Žilinská univerzita v Žiline
Fakulta riadenia a informatiky

Semestrálna práca z predmetu

Projektovanie sietí 1

OSPF

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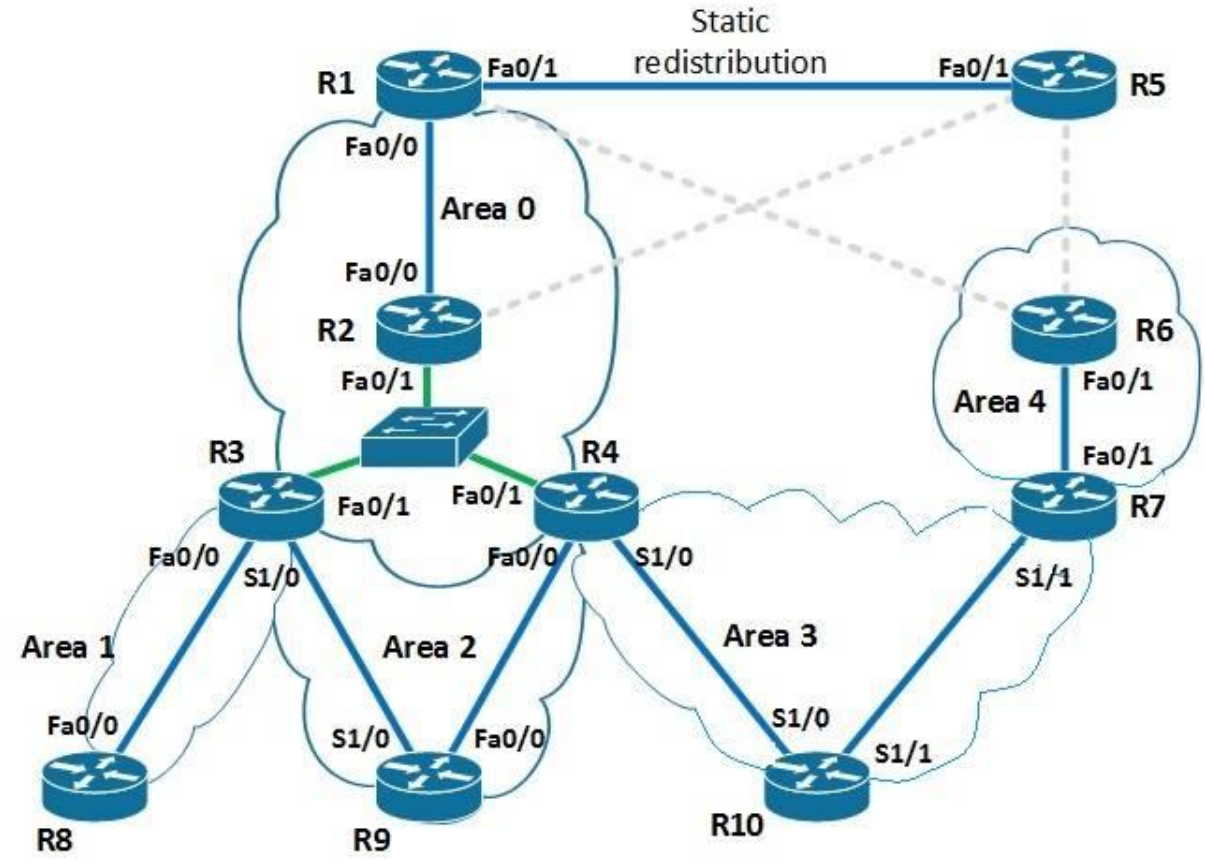
3. Topológia



4. Adresovanie

Router	Interface	IP+Maska
R1	Lo0	10.255.255.1/32
	E2/0	10.0.12.1/24
	E2/1	192.168.15.1/24
R2	Lo0	10.255.255.2/32
	E2/0	10.0.12.2/24
	E2/1	10.0.20.2/24
R3	Lo0	10.255.255.3/32
	E2/0	10.1.38.3/24
	E2/1	10.0.20.3/24
	S1/0	10.2.39.3/24
R4	Lo0	10.255.255.4/32
	E2/0	10.2.49.4/24
	E2/1	10.0.20.4/24
	S1/0	10.3.41.4/24
R5	Lo0	10.255.255.5/32
	E2/1	192.168.15.5/24
R6	Lo0	10.255.255.6/32
	E2/1	10.4.67.6/24
R7	Lo0	10.255.255.7/32
	E2/1	10.4.67.7/24
	S1/1	10.3.71.7/24
R8	Lo0	10.255.255.8/32
	E2/0	10.1.38.8/24
R9	Lo0	10.255.255.9/32
	E2/0	10.2.49.9/24
	S1/0	10.2.39.9/24
R10	Lo0	10.255.255.10/32
	S1/0	10.3.41.10/24
	S1/1	10.3.71.10/24

5. Nakonfigurovať OSPF s viacerými oblasťami

Príkaz `sh ip protocols` na R3:

```
 Routing for Networks:
 Routing on Interfaces Configured Explicitly (Area 0):
   Loopback0
   FastEthernet0/1
 Routing on Interfaces Configured Explicitly (Area 1):
   FastEthernet0/0
 Routing on Interfaces Configured Explicitly (Area 2):
   Serial1/0
```

Príkaz `sh ip protocols` na R7:

```
Routing for Networks:
Routing on Interfaces Configured Explicitly (Area 3):
  Serial1/1
Routing on Interfaces Configured Explicitly (Area 4):
  FastEthernet0/1
  Loopback0
```

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

Medzi routrami R1<->R2,R3<->R8,R4<->R9,R6<->R7 sme nastavili point-to-point spojenie. P2P treba nastaviť na danom interface príkazom: *`ip ospf network point-to-point`*

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

```
R3#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          1     0               10.255.255.3/24    1     LOOP  0/0
Fa0/1        1     0               10.0.20.3/24       10    BDR   2/2
Fa0/0        1     1               10.1.38.3/24       10    P2P   0/0
Se1/0        1     2               10.2.39.3/24       64    P2P   1/1
```

```
R10#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Se1/1        1     3               10.3.17.10/24      64    P2P   1/1
Se1/0        1     3               10.3.14.10/24      64    P2P   1/1
Lo0          1     3               10.255.255.10/32   1     LOOP  0/0
```

7. Router-id - loopback0, passive-interface

Ako router-id sa zoberie najväčšie číslo ip adresy, ktorá je pripojená na danom smerovači. Ak sme ako prvý nezadali loopback tak bolo treba router-id znova nastaviť, takže bolo potrebné vymazať OSPF z každého routra, vypnúť a zapnúť OSPF a potom každému routru priradiť manuálne router id príkazom: `router-id 10.255.255.1` (syntax: router-id [ip adresa lo0])

Loopback0 sme nastavili ako pasívny interface. Nepotrebujeme na ne posielať OSPF packety, pretože je to koncová sieť. Pasívny loopback nastavíme na každom routri príkazom: *passive-interface lo0*

```
R8(config)#do sh ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "application"
  Sending updates every 0 seconds
  Invalid after 0 seconds, hold down 0, flushed after 0
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Maximum path: 32
  Routing for Networks:
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 4)

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:
  Routing on Interfaces Configured Explicitly (Area 1):
    Loopback0
    Ethernet2/0
  Passive Interface(s):
    Loopback0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.255.255.3         110      1d16h
    10.255.255.1         110      1d16h
    10.0.20.3            110      1d17h
  Distance: (default is 110)
```

8. Area 1 – Totally Stubby,Area 2 – Stub,Area 4 – pripojenie pomocou virtuálnej linky

Area 1 totaly stubby:

```
R8#sh ip route ospf
     10.0.0.0/8 is variably subnetted, 13 subnets, 2 masks
O IA    10.255.255.10/32 [110/85] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.255.255.9/32 [110/75] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.0.12.0/24 [110/30] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.3.14.0/24 [110/84] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.255.255.3/32 [110/11] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.255.255.1/32 [110/31] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.255.255.4/32 [110/21] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.3.17.0/24 [110/148] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.0.20.0/24 [110/20] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.2.39.0/24 [110/74] via 10.1.38.3, 00:00:02, FastEthernet0/0
O IA    10.2.49.0/24 [110/84] via 10.1.38.3, 00:00:02, FastEthernet0/0
O*IA 0.0.0.0/0 [110/11] via 10.1.38.3, 00:02:03, FastEthernet0/0
R8#sh ip route ospf

R8#sh ip route ospf
O*IA 0.0.0.0/0 [110/11] via 10.1.38.3, 00:00:03, FastEthernet0/0
```

Pred nastavením na totally stubby

Po nastavení na totally stubby

Area 2 stub:

V zadaní bolo pôvodne, area 3 má byť stub ale to bolo v rozpore z ďalšou úlohou (virtuálne linky) a preto sme nastavili areu 2 ako stub.

```
R9(config)#do sh ip route ospf
     10.0.0.0/8 is variably subnetted, 13 subnets, 3 masks
O IA    10.255.255.10/32 [110/75] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.255.255.8/32 [110/31] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.0.12.0/24 [110/30] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.3.14.0/24 [110/74] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.255.255.3/32 [110/21] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.255.255.1/32 [110/31] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.1.0.0/16 [110/30] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.255.255.4/32 [110/11] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.3.17.0/24 [110/138] via 10.2.49.4, 00:02:06, FastEthernet0/0
O IA    10.0.20.0/24 [110/20] via 10.2.49.4, 00:02:06, FastEthernet0/0
O*IA 0.0.0.0/0 [110/11] via 10.2.49.4, 00:02:06, FastEthernet0/0
```

Virtuálne linky:

```
R4(config)#do sh ip ospf virtual-links
Virtual Link OSPF_VL0 to router 10.255.255.7 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 3, via interface Serial1/0
 Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0          128       no          no            Base
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:06
    Adjacency State FULL (Hello suppressed)
    Index 1/3/4, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0)/0x0(0) Next 0x0(0)/0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

```
R7#sh ip ospf virtual-links
Virtual Link OSPF_VL0 to router 10.255.255.4 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 3, via interface Serial1/1
 Topology-MTID    Cost    Disabled     Shutdown      Topology Name
        0           128       no          no            Base
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:09
    Adjacency State FULL (Hello suppressed)
    Index 1/1/3, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0)/0x0(0) Next 0x0(0)/0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

9. Statická redistribúcia smerovacích záznamov z R5

Na R1 sme zadali príkazy:

```
ip route 10.255.255.5 255.255.255.255 192.168.15.5
router ospf 1
redistribute static subnets
redistribute connected subnets
```

Na R5:

```
ip route 0.0.0.0 0.0.0.0 192.168.15.1
```

```
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

C    192.168.15.0/24 is directly connected, FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 17 subnets, 3 masks
O IA    10.255.255.10/32 [110/85] via 10.0.12.2, 00:45:26, FastEthernet0/0
O IA    10.255.255.8/32 [110/31] via 10.0.12.2, 00:00:06, FastEthernet0/0
O IA    10.255.255.9/32 [110/31] via 10.0.12.2, 00:45:26, FastEthernet0/0
C       10.0.12.0/24 is directly connected, FastEthernet0/0
O IA    10.3.14.0/24 [110/84] via 10.0.12.2, 00:45:26, FastEthernet0/0
O       10.255.255.2/32 [110/11] via 10.0.12.2, 01:10:55, FastEthernet0/0
O IA    10.2.0.0/16 [110/21] via 10.0.12.2, 00:05:52, FastEthernet0/0
O       10.255.255.3/32 [110/21] via 10.0.12.2, 00:45:39, FastEthernet0/0
C       10.255.255.0/24 is directly connected, Loopback0
O IA    10.1.0.0/16 [110/30] via 10.0.12.2, 00:45:39, FastEthernet0/0
O IA    10.255.255.6/32 [110/159] via 10.0.12.2, 00:45:39, FastEthernet0/0
O IA    10.255.255.7/32 [110/149] via 10.0.12.2, 00:47:06, FastEthernet0/0
O       10.255.255.4/32 [110/21] via 10.0.12.2, 00:47:06, FastEthernet0/0
S       10.255.255.5/32 [1/0] via 192.168.15.5
O IA    10.3.17.0/24 [110/148] via 10.0.12.2, 00:47:06, FastEthernet0/0
O       10.0.20.0/24 [110/20] via 10.0.12.2, 00:47:06, FastEthernet0/0
O IA    10.4.67.0/24 [110/158] via 10.0.12.2, 00:47:06, FastEthernet0/0
     192.168.255.0/32 is subnetted, 1 subnets
S       192.168.255.5 [1/0] via 192.168.15.2
```

10. Kontrola DR prostredníctvom "ip ospf priority"

R2 sme nastavili ako DR a to tak, že na routri R2 sme dali prioritu 3, R3 prioritu 2 a R4 prioritu 1 a nakoniec bolo treba aj zapnúť a vypnúť tieto interfaci.

```
R2(config)#do sh ip ospf int e2/1
Ethernet2/1 is up, line protocol is up
  Internet Address 10.0.20.2/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 10.255.255.2, Network Type BROADCAST, Cost: 10
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           10        no          no            Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State DR, Priority 3
  Designated Router (ID) 10.255.255.2, Interface address 10.0.20.2
  Backup Designated router (ID) 10.255.255.3, Interface address 10.0.20.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:07
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/2/2, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 5
```

```
R4(config)#do sh ip ospf int e2/1
Ethernet2/1 is up, line protocol is up
  Internet Address 10.0.20.4/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 10.255.255.4, Network Type BROADCAST, Cost: 10
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           10        no          no            Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State DROTHER, Priority 1
  Designated Router (ID) 10.255.255.2, Interface address 10.0.20.2
  Backup Designated router (ID) 10.255.255.3, Interface address 10.0.20.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 7
```

```
R3(config)#do sh ip ospf int e2/1
Ethernet2/1 is up, line protocol is up
  Internet Address 10.0.20.3/24, Area 0, Attached via Interface Enable
  Process ID 1, Router ID 10.255.255.3, Network Type BROADCAST, Cost: 10
  Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0           10        no          no            Base
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State BDR, Priority 2
  Designated Router (ID) 10.255.255.2, Interface address 10.0.20.2
  Backup Designated router (ID) 10.255.255.3, Interface address 10.0.20.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:07
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 3
```

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

Ak chceme, aby bol router R3 preferovaný pred routrom R4, tak je potrebné nastaviť cenu prechodu cez R3 menšiu ako cez router R4.
Pre príklad sme nastavili pre prechod z R9 na R3 cenu 1 a medzi R9 a R4 sme nastavili cenu 100.

```
R9#sh ip ospf int brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          1     2               10.255.255.9/32    1     LOOP  0/0
Fa0/0        1     2               10.2.49.9/24       100   P2P   1/1
Se1/0        1     2               10.2.39.9/24       1     P2P   1/1
```

Overenie, že preferujem R3(pred R4).Traceroute z R9 na R2:

```
R9#traceroute 10.0.12.2

Type escape sequence to abort.
Tracing the route to 10.0.12.2

  1 10.2.39.3 804 msec 1072 msec 516 msec
  2 10.0.20.2 1360 msec 612 msec 720 msec
```

Opačný smer z R2 na R9:

```
R2#traceroute R9

Type escape sequence to abort.
Tracing the route to R9 (10.255.255.9)

  1 10.0.20.3 404 msec 528 msec 768 msec
  2 10.2.39.9 972 msec 952 msec 712 msec
```

Sumarizácia arei 1,2 (zostručnenie, čo spadá do priestoru). Sumarizujem areu 1,2 voči ostatným.
Príkaz na R3:

```
area 1 range 10.1.0.0 255.255.0.0
```

Príkaz na R4:

```
area 2 range 10.2.0.0 255.255.0.0
```

R3:

```
show ip route 10.1.0.0 255.255.0.0 longer-prefixes
```

```
     10.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
O       10.1.0.0/16 is a summary, 00:53:08, Null0
C       10.1.38.0/24 is directly connected, FastEthernet0/0
```

```
show ip route 10.2.0.0 255.255.0.0 longer-prefixes
```

```
     10.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
O       10.2.0.0/16 is a summary, 00:14:35, Null0
C       10.2.39.0/24 is directly connected, Serial1/0
O       10.2.49.0/24 [110/164] via 10.2.39.9, 00:14:25, Serial1/0
```

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

Zvolili sme hello interval aj dead interval 1:

```
ip ospf dead-interval 1
ip ospf hello-interval 1
```

Overenie cez ping z R9 na R5. Preferovaná cesta bola cez router R3 ale keďže sme chceli overiť nastavené intervaly, tak sme po zahájení pingu odpojili S1/0 na routri R3. Spojenie sa stratilo a následne hneď obnovilo cez R4.

```
Sending 1000, 100-byte ICMP Echos to 10.255.255.5, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!..
*Mar  1 00:17:36.003: %OSPF-5-ADJCHG: Process 1, Nbr 10.255.255.3 on Serial1/0 from FULL to DOWN, Neighbor Dow
n: Dead timer expired...!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
*Mar  1 00:18:03.803: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to down!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!
Success rate is 99 percent (995/1000), round-trip min/avg/max = 16/41/76 ms
R9#
```

13. Kontrola OSPF databáz a smerovacích tabuliek

```
R1#sh ip ospf database

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

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link
count
10.0.12.1       10.0.12.1       584         0x8000000B 0x0047E1 4
10.0.20.3       10.0.20.3       567         0x8000000B 0x001568 2
10.255.255.1    10.255.255.1    1176        0x80000008 0x00BAD6 3
10.255.255.4    10.255.255.4    576         0x8000000D 0x008459 3
10.255.255.7    10.255.255.7    3     (DNA) 0x80000002 0x00F564 1

                Net Link States (Area 0)
```

```
Link ID         ADV Router      Age         Seq#       Checksum
10.0.20.2       10.0.12.1       584         0x80000008 0x00AA07

                Summary Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.1.0.0        10.0.20.3       63          0x80000004 0x0060A3
10.2.0.0        10.0.20.3       49          0x80000001 0x00FF0F
10.2.0.0        10.255.255.4    324         0x80000004 0x00DA3B
10.3.14.0       10.255.255.4    324         0x80000004 0x00527E
10.3.14.0       10.255.255.7    14    (DNA) 0x80000001 0x00C8C7
10.3.17.0       10.255.255.4    342         0x80000004 0x00B3D9
10.3.17.0       10.255.255.7    14    (DNA) 0x80000001 0x0025A8
10.4.67.0       10.255.255.7    14    (DNA) 0x80000001 0x00D2FD
10.255.255.6    10.255.255.7    14    (DNA) 0x80000001 0x00B45C
10.255.255.7    10.255.255.7    14    (DNA) 0x80000001 0x0046D3
10.255.255.8    10.0.20.3       19          0x80000001 0x002CD2
10.255.255.9    10.0.20.3       55          0x80000001 0x004087
10.255.255.9    10.255.255.4    593         0x80000003 0x00A46A
10.255.255.10   10.255.255.4    342         0x80000004 0x00B620
10.255.255.10   10.255.255.7    14    (DNA) 0x80000001 0x00AA2C

                Type-5 AS External Link States

Link ID         ADV Router      Age         Seq#       Checksum Tag
10.255.255.5    10.255.255.1    204         0x80000003 0x00CEB5 0
192.168.15.0    10.255.255.1    204         0x80000003 0x002CEE 0
192.168.255.5   10.255.255.1    214         0x80000003 0x009F85 0
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

C    192.168.15.0/24 is directly connected, FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 17 subnets, 3 masks
```

```
O IA    10.255.255.10/32 [110/85] via 10.0.12.2, 00:41:30,
FastEthernet0/0
O IA    10.255.255.8/32 [110/31] via 10.0.12.2, 00:00:55,
FastEthernet0/0
O IA    10.255.255.9/32 [110/31] via 10.0.12.2, 00:41:30,
FastEthernet0/0
C       10.0.12.0/24 is directly connected, FastEthernet0/0
O IA    10.3.14.0/24 [110/84] via 10.0.12.2, 00:41:30,
FastEthernet0/0
O       10.255.255.2/32 [110/11] via 10.0.12.2, 01:07:02,
FastEthernet0/0
O IA    10.2.0.0/16 [110/21] via 10.0.12.2, 00:01:59,
FastEthernet0/0
O       10.255.255.3/32 [110/21] via 10.0.12.2, 00:41:46,
FastEthernet0/0
C       10.255.255.0/24 is directly connected, Loopback0
O IA    10.1.0.0/16 [110/30] via 10.0.12.2, 00:41:46,
FastEthernet0/0
O IA    10.255.255.6/32 [110/159] via 10.0.12.2, 00:41:46,
FastEthernet0/0
O IA    10.255.255.7/32 [110/149] via 10.0.12.2, 00:41:50,
FastEthernet0/0
O       10.255.255.4/32 [110/21] via 10.0.12.2, 00:41:50,
FastEthernet0/0
S       10.255.255.5/32 [1/0] via 192.168.15.5
O IA    10.3.17.0/24 [110/148] via 10.0.12.2, 00:41:50,
FastEthernet0/0
O       10.0.20.0/24 [110/20] via 10.0.12.2, 00:41:50,
FastEthernet0/0
O IA    10.4.67.0/24 [110/158] via 10.0.12.2, 00:41:50,
FastEthernet0/0
     192.168.255.0/32 is subnetted, 1 subnets
S       192.168.255.5 [1/0] via 192.168.15.2

R4#sh ip ospf database

            OSPF Router with ID (10.255.255.4) (Process ID 1)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link
count
10.0.12.1       10.0.12.1       670         0x8000000B 0x0047E1 4
10.0.20.3       10.0.20.3       653         0x8000000B 0x001568 2
10.255.255.1    10.255.255.1    1255        0x80000008 0x00BAD6 3
10.255.255.4    10.255.255.4    661         0x8000000D 0x008459 3
10.255.255.7    10.255.255.7    1     (DNA) 0x80000002 0x00F564 1
```

Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.0.20.2	10.0.12.1	670	0x80000008	0x00AA07

Summary Net Link States (Area 0)

Link ID	ADV Router	Age		Seq#	Checksum
10.1.0.0	10.0.20.3	157		0x80000004	0x0060A3
10.2.0.0	10.0.20.3	143		0x80000001	0x00FF0F
10.2.0.0	10.255.255.4	418		0x80000004	0x00DA3B
10.3.14.0	10.255.255.4	418		0x80000004	0x00527E
10.3.14.0	10.255.255.7	12	(DNA)	0x80000001	0x00C8C7
10.3.17.0	10.255.255.4	437		0x80000004	0x00B3D9
10.3.17.0	10.255.255.7	12	(DNA)	0x80000001	0x0025A8
10.4.67.0	10.255.255.7	12	(DNA)	0x80000001	0x00D2FD
10.255.255.6	10.255.255.7	12	(DNA)	0x80000001	0x00B45C
10.255.255.7	10.255.255.7	12	(DNA)	0x80000001	0x0046D3
10.255.255.8	10.0.20.3	118		0x80000001	0x002CD2
10.255.255.9	10.0.20.3	151		0x80000001	0x004087
10.255.255.9	10.255.255.4	680		0x80000003	0x00A46A
10.255.255.10	10.255.255.4	437		0x80000004	0x00B620
10.255.255.10	10.255.255.7	12	(DNA)	0x80000001	0x00AA2C

Router Link States (Area 2)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.0.20.3	10.0.20.3	163	0x80000010	0x003E99	2
10.255.255.4	10.255.255.4	680	0x80000008	0x00E07C	2
10.255.255.9	10.255.255.9	164	0x80000013	0x0019A6	5

Summary Net Link States (Area 2)

Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	10.0.20.3	1414	0x80000003	0x00B466
0.0.0.0	10.255.255.4	1436	0x80000003	0x003BF2
10.0.12.0	10.0.20.3	677	0x80000002	0x006E84
10.0.12.0	10.255.255.4	684	0x80000002	0x00F411
10.0.20.0	10.0.20.3	677	0x80000002	0x00B143
10.0.20.0	10.255.255.4	684	0x80000004	0x0034D1
10.1.0.0	10.0.20.3	1416	0x80000004	0x007E87
10.1.0.0	10.255.255.4	684	0x80000002	0x006DA3
10.2.0.0	10.0.20.3	392	0x80000001	0x00DC21
10.3.14.0	10.0.20.3	677	0x80000002	0x005265
10.3.14.0	10.255.255.4	1436	0x80000004	0x007062
10.3.17.0	10.0.20.3	677	0x80000002	0x00B3C0
10.3.17.0	10.255.255.4	1436	0x80000004	0x00D1BD

10.4.67.0	10.0.20.3	677	0x80000002	0x00E353
10.4.67.0	10.255.255.4	684	0x80000002	0x00064E
10.255.255.1	10.0.20.3	677	0x80000002	0x00F20A
10.255.255.1	10.255.255.4	688	0x80000002	0x007996
10.255.255.2	10.0.20.3	681	0x80000002	0x008481
10.255.255.2	10.255.255.4	688	0x80000002	0x000B0E
10.255.255.3	10.0.20.3	1420	0x80000005	0x0010FB
10.255.255.3	10.255.255.4	688	0x80000002	0x000117
10.255.255.4	10.0.20.3	681	0x80000002	0x007093
10.255.255.4	10.255.255.4	931	0x80000006	0x008A92
10.255.255.6	10.0.20.3	681	0x80000002	0x00C5B1
10.255.255.6	10.255.255.4	702	0x80000002	0x00E7AC
10.255.255.7	10.0.20.3	695	0x80000002	0x005729
10.255.255.7	10.255.255.4	702	0x80000002	0x007924
10.255.255.8	10.0.20.3	142	0x80000001	0x004AB6
10.255.255.8	10.255.255.4	140	0x80000001	0x0035D4
10.255.255.10	10.0.20.3	695	0x80000002	0x00B607
10.255.255.10	10.255.255.4	1454	0x80000004	0x00D404

Router Link States (Area 3)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.255.255.4	10.255.255.4	459	0x8000000E	0x006CBB	2
10.255.255.7	10.255.255.7	506	0x8000000E	0x00CC4C	2
10.255.255.10	10.255.255.10	887	0x8000000A	0x00AC5D	5

Summary Net Link States (Area 3)

Link ID	ADV Router	Age	Seq#	Checksum
10.0.12.0	10.255.255.4	702	0x80000002	0x00D62D
10.0.20.0	10.255.255.4	718	0x80000004	0x0016ED
10.1.0.0	10.255.255.4	718	0x80000002	0x004FBF
10.2.0.0	10.255.255.4	476	0x80000004	0x00DA3B
10.4.67.0	10.255.255.7	781	0x80000002	0x00D0FE
10.255.255.1	10.255.255.4	721	0x80000002	0x005BB2
10.255.255.2	10.255.255.4	721	0x80000002	0x00EC2A
10.255.255.3	10.255.255.4	721	0x80000002	0x00E233
10.255.255.4	10.255.255.4	964	0x80000005	0x006EAD
10.255.255.6	10.255.255.7	784	0x80000002	0x00B25D
10.255.255.7	10.255.255.7	784	0x80000002	0x0044D4
10.255.255.8	10.255.255.4	159	0x80000001	0x0017F0
10.255.255.9	10.255.255.4	721	0x80000003	0x00A46A

Summary ASB Link States (Area 3)

Link ID	ADV Router	Age	Seq#	Checksum
10.255.255.1	10.255.255.4	721	0x80000002	0x0043CA

```
10.255.255.1    10.255.255.7    525         0x80000002 0x003654

                Type-5 AS External Link States

Link ID         ADV Router      Age         Seq#       Checksum Tag
10.255.255.5    10.255.255.1    344         0x80000003 0x00CEB5 0
192.168.15.0    10.255.255.1    347         0x80000003 0x002CEE 0
192.168.255.5   10.255.255.1    347         0x80000003 0x009F85 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

O E2 192.168.15.0/24 [110/20] via 10.0.20.2, 00:12:59,
FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 19 subnets, 3 masks
O       10.255.255.10/32 [110/65] via 10.3.14.10, 00:13:00,
Serial1/0
O IA    10.255.255.8/32 [110/21] via 10.0.20.3, 00:02:49,
FastEthernet0/1
O       10.255.255.9/32 [110/11] via 10.2.49.9, 00:13:00,
FastEthernet0/0
O       10.0.12.0/24 [110/20] via 10.0.20.2, 00:13:00,
FastEthernet0/1
C       10.3.14.0/24 is directly connected, Serial1/0
O       10.255.255.2/32 [110/11] via 10.0.20.2, 00:13:04,
FastEthernet0/1
O       10.2.0.0/16 is a summary, 00:13:04, Null0
O       10.255.255.3/32 [110/11] via 10.0.20.3, 00:13:04,
FastEthernet0/1
C       10.255.255.0/24 is directly connected, Loopback0
O       10.255.255.1/32 [110/21] via 10.0.20.2, 00:13:04,
FastEthernet0/1
O IA    10.1.0.0/16 [110/20] via 10.0.20.3, 00:13:04,
FastEthernet0/1
O IA    10.255.255.6/32 [110/139] via 10.3.14.10, 00:13:17,
Serial1/0
```

```
O IA    10.255.255.7/32 [110/129] via 10.3.14.10, 00:13:17,
Serial1/0
O E2    10.255.255.5/32 [110/20] via 10.0.20.2, 00:13:17,
FastEthernet0/1
O       10.3.17.0/24 [110/128] via 10.3.14.10, 00:13:17, Serial1/0
C       10.0.20.0/24 is directly connected, FastEthernet0/1
O       10.2.39.0/24 [110/11] via 10.2.49.9, 00:13:17,
FastEthernet0/0
C       10.2.49.0/24 is directly connected, FastEthernet0/0
O IA    10.4.67.0/24 [110/138] via 10.3.14.10, 00:13:17, Serial1/0
     192.168.255.0/32 is subnetted, 1 subnets
O E2    192.168.255.5 [110/20] via 10.0.20.2, 00:13:17,
FastEthernet0/1
```

14. Overenie konektivity

Ping z R5 na interface fa0/1 na routeri R6:

```
R5#ping 10.4.67.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.67.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1692/1692/1692 ms
```

Ping z R6 na interface fa0/1 na routeri R5

```
R7#ping 192.168.15.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.15.5, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1636/1714/1800 ms
```

Ping z R1 na int fa0/1 na routri R6:

```
R1#ping 10.4.67.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.67.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
868/1172/1536 ms
```

Ping z R1 na všetky loopbacky:

ip host R1 10.1.255.1
ip host R2 10.1.255.2
ip host R3 10.1.255.3 10

ip host R4 10.1.255.4
ip host R5 10.1.255.5
ip host R6 10.2.255.6
ip host R7 10.2.255.7
ip host R8 10.1.255.8
ip host R9 10.1.255.9
ip host R10 10.2.255.10

```
R1#ping R1

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 = 4/4/4 ms

R1#ping R2

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 =
264/394/532 ms
R1#ping R3

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 =
516/764/936 ms
R1#ping R4

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 =
664/827/940 ms
R1#ping R5

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 =
312/400/536 ms
R1#ping R6
```

```
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 =
1180/1515/1760 ms
R1#ping R7

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 =
1140/1271/1676 ms
R1#ping R8

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 =
796/1008/1196 ms
R1#ping R9

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 =
772/984/1220 ms
R1#ping R10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.255.255.10, timeout is 2
seconds:
!!!!!

R1#traceroute R6

Type escape sequence to abort.
Tracing the route to R6 (10.255.255.6)

  1 10.0.12.2 248 msec 592 msec 264 msec
  2 10.0.20.4 652 msec 656 msec 664 msec
  3 10.3.14.10 692 msec 868 msec 1048 msec
  4 10.3.17.7 1312 msec 1692 msec 1316 msec
  5 10.4.67.6 1660 msec 1308 msec 1052 msec
```