**ŽILINSKÁ UNIVERZITA V ŽILINE**

**Fakulta riadenia a informatiky**

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Projektovanie sietí 1

OSPF

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### Topológia



### Adresovanie

# Nakonfigurovať OSPF s viacerými oblasťami

Smerovací protokol OSPF sme konfigurovali na všetkých zariadeniach (smerovačoch) okrem R5- tento smerovač nepatrí ani do jednej z oblastí. Keďže pri OSPF tvorí hranicu oblasti samotné zariadenie, konfigurácia prebiehala na jednotlivých rozhraniach. Na všetkých rozhraniach sme najprv aktivovali OSPF, pridelili mu oblasť, do ktorej patrí a taktiež príslušnú sieť.

Kontrolu konfigurácie sme vykonali pomocou príkazu *show ip protocols* na každom   
zo smerovačov. Príkaz zobrazí typ smerovacieho protokolu a číslo procesu, ID daného zariadenia a siete spolu s oblasťami, pre ktoré je OSPF vykonávané.

**R3#sh ip protocols**

Routing Protocol is "ospf 1"

Router ID 10.255.255.3

It is an area border router

Number of areas in this router is 3. 1 normal 2 stub 0 nssa

Routing for Networks:

**10.0.23.0 0.0.0.255 area 0**

**10.1.38.0 0.0.0.255 area 1**

**10.2.39.0 0.0.0.255 area 2**

**R10#sh ip protocols**

Routing Protocol is "ospf 1"

Router ID 10.255.255.10

It is an area border router

Number of areas in this router is 3. 3 normal 0 stub 0 nssa

Routing for Networks:

**10.3.104.0 0.0.0.255 area 3**

**10.4.107.0 0.0.0.255 area 4**

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

Na všetkých rozhraniach Fast Ethernet daných oblastí (okrem liniek medzi smerovačmi R2, R3 a R4) sme nakonfigurovali spojenie point to point príkazom *ip ospf network point-to-point*. Na sériových linkách nebolo potrebné tento príkaz zadávať, keďže tie sú point-to-point implicitne.

Správnosť konfigurácie sme vykonali príkazom *show ip ospf interface brief*. Z výpisu je možné vyčítať, ktoré rozhranie patrí akej oblasti, akú používa IP spolu s maskou a v stĺpci State je vidieť dané spojenie. P2P znamená linka typu point-to-point, DR, BDR a DROTH znamená, že smerovače sú v danej sieti broadcastovo prepojené L2 prepínačom – volil sa Designated Router a Backup Designated Router.

**R1#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/0 1 0 10.0.12.1/24 10 **P2P** 1/1

**R2#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/1 1 0 10.0.234.2/24 10 **DR** 2/2

Fa0/0 1 0 10.0.12.2/24 10 **P2P** 1/1

**R3#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Fa0/1 1 0 10.0.234.3/24 10 **BDR**  2/2

Fa0/0 1 1 10.1.38.3/24 10 **P2P** 1/1

Lo0 1 1 10.255.255.3/32 1 **LOOP** 0/0

Se1/0 1 2 10.2.39.3/24 64 **P2P** 1/1

**R4#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

VL0 1 0 10.3.104.4/24 64 **P2P** 1/1

Fa0/1 1 0 10.0.234.4/24 10 **DROTH** 2/2

Fa0/0 1 2 10.2.49.4/24 300 **P2P** 1/1

Se1/0 1 3 10.3.104.4/24 64 **P2P** 1/1

Lo0 1 3 10.255.255.4/32 1 **LOOP** 0/0

**R7#**sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Se1/1 1 4 10.4.107.7/24 64 **P2P** 1/1

Fa0/1 1 4 10.4.67.7/24 10 **P2P** 1/1

# Router-id - loopback0, passive-interface

Každému smerovaču sme nastavili ID ako IP adresu jeho loopbacku a následne sme všetky loopbacky nastavili ako passive-interface.

**R1#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.1**

**R2#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.2**

**R3#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.3**

**R4#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.4**

**R5#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.5**

**R6#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.6**

**R7#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.7**

**R8#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.8**

**R9#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.9**

**R10#**sh ip ospf | sec Routing Process

Routing Process "ospf 1" with ID **10.255.255.10**

## Passive interface

**R1#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R2#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R3#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R4#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R5#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R6**#sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R7#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R8#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R9#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

**R10#**sh ip protocols | section Passive

Passive Interface(s):

**Loopback0**

# Area 1 – Totally Stubby

Area Totally Stubby je oblasť, do ktorej sa nepreposielajú LSA3, LSA4 a LSA5 a zároveň neakceptuje LSA4 a LSA5. Táto oblasť nemá informácie o externých sieťach, ASBR ani o sieťach z iných oblastí, nemôže obsahovať ASBR a má informácie len o intra area cestách. Funkcionalita spočíva v dodatočnej činnosti ABR.

Pre konfiguráciu sme použili na smerovači R8 príkaz *area 1 stub* a na R3 príkaz *area 1 stub no-summary*.

Overenie vykonáme príkazom *show ip ospf database*.

**R8#**sh ip ospf database

OSPF Router with ID (10.255.255.8) (Process ID 1)

Router Link States (Area 1)

Link ID **ADV Router** Age Seq# Checksum Link count

10.255.255.3 **10.255.255.3** 503 0x80000005 0x00A2BB 3

10.255.255.8 10.255.255.8 568 0x80000003 0x000C69 2

Summary Net Link States (Area 1)

Link ID **ADV Router** Age Seq# Checksum

0.0.0.0 **10.255.255.3** 503 0x80000003 0x0041ED

# Area 2 – Stub

Area Stubby je oblasť, ktorá neakceptuje a do ktorej sa nepreposielajú LSA4 a LSA5, nemá informácie o ASBR ani o externých sieťach, nemôže obsahovať ASBR. Informácie má o sieťach z iných oblastí, ale nie o ich topológii.

Na smerovačoch R3, R4 a R9 sme použili príkaz *area 2 stub*. Pre správnosť konfigurácie použijeme príkaz *show ip ospf | begin Area 2*.

**R9#**sh ip ospf | begin Area 2

Area 2

Number of interfaces in this area is 2

**It is a stub area**

# Area 4 – pripojenie pomocou virtuálnej linky

R10#sh ip ospf virtual-Link

Virtual Link OSPF\_VL0 to router 10.255.255.4 is up

Run as demand circuit

DoNotAge LSA allowed.

Transit area 3, via interface Serial1/0, Cost of using 64

Transmit Delay is 1 sec, State POINT\_TO\_POINT,

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:02

Adjacency State FULL (Hello suppressed)

Index 1/3, retransmission queue length 0, number of retransmission 0

First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)

Last retransmission scan length is 0, maximum is 0

Last retransmission scan time is 0 msec, maximum is 0 msec

# Statická redistribúcia smerovacích záznamov z R5

Aby mohol smerovač R5 komunikovať s ostatnými smerovačmi v oblastiach, bolo potrebné na smerovači R1 nastaviť statickú redistribúciu príkazom *redistribute static subnets*. Ten zabezpečí redistribúciu všetkých staticky smerovaných sietí – sieť k prepínaču R5.

Kontrola konfigurácie cez *show ip route 10.255.255.5*.

**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 ospf 1

Advertised by ospf 1 subnets

Routing Descriptor Blocks:

\* 10.100.15.5, via FastEthernet0/1

Route metric is 0, traffic share count is 1

# Kontrola DR prostredníctvom “ip ospf priority”

Na smerovači R2 sme na rozhraní fa0/1 nastavili prioritu 1 príkazom *ip ospf priority 1,* čo z neho spravilo DR a na smerovači R3 na rozhraní fa0/1 prioritu 10 – smerovač sa stal BDR. Overenie konfigurácie sme vykonali príkazom pre zobrazenie všetkých susedov smerovača R4.

**R4#**sh ip ospf neigh

Neighbor ID Pri State Dead Time Address Interface

10.255.255.10 0 FULL/ - - 10.3.104.10 OSPF\_VL0

10.255.255.2 **1** FULL/**DR** 00:00:15 10.0.234.2 FastEthernet0/1

10.255.255.3 **10** FULL/**BDR** 00:00:18 10.0.234.3 FastEthernet0/1

10.255.255.9 0 FULL/ - 00:00:31 10.2.49.9 FastEthernet0/0

10.255.255.10 0 FULL/ - 00:00:36 10.3.104.10 Serial1/0

# Kontrola OSPF databáz a smerovacích tabuliek

Kontrolu ospf databáz a smerovacích tabuliek sme vykonali príkazmi *show ip ospf database* a *show ip route*.

**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, 13 subnets, 2 masks

O 10.0.12.0/24 [110/20] via 10.0.234.2, 01:28:10, FastEthernet0/1

O IA 10.255.255.3/32 [110/11] via 10.0.234.3, 01:28:10, FastEthernet0/1

O E2 10.255.255.1/32 [110/20] via 10.0.234.2, 01:27:51, FastEthernet0/1

C 10.255.255.4/32 is directly connected, Loopback0

O E2 10.255.255.5/32 [110/20] via 10.0.234.2, 01:27:51, FastEthernet0/1

O IA 10.1.38.0/24 [110/20] via 10.0.234.3, 01:28:10, FastEthernet0/1

O 10.2.39.0/24 [110/364] via 10.2.49.9, 01:25:53, FastEthernet0/0

C 10.2.49.0/24 is directly connected, FastEthernet0/0

O IA 10.4.67.0/24 [110/138] via 10.3.104.10, 01:25:13, Serial1/0

O E2 10.100.15.0/24 [110/20] via 10.0.234.2, 01:27:52, FastEthernet0/1

C 10.3.104.0/24 is directly connected, Serial1/0

O IA 10.4.107.0/24 [110/128] via 10.3.104.10, 01:25:13, Serial1/0

C 10.0.234.0/24 is directly connected, FastEthernet0/1

**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

10.255.255.1 10.255.255.1 1474 0x80000005 0x005C5F 2

10.255.255.2 10.255.255.2 1612 0x80000004 0x002293 3

10.255.255.3 10.255.255.3 1432 0x80000005 0x009F7C 1

10.255.255.4 10.255.255.4 1618 0x80000005 0x000F2B 2

10.255.255.10 10.255.255.10 1 (DNA) 0x80000002 0x00DA5F 1

Net Link States (Area 0)

Link ID ADV Router Age Seq# Checksum

10.0.234.2 10.255.255.2 1612 0x80000004 0x005EAA

Summary Net Link States (Area 0)

Link ID ADV Router Age Seq# Checksum

10.1.38.0 10.255.255.3 1432 0x80000003 0x004BA7

10.2.39.0 10.255.255.3 1432 0x80000003 0x005268

10.2.39.0 10.255.255.4 1618 0x80000003 0x000F7D

10.2.49.0 10.255.255.3 1432 0x80000003 0x00A6DC

10.2.49.0 10.255.255.4 1620 0x80000003 0x001EA4

10.3.104.0 10.255.255.4 1620 0x80000003 0x007205

10.3.104.0 10.255.255.10 13 (DNA) 0x80000001 0x005221

10.4.67.0 10.255.255.10 13 (DNA) 0x80000001 0x00434A

10.4.107.0 10.255.255.10 13 (DNA) 0x80000001 0x00254A

10.255.255.3 10.255.255.3 1434 0x80000003 0x00829D

10.255.255.4 10.255.255.4 1620 0x80000003 0x0072AB

10.255.255.4 10.255.255.10 13 (DNA) 0x80000001 0x00D405

Router Link States (Area 2)

Link ID ADV Router Age Seq# Checksum Link count

10.255.255.3 10.255.255.3 1435 0x80000007 0x00B94F 2

10.255.255.4 10.255.255.4 1620 0x80000004 0x007D9D 2

10.255.255.9 10.255.255.9 1286 0x80000005 0x00E60F 4

Summary Net Link States (Area 2)

Link ID ADV Router Age Seq# Checksum

0.0.0.0 10.255.255.3 1435 0x80000003 0x0041ED

0.0.0.0 10.255.255.4 1621 0x80000003 0x003BF2

10.0.12.0 10.255.255.3 1436 0x80000003 0x00F80D

10.0.12.0 10.255.255.4 1621 0x80000003 0x00F212

10.0.234.0 10.255.255.3 1437 0x80000003 0x000130

10.0.234.0 10.255.255.4 1622 0x80000003 0x00FA35

10.1.38.0 10.255.255.3 1437 0x80000003 0x00698B

10.1.38.0 10.255.255.4 1622 0x80000003 0x00C722

10.3.104.0 10.255.255.3 1437 0x80000003 0x00FA75

10.3.104.0 10.255.255.4 1622 0x80000003 0x0090E8

10.4.67.0 10.255.255.3 1437 0x80000003 0x006EDB

10.4.67.0 10.255.255.4 1622 0x80000003 0x00044F

10.4.107.0 10.255.255.3 1437 0x80000003 0x0050DB

10.4.107.0 10.255.255.4 1622 0x80000003 0x00E54F

10.255.255.3 10.255.255.3 1437 0x80000003 0x00A081

10.255.255.3 10.255.255.4 1622 0x80000003 0x00FE18

10.255.255.4 10.255.255.3 1437 0x80000003 0x00FA1C

10.255.255.4 10.255.255.4 1622 0x80000003 0x00908F

Router Link States (Area 3)

Link ID ADV Router Age Seq# Checksum Link count

10.255.255.4 10.255.255.4 1622 0x80000008 0x00F564 3

10.255.255.10 10.255.255.10 1292 0x80000006 0x00343B 2

Summary Net Link States (Area 3)

Link ID ADV Router Age Seq# Checksum

10.0.12.0 10.255.255.4 1623 0x80000003 0x00D42E

10.0.234.0 10.255.255.4 1624 0x80000003 0x00DC51

10.1.38.0 10.255.255.4 1624 0x80000003 0x00A93E

10.2.39.0 10.255.255.4 1624 0x80000003 0x000F7D

10.2.49.0 10.255.255.4 1624 0x80000003 0x001EA4

10.4.67.0 10.255.255.10 1293 0x80000003 0x003F4C

10.4.107.0 10.255.255.10 1293 0x80000003 0x00214C

10.255.255.3 10.255.255.4 1624 0x80000003 0x00E034

Summary ASB Link States (Area 3)

Link ID ADV Router Age Seq# Checksum

10.255.255.1 10.255.255.4 1624 0x80000003 0x0041CB

10.255.255.1 10.255.255.10 1293 0x80000003 0x009F27

Type-5 AS External Link States

Link ID ADV Router Age Seq# Checksum Tag

10.100.15.0 10.255.255.1 1480 0x80000003 0x00A66F 0

10.255.255.1 10.255.255.1 1744 0x80000003 0x00F691 0

10.255.255.5 10.255.255.1 1481 0x80000003 0x00CEB5 0

# Kontrola konektivity

Pre kontrolu konektivity sme použili skript, ktorý použije príkaz *ping* na všetky uvedené IP adresy zariadení. Odpoveď sme dostali od všetkých zariadení.

R1#tclsh

R1(tcl)#foreach address {

+>(tcl)#10.0.12.1

+>(tcl)#10.100.15.1

+>(tcl)#10.0.12.2

+>(tcl)#10.0.234.2

+>(tcl)#10.1.38.3

+>(tcl)#10.0.234.3

+>(tcl)#10.2.39.3

+>(tcl)#10.2.49.4

+>(tcl)#10.0.234.4

+>(tcl)#10.3.104.4

+>(tcl)#10.100.15.5

+>(tcl)#10.4.67.6

+>(tcl)#10.4.67.7

+>(tcl)#10.4.107.7

+>(tcl)#10.1.38.8

+>(tcl)#10.2.39.9

+>(tcl)#10.2.49.9

+>(tcl)#10.3.104.10

+>(tcl)#10.4.107.10

+>(tcl)#} {

+>(tcl)#ping $address }

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.12.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.100.15.1, 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 10.0.12.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 8/17/20 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 12/19/24 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.1.38.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/38/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/39/44 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.39.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/38/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.49.4, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/38/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.234.4, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/37/44 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.3.104.4, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/39/40 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.100.15.5, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 12/15/20 ms

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 = 96/98/104 ms

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 = 68/78/84 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.4.107.7, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 72/79/84 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.1.38.8, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/64 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.39.9, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.2.49.9, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/57/60 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.3.104.10, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 40/54/60 ms

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.4.107.10, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms

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

Pre dosiahnutie toho, aby bol R3 primárnym a R4 sekundárnym smerovačom, ceny príslušných strán sme nastavili na 64 a 300 príkazom *ip ospf cost x* na konkrétnom rozhraní.

R9#sh ip ospf interface brief

Interface PID Area IP Address/Mask Cost State Nbrs F/C

Se1/0 1 2 10.2.39.9/24 **64** P2P 1/1

Fa0/0 1 2 10.2.49.9/24 **300** P2P 1/1

Správnosť konfigurácie sme overili príkazom *traceroute* na smerovači R9 a R1 – všetky pakety boli smerované cez smerovač R3.

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

Hello interval sme nastavili na jednotlivých smerovačoch a ich rozhraniach príkazom *ip ospf hello-interval 5*, dead interval je automaticky štvornásobný.

**R2#**sh ip ospf interface

FastEthernet0/1 is up, line protocol is up

Internet Address 10.0.234.2/24, Area 0

. . .

Timer intervals configured, **Hello 5, Dead 20**, Wait 20, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:00

. . .

Pozrieť 6 úlohu, tú neviem ako si robila + pozrieť aďovu a marekovu dokumentaciu kvôli poslednej úlohe (vytrhnutie linky)