Nastavni predmet:	RAČUNALNE MREŽE
Vježba:	LV8 - Konfiguracija protokola OSPF
Cilj vježbe:	Naučiti i izvesti usmjernički protokol OSPF

Teo Šiletić, Filip Škrabec, 3.C

PRIPREMA ZA VJEŽBU

1. **Koje su karakteristike protokola OSPF?**

Karakteristike OSPF-a:

Link-state algoritam (Dijkstra za najkraći put).

Brza konvergencija i podrška za VLSM.

Hierarhija (mreža podijeljena u oblasti).

Autentifikacija i razmjena podataka o topologiji.

Metoda troška (cost) za odlučivanje o putu.

2. **Što je Wildcard maska?**

Wildcard maska pobliže definira mrežu o kojoj se radi i predstavlja inverziju subnet maske. Maska koja označava koji dijelovi IP adrese mogu biti bilo koji. Koristi se u OSPF-u, ACL-ima i sličnim protokolima za definiranje IP raspona.

Primjer

Mreža 172.16.1.4/28 ima subnet masku:
255.255.255.240 ili 11111111.11111111.11111111.11110000
Invertirana subnet maska je:
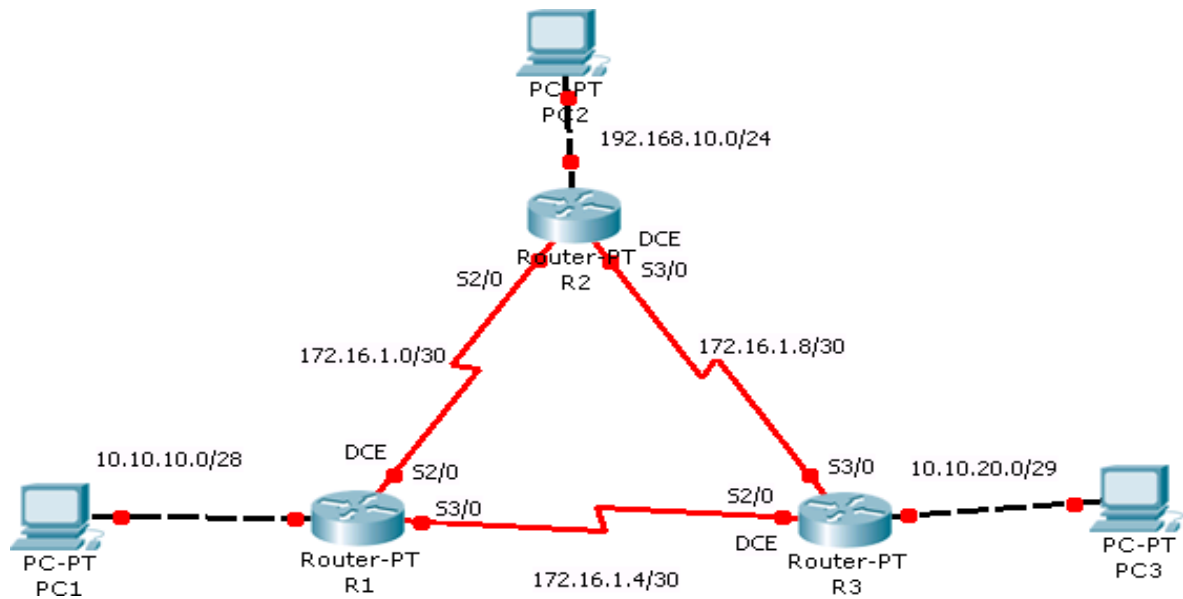00000000.00000000.00000000.00001111 ili u dekadskom zapisu: 0.0.0.15

IZVOĐENJE VJEŽBE

Uvod

Ruting protokoli pomažu usmjerniku da nauči usmjeravati pakete podataka do odredišta na udaljenim mrežama.
OSPF je dinamički ruting protokol koji podržava VLSM.

Topologija:

Tablica adresa

Ruter	Adresa Fastethernet sučelja	Mrežna maska	Oznaka ser. sučelja	Tip ser. sučelja	Adresa serijskog sučelja	Mrežna maska	Default gateway
R1	10.10.10.1	255.255.255.240					
			S2/0	DCE	172.16.1.1	255.255.255.252	
			S3/0	DTE	172.16.1.6	255.255.255.252	
R2	192.168.10.1	255.255.255.0					
			S2/0	DTE	172.16.1.2	255.255.255.252	
			S3/0	DCE	172.16.1.9	255.255.255.252	
R3	10.10.20.1	255.255.255.248					
			S2/0	DCE	172.16.1.5	255.255.255.252	
			S3/0	DTE	172.16.1.10	255.255.255.252	
PC1	10.10.10.10	255.255.255.240					10.10.10.1
PC2	192.168.10.10	255.255.255.0					192.168.10.1
PC3	10.10.20.10	255.255.255.248					10.10.20.1

Zadaci:

1. U PT-u spoji uređaje prema zadanoj topologiji i izvrši temeljnu konfiguraciju usmjernika, koristeći tab CLI u Packet Traceru
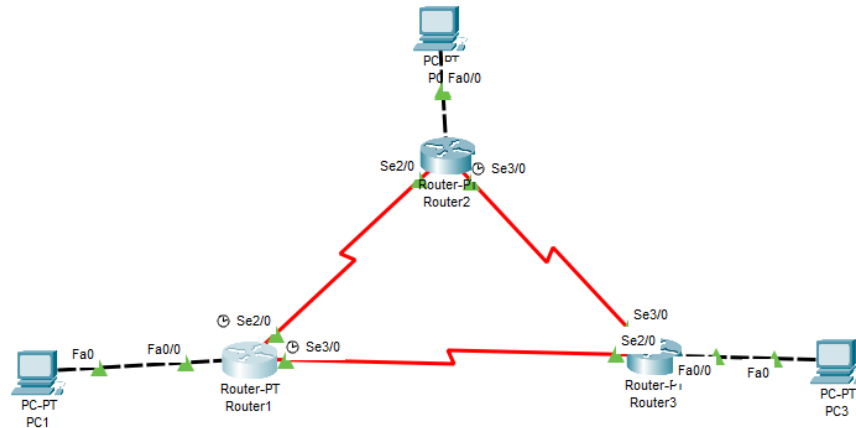
```
Router>ENABLE
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fastethernet 0/0
R1(config-if)#ip address 10.10.10.1 255.255.255.240
R1(config-if)#exit
R1(config)#interface s2/0
R1(config-if)#ip address 172.16.1.1 255.255.255.252
R1(config-if)#exit
R1(config)#interface s3/0
R1(config-if)#ip address 172.16.1.6 255.255.255.252
R1(config-if)#exit

Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface fastethernet 0/0
R2(config-if)#ip address 192.168.10.1 255.255.255.0
R2(config-if)#exit
R2(config)#interface s2/0
R2(config-if)#ip address 172.16.1.2 255.255.255.252
R2(config-if)#interface s3/0
R2(config-if)#exit
R2(config)#interface s3/0
R2(config-if)#ip address 172.16.1.9 255.255.255.252
R2(config-if)#exit

Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
R3(config)#interface fastethernet 0/0
R3(config-if)#ip address 10.10.20.1 255.255.255.248
R3(config-if)#exit
R3(config)#
R3(ip address 10.10.20.1 255.255.255.248ip address 172.16.1.5 255.255.2.2ip address
172.16.1.5 2interfip address 172.16.1.5 255.255.255.252ip address 172.16.1.10
255.255.255.252
R3(config-if)#exit
R3(config)#
```

2. Konfiguriraj sučelja na usmjernicima R1, R2 i R3, koristeći priloženu tablicu adresa i zabilješke s prethodnih vježbi, pri čemu voditi računa da su IP adrese izmijenjene.

```
Device Name: Router1
Device Model: Router-PT
Hostname: R1

Port           Link   IP Address      IPv6 Address            MAC Address
FastEthernet0/0  Up     10.10.10.1/28   <not set>             00D0.FF3B.33E3
FastEthernet1/0  Up     <not set>       <not set>             0030.F274.B34B
Serial2/0        Up     172.16.1.1/30   <not set>             <not set>
Serial3/0        Up     172.16.1.6/30   <not set>             <not set>
FastEthernet4/0  Down   <not set>       <not set>             0000.0CE5.AB9C
FastEthernet5/0  Down   <not set>       <not set>             0060.47CE.C7D7

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > Router1
Device Name: Router2
Device Model: Router-PT
Hostname: R2

Port           Link   IP Address       IPv6 Address           MAC Address
FastEthernet0/0  Up     192.168.10.1/24  <not set>             0060.7055.2636
FastEthernet1/0  Up     <not set>        <not set>             0030.A361.2689
Serial2/0        Up     172.16.1.2/30    <not set>             <not set>
Serial3/0        Up     172.16.1.9/30    <not set>             <not set>
FastEthernet4/0  Down   <not set>        <not set>             000C.85A5.13D2
FastEthernet5/0  Down   <not set>        <not set>             0050.0FB0.8D63

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > Router2
```

```
Device Name: Router3
Device Model: Router-PT
Hostname: R3

Port            Link    IP Address          IPv6 Address                        MAC Address
FastEthernet0/0 Up      10.10.20.1/29       <not set>                           0001.4284.85C3
FastEthernet1/0 Up      <not set>           <not set>                           0001.97B1.3596
Serial2/0       Up      172.16.1.5/30       <not set>                           <not set>
Serial3/0       Up      172.16.1.10/30      <not set>                           <not set>
FastEthernet4/0 Down    <not set>           <not set>                           0001.9666.0112
FastEthernet5/0 Down    <not set>           <not set>                           0040.0B58.002C

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > Router3
```

3. Pinganjem provjeri da li postoji povezanost između PC1 i PC2. Obrazloži zašto je tako.

```
C:\>ping 192.168.10.10

Pinging 192.168.10.10 with 32 bytes of data:

Reply from 10.10.10.1: Destination host unreachable.
Reply from 10.10.10.1: Destination host unreachable.
Request timed out.
Reply from 10.10.10.1: Destination host unreachable.

Ping statistics for 192.168.10.10:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Ne postoji jer još nismo konfigurirali ospf protokol.

4. Pinganjem provjeri do koje razine povezanost postoji.

```
C:\>ping 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:

Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Povezanost postoji do povezanog rutera jer nismo još konfigurirali ospf protkol.

Obrazloži rezultate pinganja.

5. Naredbom **show ip route** na ruteru R1 provjeri stanje ruting tablice. Ispiši koje su mreže navedene u tablici.

```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

     10.0.0.0/28 is subnetted, 1 subnets
C       10.10.10.0 is directly connected, FastEthernet0/0
     172.16.0.0/30 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.1.4 is directly connected, Serial3/0

R1#
```

6. Konfiguriraj OSPF ruting prema sljedećim uputama čime će se omogućiti povezanost svih mreža.

    Postupak konfiguracije OSPF rutinga:

1. Temeljna konfiguracija usmjernika – standardni postupak
2. Konfiguracija sučelja – standardni postupak
3. Konfiguracija OSPF
a) **R1(config)#router ospf 1**
    - to je naredba koja pokreće ospf konfiguraciju (autonomni sustav AS = 1)

b) **R1(config-router)#network mrežna adresa wildcard maska područje**
Instrukcija kojom se sučelje na kojem se nalazi mrežna adresa sa odgovarajućom wildcard maskom, osposobljava za rad sa OSPF rutingom
Riječ područje označava skup usmjernika koji predstavljaju određenu cjelinu unutar koje se ospf ruting protokol koristi (obično započinjemo sa area 0).

Za našu pretpostavljenu topologiju, za usmjernik R1 imati ćemo:
R1(config-router)#network 10.10.10.0 0.0.0.15 area 0
R1(config-router)#network 172.16.1.0 0.0.0.3 area 0
R1(config-router)#network 172.16.1.4 0.0.0.3 area 0

7. Naredbom **show ip route** na svim usmjernicima provjeri stanje ruting tablica. Ispiši koje su mreže navedene u tablici.

```
R1>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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, 2 subnets, 2 masks
C       10.10.10.0/28 is directly connected, FastEthernet0/0
O       10.10.20.0/29 [110/65] via 172.16.1.5, 00:00:05, Serial3/0
     172.16.0.0/30 is subnetted, 3 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.1.4 is directly connected, Serial3/0
O       172.16.1.8 [110/128] via 172.16.1.2, 00:00:05, Serial2/0
                   [110/128] via 172.16.1.5, 00:00:05, Serial3/0
O    192.168.10.0/24 [110/65] via 172.16.1.2, 00:04:23, Serial2/0

R1>
```

8. Postupak ponoviti na preostalim usmjernicima.

```
R2>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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, 2 subnets, 2 masks
O       10.10.10.0/28 [110/65] via 172.16.1.1, 00:05:35, Serial2/0
O       10.10.20.0/29 [110/65] via 172.16.1.10, 00:01:32, Serial3/0
     172.16.0.0/30 is subnetted, 3 subnets
C       172.16.1.0 is directly connected, Serial2/0
O       172.16.1.4 [110/128] via 172.16.1.1, 00:01:32, Serial2/0
                   [110/128] via 172.16.1.10, 00:01:32, Serial3/0
C       172.16.1.8 is directly connected, Serial3/0
C    192.168.10.0/24 is directly connected, FastEthernet0/0

R2>
```

```
R3>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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, 2 subnets, 2 masks
O       10.10.10.0/28 [110/65] via 172.16.1.6, 00:03:08, Serial2/0
C       10.10.20.0/29 is directly connected, FastEthernet0/0
     172.16.0.0/30 is subnetted, 3 subnets
O       172.16.1.0 [110/128] via 172.16.1.9, 00:03:08, Serial3/0
                   [110/128] via 172.16.1.6, 00:03:08, Serial2/0
C       172.16.1.4 is directly connected, Serial2/0
C       172.16.1.8 is directly connected, Serial3/0
O    192.168.10.0/24 [110/65] via 172.16.1.9, 00:03:08, Serial3/0

R3>
```

9. Pinganjem provjeri povezanost između PC1, PC2 i PC3.

PC1 i PC2

```
C:\>ping 192.168.10.10

Pinging 192.168.10.10 with 32 bytes of data:

Reply from 192.168.10.10: bytes=32 time=9ms TTL=126
Reply from 192.168.10.10: bytes=32 time=10ms TTL=126
Reply from 192.168.10.10: bytes=32 time=1ms TTL=126
Reply from 192.168.10.10: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 5ms

C:\>
```