1 10.1.89.9 20 msec 12 msec 20 msec
 2 10.1.49.4 28 msec 32 msec 28 msec
 3 10.1.234.2 40 msec 36 msec 44 msec
 4 10.1.12.1 76 msec 72 msec 60 msec
 5 10.255.15.5 96 msec 84 msec *
```

```
R9#traceroute 10.255.255.5 source 10.255.255.9
Type escape sequence to abort.
Tracing the route to 10.255.255.5

 1 10.1.49.4 4 msec 12 msec 16 msec
 2 10.1.234.2 28 msec 52 msec 28 msec
 3 10.1.12.1 80 msec 56 msec 84 msec
 4 10.255.15.5 100 msec 92 msec *
```



### 13. Skrátenie hello a dead-intervalov časovačov, zistenie funkčnosti vytrhnutím jednej z liniek smerom k L2 prepínaču

Hello časovač je štandardne nastavený na 10 sekúnd, preto sme sa ho rozhodli skrátiť na 5 sekúnd a následne overili funkčnosť nastavenia.

```
*Mar 2 01:03:48.001: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:03:48.489: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type
L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 01:03:48.689: ISIS-Adj: Rec serial IIH from *HDLC* (Serial1/0), cir type L1L2, cir
id 01, length 1499
*Mar 2 01:03:48.693: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar 2 01:03:48.693: ISIS-Adj: Action = ACCEPT
*Mar 2 01:03:48.889: ISIS-Adj: Rec serial IIH from c01c.6127.0000 (FastEthernet0/0), cir type L1, cir id 01, length 1496
*Mar 2 01:03:48.893: ISIS-Adj: rcvd state UP, old state UP, new state UP
R4#
*Mar 2 01:03:48.897: ISIS-Adj: Action = ACCEPT
*Mar 2 01:03:49.469: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:03:49.661: ISIS-Adj: Rec L2 IIH from c016.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
R4#
*Mar 2 01:03:50.733: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
R4#
*Mar 2 01:03:52.049: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:03:52.601: ISIS-Adj: Sending serial IIH on Serial1/0, length 1499
*Mar 2 01:03:52.633: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
R4#
*Mar 2 01:03:53.353: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:03:53.421: ISIS-Adj: Rec L2 IIH from c016.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
R4#
*Mar 2 01:03:54.505: ISIS-Adj: Sending serial IIH on FastEthernet0/0, length 1496
*Mar 2 01:03:54.993: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
R4#
*Mar 2 01:03:56.321: ISIS-Adj: Rec serial IIH from *HDLC* (Serial1/0), cir type L1L2, cir id 01, length 1499
*Mar 2 01:03:56.325: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar 2 01:03:56.329: ISIS-Adj: Action = ACCEPT
*Mar 2 01:03:56.649: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:03:56.677: ISIS-Adj: Rec serial IIH from c01c.6127.0000 (FastEthernet0/0), cir type L1, cir id 01, length 1496
*Mar 2 01:03:56.681: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar 2 01:03:56.685: ISIS-Adj: Action = ACCEPT
R4#
*Mar 2 01:03:57.269: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 01:03:57.317: ISIS-Adj: Rec L2 IIH from c016.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 01:03:58.125: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
R4#
*Mar 2 01:03:59.397: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
R4#
*Mar 2 01:04:01.009: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 01:04:01.249: ISIS-Adj: Sending serial IIH on Serial1/0, length 1499
*Mar 2 01:04:01.369: ISIS-Adj: Rec L2 IIH from c016.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 01:04:01.573: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
```

Po vytrhnutí jednej z liniek smerom k L2 prepínaču, sa v záznamoch ukazuje informácia o strate spojenia. Keďže sme vytrhli linku smerujúcu k DIS, musela prebehnúť voľba nového DIS smerovača. Po určitom čase sme linku pripojili späť, a zo záznamu je vidieť, že voľba DIS smerovača je preemptívna, čiže sa udeje vždy keď sa objaví nový router s vyššou prioritou (resp. vyšším SNPA) ako má aktuálne zvolený DIS.

```
*Mar 2 00:54:36.825: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:37.033: ISIS-Adj: L2 adj count 1
*Mar 2 00:54:37.037: ISIS-Adj: L2 adjacency to c017.6127.0001 lost
*Mar 2 00:54:37.041: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:37.041: ISIS-Adj: Run level-2 DR election for FastEthernet0/1
*Mar 2 00:54:37.041: ISIS-Adj: New level-2 DR 0102.5525.5002 on FastEthernet0/1
*Mar 2 00:54:37.041: ISIS-Adj: DR hasn't elected itself
*Mar 2 00:54:37.837: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:37.837: ISIS-Adj: Run level-2 DR election for FastEthernet0/1
*Mar 2 00:54:37.841: ISIS-Adj: New level-2 DR 0102.5525.5002 on FastEthernet0/1
*Mar 2 00:54:38.041: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:39.293: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:40.121: ISIS-Adj: Sending serial IIH on FastEthernet0/0, length 1496
*Mar 2 00:54:40.529: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:42.177: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:42.973: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:43.561: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:45.221: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:45.325: ISIS-Adj: Rec serial IIH from c01b.6127.0000 (FastEthernet0/0), cir type L1, cir id 00, length 1496
*Mar 2 00:54:45.325: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar 2 00:54:45.325: ISIS-Adj: Action = ACCEPT
*Mar 2 00:54:46.589: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:47.753: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:47.869: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:49.205: ISIS-Adj: Rec L2 IIH from c017.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:49.213: ISIS-Adj: New adjacency, level 2 for c017.6127.0001
*Mar 2 00:54:49.213: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:49.221: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5002.01, length 1497
*Mar 2 00:54:49.677: ISIS-Adj: Sending serial IIH on FastEthernet0/0, length 1496
*Mar 2 00:54:50.189: ISIS-Adj: Rec L2 IIH from c017.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:50.189: ISIS-Adj: L2 adj count 2
*Mar 2 00:54:50.189: ISIS-Adj: L2 adjacency state goes to Up
*Mar 2 00:54:50.193: ISIS-Adj: Run level-2 DR election for FastEthernet0/1
*Mar 2 00:54:50.193: ISIS-Adj: New level-2 DR 0102.5525.5004 on FastEthernet0/1
*Mar 2 00:54:50.213: ISIS-Adj: Sending L2 LAN IIH on FastEthernet0/1, length 1497
*Mar 2 00:54:50.241: ISIS-Adj: Rec L2 IIH from c015.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:50.241: ISIS-Adj: Run level-2 DR election for FastEthernet0/1
*Mar 2 00:54:50.241: ISIS-Adj: No change
*Mar 2 00:54:51.161: ISIS-Adj: Rec L2 IIH from c017.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:52.533: ISIS-Adj: Rec L2 IIH from c017.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:53.841: ISIS-Adj: Rec L2 IIH from c017.6127.0001 (FastEthernet0/1), cir type L2, cir id 0102.5525.5004.01, length 1497
*Mar 2 00:54:53.853: ISIS-Adj: Rec serial IIH from c01b.6127.0000 (FastEthernet0/0), cir type L1, cir id 00, length 1496
*Mar 2 00:54:53.857: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar 2 00:54:53.857: ISIS-Adj: Action = ACCEPT
```