

Internet Peering

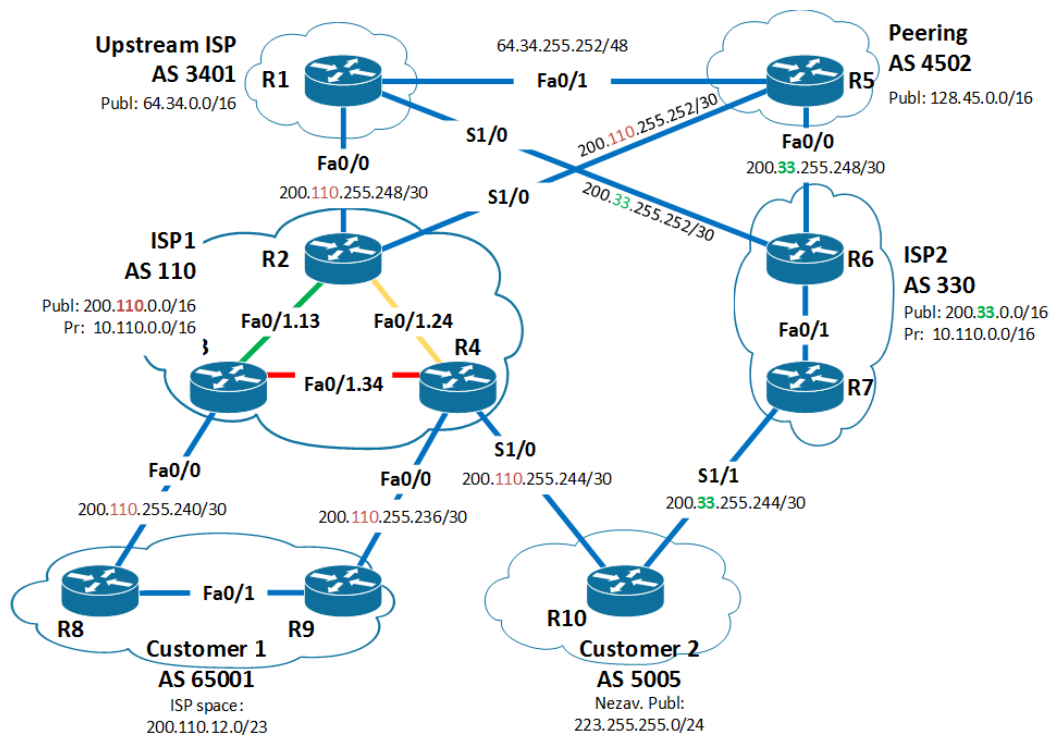
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1.1 Topológia

Budeme konfigurovať smerovacie protokoly BGP a IS-IS na topológii, ktorá je znázornená na obrázku 1. V rámci autonómnych systémov sme konfigurovali smerovacie protokoly IS-IS a BGP (iBGP). Medzi autonómnymi systémami sme konfigurovali len BGP (eBGP). IP adresácia je uvedená v tabuľke 1 a dopĺňa grafické znázornenie topológie na obrázku 1. Sieť medzi smerovačmi R1 a R5 nemá mať masku “/48” ale “/30”.



Obr. 1: Topológia BGP

Tabuľka 1: IP adresácia

Smerovač	Rozhranie	IP adresa	Maska
R1	Fa0/0	200.110.255.249	255.255.255.252
	Fa0/1	64.34.255.253	255.255.255.252
	S1/0	200.33.255.253	255.255.255.252
	Lo0	10.255.255.1	255.255.255.0
	Lo100	64.34.1.1	255.255.255.128
R2	Fa0/0	200.110.255.250	255.255.255.252
	Fa0/1.23	10.110.23.2	255.255.255.0
	Fa0/1.24	10.110.24.2	255.255.255.0
	S1/0	200.110.255.253	255.255.255.252
	Lo0	10.255.255.2	255.255.255.0
	Lo100	200.110.0.2	255.255.255.128
R3	Fa0/0	200.110.255.241	255.255.255.252
	Fa0/1.23	10.110.23.3	255.255.255.0
	Fa0/1.34	10.110.34.3	255.255.255.0
	Lo0	10.255.255.3	255.255.255.0
	Lo100	200.110.0.133	255.255.255.128
R4	Fa0/0	200.110.255.237	255.255.255.252
	Fa0/1.24	10.110.24.4	255.255.255.0
	Fa0/1.34	10.110.34.4	255.255.255.0
	S1/0	200.110.255.245	255.255.255.252
	Lo0	10.255.255.4	255.255.255.0
	Lo100	200.110.1.4	255.255.255.128
R5	Fa0/0	200.33.255.249	255.255.255.252
	Fa0/1	10.100.15.2	255.255.255.252
	S1/0	200.110.255.254	255.255.255.252
	Lo0	10.255.255.5	255.255.255.0
	Lo100	128.45.5.5	255.255.255.128
R6	Fa0/0	200.33.255.250	255.255.255.252
	Fa0/1	10.110.67.6	255.255.255.0
	S1/0	200.33.255.254	255.255.255.252
	Lo0	10.255.255.6	255.255.255.0
	Lo100	200.33.6.6	255.255.255.128
R7	Fa0/1	10.110.67.7	255.255.255.0
	S1/1	200.33.255.245	255.255.255.252
	Lo0	10.255.255.7	255.255.255.0
	Lo100	200.33.7.7	255.255.255.128
R8	Fa0/0	200.110.255.242	255.255.255.252
	Fa0/1	10.110.89.8	255.255.255.0
	Lo0	10.255.255.8	255.255.255.0
	Lo100	200.110.12.8	255.255.255.128
R9	Fa0/0	200.110.255.238	255.255.255.252
	Fa0/1	10.110.89.9	255.255.255.0
	Lo0	10.255.255.9	255.255.255.0
	Lo100	200.110.13.9	255.255.255.128
R10	S1/0	200.110.255.246	255.255.255.252
	S1/1	200.33.255.246	255.255.255.252
	Lo0	10.255.255.10	255.255.255.0
	Lo100	223.4.255.10	255.255.255.128

1.2 Úlohy

- 1.2.1 Použiť IGP IS–IS (L2 only) single area dizajn, priame p2p prepojenia
- 1.2.2 Zabezpečiť plnú konektivitu prostredníctvom iBGP alebo eBGP protokolov pre zákaznícké a internetové smerovacie záznamy
- 1.2.3 Distribúcia internetových statických smerovacích záznamov z AS3401, AS4502 a zákazníckych smerovacích záznamov z AS65001, AS5005, AS330
- 1.2.4 Sumarizácia

Popis

V celej topológii používame smerovací protokol BGP. Vnútri všetkých autonómnych systémov navyše používame smerovací protokol IS-IS. Subrozhranie “.13” (VLAN 13) sme premenovali na “.23” (VLAN 23), lebo sieť je medzi smerovačmi R2 a R3 (23), a nie medzi R1 a R3 (13).

Najprv sme linky medzi autonómnymi systémami šírili cez IS-IS. Neskôr sa toto ukázalo ako nevhodné riešenie, pretože “flappovacie” linky u zákazníkov môžu spôsobiť nestabilitu siete. Preto boli rozhrania medzi AS odstranené z IS-IS príkazmi uvedenými nižšie.

```
int <nazov_interfaceu>
  no ip router isis
router isis
  no passive-interface <nazov_interfaceu>
  no redistribute-connected
```

Na smerovačoch sme vytvorili dve virtuálne rozhrania: Loopback0 a Loopback100. Loopback0 mal IP adresu v tvare “10.255.255.X” s maskou “/32”, kde X je číslo smerovača. Router-ID sme nastavili na IP adresu rozhrania Loopback0. V rámci BGP sme ho nastavovali príkazom “bgp router-id 10.255.255.X”. Pokiaľ sa Router ID v BGP nenastaví hneď na začiatku, jeho zmena spôsobí rozpad BGP spojenia, ktoré sa po chvíli (rádovo v desiatkach sekúnd) obnoví.

Loopback100 mal IP adresu z verejného rozsahu príslušnej autonómnej oblasti s maskou “/25”. Verejné adresné rozsahy na Loopback100 rozhraniach sme sumarizovali pre každú AS príkazom “aggregate-address”. S AS 65001 vznikol problém so sumarizáciou ich verejného rozsahu na smerovačoch R3 a R4, lebo, lebo “Customer 1” (AS 65001) mal používal podrozsah verejných adries “ISP1” (AS 110). Ak by sme na R3 a R4 vykonali sumarizáciu verejných rozsahov pre Loopback100 v AS 110, spôsobilo by to, že “next-hop” adresa pre Loopback100 v AS 65001 by bol “Null0” t.j. paket by bol zahodený. Na R4 sme sumarizáciu

nerobili, pretože keby vypadla linka medzi R2 a R3, do AS 65001 by sme išli cez R4, a pokiaľ by mal R4 spomenutú sumárnu cestu, vznikol by ten istý problém s konektivitou.

V rámci BGP sme každému smerovaču nakonfigurovali siete, s ktorými susedí resp. na ktoré je priamo pripojený príkazom “neighbor”. Podľa toho, či sa susediaca sieť nachádza v AS s rovnakým číslom ako je ASN daného smerovača, použije sa iBGP, inak sa použije eBGP.

Siete obidvoch Loopback rozhraní sme ohlasovali príkazom “network” v rámci BGP. Potom sme pre ne použili príkaz “update-source”, ktorý slúži na prepísanie zdrojovej IP adresy na Loopback0. Keďže sme Loopback0 ohlásili príkazom “network”, susediace smerovače mu budú môcť odpovedať. Zdrojová adresa sa potom použije na otvorenie BGP spojenia medzi susednými smerovačmi. Loopback0 používame aj kvôli tomu, že bude vždy zapnutý, takže BGP spojenie bude stále aktívne.

Pokiaľ boli v AS viac ako dva smerovače, museli sme pridať príkaz “next-hop-self”, aby sme zaistili konektivitu medzi AS. Príkaz “next-hop-self” sa používa, keď sa BGP smerovač v jednom AS dozvie o ceste z iného AS cez eBGP a dá o tejto ceste vedieť zvyšným iBGP smerovačom v rámci svojho AS. Aby mohol iBGP smerovač získať konektivitu do tejto siete, použijeme na eBGP príkaz “next-hop-self”, ktorý namiesto toho, aby preposielal prefix s “next-hop” adresou zo siete medzi operátormi, prepíše “next-hop” adresu na svoj Loopback0. iBGP smerovač tak získa konektivitu do danej siete cez hraničný eBGP smerovač vo svojej oblasti. Keby sme tak neurobili, iBGP smerovač by sa nemohol dostať do siete v susednom AS, keď k nej nemá eBGP spojenie a z dôvodu bezpečnosti sme linky medzi AS neohlasovali príkazom “network”.

Konfigurácia

```
R1
ena
conf t
hostname R1
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.249 255.255.255.252
    no shut
int f0/1
```

```

    ip addr 64.34.255.253 255.255.255.252
    no shut
int s1/0
    ip addr 200.33.255.253 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.1 255.255.255.255
    no shut
int lo100
    ip addr 64.34.1.1 255.255.255.128
    no shut
router bgp 3401
    bgp router-id 10.255.255.1
    neighbor 64.34.255.254 remote-as 4502
    neighbor 200.33.255.254 remote-as 330
    neighbor 200.110.255.250 remote-as 110
    network 10.255.255.1 mask 255.255.255.255
    network 64.34.1.0 mask 255.255.255.128
    aggregate-address 64.34.0.0 255.255.0.0 summary-only
    no auto-summary
    no sync
    bgp log-neighbor-changes

```

```

R2
ena
conf t
hostname R2
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.250 255.255.255.252
    no shut
int f0/1
    no ip add
    isis network point-to-point
    no sh
int f0/1.23
    encap dot1q 23
    ip addr 10.110.23.2 255.255.255.0
    ip router isis
int f0/1.24
    encap dot1q 24

```

```

    ip addr 10.110.24.2 255.255.255.0
    ip router isis
int s1/0
    ip addr 200.110.255.253 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.2 255.255.255.255
    ip router isis
    no shut
int lo100
    ip addr 200.110.0.2 255.255.255.128
    ip router isis
    no shut
router isis
    net 49.0001.0102.5525.5002.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 110
    bgp router-id 10.255.255.2
    neighbor 10.255.255.3 remote-as 110
    neighbor 10.255.255.3 update-source lo0
    neighbor 10.255.255.3 next-hop-self
    neighbor 10.255.255.4 remote-as 110
    neighbor 10.255.255.4 update-source lo0
    neighbor 10.255.255.4 next-hop-self
    neighbor 200.110.255.249 remote-as 3401
    neighbor 200.110.255.254 remote-as 4502
    network 10.255.255.2 mask 255.255.255.255
    network 200.110.0.0 mask 255.255.255.128
    aggregate-address 200.110.0.0 255.255.0.0 summary-only
    no auto-summary
    no sync
    bgp log-neighbor-changes

```

```

R3
ena
conf t
hostname R3
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15

```



```

    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.241 255.255.255.252
    no shut
int f0/1
    no ip addr
    isis network point-to-point
    no shut
int f0/1.23
    encap dot1q 23
    ip addr 10.110.23.3 255.255.255.0
    ip router isis
int f0/1.34
    encap dot1q 34
    ip addr 10.110.34.3 255.255.255.0
    ip router isis
int lo0
    ip addr 10.255.255.3 255.255.255.255
    ip router isis
    no shut
int lo100
    ip addr 200.110.0.133 255.255.255.128
    ip router isis
    no shut
router isis
    net 49.0001.0102.5525.5003.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 110
    bgp router-id 10.255.255.3
    neighbor 10.255.255.2 remote-as 110
    neighbor 10.255.255.2 update-source lo0
    neighbor 10.255.255.2 next-hop-self
    neighbor 10.255.255.4 remote-as 110
    neighbor 10.255.255.4 update-source lo0
    neighbor 10.255.255.4 next-hop-self
    neighbor 200.110.255.242 remote-as 65001
    network 10.255.255.3 mask 255.255.255.255
    network 200.110.0.128 mask 255.255.255.128
    no auto-summary
    no sync
    bgp log-neighbor-changes

```

```

R4
ena
conf t
hostname R4
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.237 255.255.255.252
    no shut
int f0/1
    no ip addr
    isis network point-to-point
    no sh
int f0/1.24
    encaps dot1q 24
    ip addr 10.110.24.4 255.255.255.0
    ip router isis
int f0/1.34
    encaps dot1q 34
    ip addr 10.110.34.4 255.255.255.0
    ip router isis
int s1/0
    ip addr 200.110.255.245 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.4 255.255.255.255
    ip router isis
    no shut
int lo100
    ip addr 200.110.1.4 255.255.255.128
    ip router isis
    no shut
router isis
    net 49.0001.0102.5525.5004.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 110
    bgp router-id 10.255.255.4
    neighbor 10.255.255.2 remote-as 110
    neighbor 10.255.255.2 update-source lo0

```

```

neighbor 10.255.255.2 next-hop-self
neighbor 10.255.255.3 remote-as 110
neighbor 10.255.255.3 update-source lo0
neighbor 10.255.255.3 next-hop-self
neighbor 200.110.255.238 remote-as 65001
neighbor 200.110.255.246 remote-as 5005
network 10.255.255.4 mask 255.255.255.255
network 200.110.1.0 mask 255.255.255.128
no auto-summary
no sync
bgp log-neighbor-changes

```

```

R5
ena
conf t
hostname R5
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.33.255.249 255.255.255.252
    no shut
int f0/1
    ip addr 64.34.255.254 255.255.255.252
    no shut
int s1/0
    ip addr 200.110.255.254 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.5 255.255.255.255
    no shut
int lo100
    ip addr 128.45.5.5 255.255.255.128
    no shut
router bgp 4502
    bgp router-id 10.255.255.5
    neighbor 200.33.255.250 remote-as 330
    neighbor 200.110.255.253 remote-as 110
    neighbor 64.34.255.253 remote-as 3401
    network 10.255.255.5 mask 255.255.255.255
    network 128.45.5.0 mask 255.255.255.128
    aggregate-address 128.45.0.0 255.255.0.0 summary-only
    no auto-summary
    no sync

```

bgp log-neighbor-changes

```
R6
ena
conf t
hostname R6
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.33.255.250 255.255.255.252
    no shut
int f0/1
    ip addr 10.110.67.6 255.255.255.0
    ip router isis
    isis network point-to-point
    no shut
int s1/0
    ip addr 200.33.255.254 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.6 255.255.255.255
    ip router isis
    no shut
int lo100
    ip add 200.33.6.6 255.255.255.128
    ip router isis
router isis
    net 49.0001.0102.5525.5006.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 330
    bgp router-id 10.255.255.6
    neighbor 10.255.255.7 remote-as 330
    neighbor 10.255.255.7 update-source lo0
    neighbor 10.255.255.7 next-hop-self
    neighbor 200.33.255.253 remote-as 3401
    neighbor 200.33.255.249 remote-as 4502
```

```
network 10.255.255.6 mask 255.255.255.255
network 200.33.6.0 mask 255.255.255.128
aggregate-address 200.33.0.0 255.255.0.0 summary-only
no auto-summary
no sync
bgp log-neighbor-changes
```

```
R7
ena
conf t
hostname R7
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/1
    ip addr 10.110.67.7 255.255.255.0
    ip router isis
    isis network point-to-point
    no shut
int s1/1
    ip addr 200.33.255.245 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.7 255.255.255.255
    ip router isis
    no shut
int lo100
    ip addr 200.33.7.7 255.255.255.128
    ip router isis
    no shut
router isis
    net 49.0001.0102.5525.5007.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 330
    bgp router-id 10.255.255.7
    neighbor 10.255.255.6 remote-as 330
    neighbor 10.255.255.6 update-source lo0
    neighbor 10.255.255.6 next-hop-self
```

```

neighbor 200.33.255.246 remote-as 5005
network 10.255.255.7 mask 255.255.255.255
network 200.33.7.0 255.255.255.128
aggregate-address 200.33.0.0 255.255.0.0 summary-only
no auto-summary
no sync
bgp log-neighbor-changes

```

```

R8
ena
conf t
hostname R8
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.242 255.255.255.252
    no shut
int f0/1
    ip addr 10.110.89.8 255.255.255.0
    ip router isis
    isis network point-to-point
    no shut
int lo0
    ip addr 10.255.255.8 255.255.255.255
    ip router isis
    no shut
int lo100
    ip add 200.110.12.8 255.255.255.128
    ip router isis
router isis
    net 49.0001.0102.5525.5008.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 65001
    bgp router-id 10.255.255.8
    neighbor 10.255.255.9 remote-as 65001
    neighbor 10.255.255.9 update-source lo0

```

```
neighbor 200.110.255.241 remote-as 110
network 10.255.255.8 mask 255.255.255.255
network 200.110.12.0 mask 255.255.255.128
aggregate-address 200.110.12.0 255.255.254.0 summary-only
no auto-summary
no sync
bgp log-neighbor-changes
```

```
R9
ena
conf t
hostname R9
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int f0/0
    ip addr 200.110.255.238 255.255.255.252
    no sh
int f0/1
    ip addr 10.110.89.9 255.255.255.0
    ip router isis
    isis network point-to-point
    no shut
int lo0
    ip addr 10.255.255.9 255.255.255.255
    ip router isis
    no shut
int lo100
    ip addr 200.110.13.9 255.255.255.128
    ip router isis
    no shut
router isis
    net 49.0001.0102.5525.5009.00
    passive-interface lo0
    passive-interface lo100
    redistribute static
    is-type level-2
    metric-style wide
    exit
router bgp 65001
    bgp router-id 10.255.255.9
```

```

neighbor 10.255.255.8 remote-as 65001
neighbor 10.255.255.8 update-source lo0
neighbor 200.110.255.237 remote-as 110
network 10.255.255.9 mask 255.255.255.255
network 200.110.13.0 mask 255.255.255.128
aggregate-address 200.110.12.0 255.255.254.0 summary-only
no auto-summary
no sync
bgp log-neighbor-changes

```

```

R10
ena
conf t
hostname R10
no ip domain-lookup
username admin privil 15 secret admin
line con 0
    login local
    logging syn
    exec-time 120
line vty 0 15
    privilege level 15
    no login
int s1/0
    ip addr 200.110.255.246 255.255.255.252
    no shut
int s1/1
    ip addr 200.33.255.246 255.255.255.252
    no shut
int lo0
    ip addr 10.255.255.10 255.255.255.255
    no shut
int lo100
    ip addr 223.255.255.10 255.255.255.128
    no shut
router bgp 5005
    bgp router-id 10.255.255.10
    neighbor 200.110.255.245 remote-as 110
    neighbor 200.33.255.245 remote-as 330
    network 10.255.255.10 mask 255.255.255.255
    network 223.255.255.0 mask 255.255.255.128
    aggregate-address 223.255.255.0 255.255.255.0 summary-only
    no auto-summary
    no sync
    bgp log-neighbor-changes

```


Overenie

Kontrola, že vnútorný smerovací protokol IS-IS neohlasuje žiadne siete medzi operátormi, a že s

Nižšie uvádzame výpisy príkazov “show ip bgp” a “show ip route” pred odstránením liniek.

```
R1#sh ip bgp
```

```
BGP table version is 23, local router ID is 64.34.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,  
r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.255.255.1/32	0.0.0.0	0		32768	i
* 10.255.255.2/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250	0		0	110 i
* 10.255.255.3/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250			0	110 i
* 10.255.255.4/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250			0	110 i
* 10.255.255.5/32	200.110.255.250			0	110 4502 i
*	200.33.255.254			0	330 4502 i
*>	64.34.255.254	0		0	4502 i
* 10.255.255.6/32	200.110.255.250			0	110 4502 330 i
*	64.34.255.254			0	4502 330 i
*>	200.33.255.254	0		0	330 i
* 10.255.255.7/32	200.110.255.250			0	110 4502 330 i
*	64.34.255.254			0	4502 330 i
*>	200.33.255.254			0	330 i
* 10.255.255.8/32	64.34.255.254			0	4502 110 65001 i
Network	Next Hop	Metric	LocPrf	Weight	Path
*	200.33.255.254			0	330 4502 110 65001
*>	200.110.255.250			0	110 65001 i
* 10.255.255.9/32	64.34.255.254			0	4502 110 65001 i
*	200.33.255.254			0	330 4502 110 65001
*>	200.110.255.250			0	110 65001 i
* 10.255.255.10/32	64.34.255.254			0	4502 110 5005 i
*	200.110.255.250			0	110 5005 i
*>	200.33.255.254			0	330 5005 i
*> 64.34.1.0/25	0.0.0.0	0		32768	i
* 128.45.5.0/25	200.110.255.250			0	110 4502 i
*	200.33.255.254			0	330 4502 i
*>	64.34.255.254	0		0	4502 i
* 200.33.6.0/25	64.34.255.254			0	4502 330 i
*>	200.33.255.254	0		0	330 i
* 200.33.7.0/25	64.34.255.254			0	4502 330 i
*>	200.33.255.254			0	330 i
* 200.110.0.0/25	200.33.255.254			0	330 4502 110 i
*	64.34.255.254			0	4502 110 i
*>	200.110.255.250	0		0	110 i

```

* 200.110.0.128/25 200.33.255.254 0 330 4502 110 i
  Network          Next Hop      Metric LocPrf Weight Path
*                  64.34.255.254    0 4502 110 i
*>                 200.110.255.250    0 110 i
*> 200.110.1.0/25 200.110.255.250    0 110 i
*                  64.34.255.254    0 4502 110 i
*                  200.33.255.254    0 330 4502 110 i
* 200.110.12.0/25 200.33.255.254    0 330 4502 110 650
*                  64.34.255.254    0 4502 110 65001 i
*>                 200.110.255.250    0 110 65001 i
* 200.110.13.0/25 200.33.255.254    0 330 4502 110 650
*                  64.34.255.254    0 4502 110 65001 i
*>                 200.110.255.250    0 110 65001 i
* 223.255.255.0/25 64.34.255.254    0 4502 330 5005 i
*                  200.110.255.250    0 110 5005 i
*>                 200.33.255.254    0 330 5005 i

```

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

```

      200.110.1.0/25 is subnetted, 1 subnets
B      200.110.1.0 [20/0] via 200.110.255.250, 00:06:48
      200.33.6.0/25 is subnetted, 1 subnets
B      200.33.6.0 [20/0] via 200.33.255.254, 00:08:41
      223.255.255.0/25 is subnetted, 1 subnets
B      223.255.255.0 [20/0] via 200.33.255.254, 00:11:55
      200.33.7.0/25 is subnetted, 1 subnets
B      200.33.7.0 [20/0] via 200.33.255.254, 00:09:14
      64.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      64.34.255.252/30 is directly connected, FastEthernet0/1
C      64.34.1.0/25 is directly connected, Loopback1
      200.110.255.0/30 is subnetted, 1 subnets
C      200.110.255.248 is directly connected, FastEthernet0/0
      200.33.255.0/30 is subnetted, 1 subnets
C      200.33.255.252 is directly connected, Serial1/0
      200.110.0.0/25 is subnetted, 1 subnets
B      200.110.0.0 [20/0] via 200.110.255.250, 00:10:45
      200.110.0.128/25 is subnetted, 1 subnets
B      200.110.0.128 [20/0] via 200.110.255.250, 00:07:52

```

```

    200.110.12.0/25 is subnetted, 1 subnets
B       200.110.12.0 [20/0] via 200.110.255.250, 00:10:14
    128.45.0.0/25 is subnetted, 1 subnets
B       128.45.5.0 [20/0] via 64.34.255.254, 00:07:22
    200.110.13.0/25 is subnetted, 1 subnets
B       200.110.13.0 [20/0] via 200.110.255.250, 00:11:15
    10.0.0.0/32 is subnetted, 10 subnets
B       10.255.255.10 [20/0] via 200.33.255.254, 00:18:19
B       10.255.255.8 [20/0] via 200.110.255.250, 00:18:19
B       10.255.255.9 [20/0] via 200.110.255.250, 00:18:19
B       10.255.255.2 [20/0] via 200.110.255.250, 00:21:55
B       10.255.255.3 [20/0] via 200.110.255.250, 00:20:22
C       10.255.255.1 is directly connected, Loopback0
B       10.255.255.6 [20/0] via 200.33.255.254, 00:19:22
B       10.255.255.7 [20/0] via 200.33.255.254, 00:18:52
B       10.255.255.4 [20/0] via 200.110.255.250, 00:19:53
B       10.255.255.5 [20/0] via 64.34.255.254, 00:19:36

```

Nižšie uvádzame výpisy príkazov “show ip bgp” a “show ip route” po odstránení liniek prikazmi uvedenými v časti “Popis”.

```
R1#show ip bgp
```

```
BGP table version is 63, local router ID is 64.34.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.255.255.1/32	0.0.0.0	0		32768	i
* 10.255.255.2/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250	0		0	110 i
* 10.255.255.3/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250			0	110 i
* 10.255.255.4/32	64.34.255.254			0	4502 110 i
*>	200.110.255.250			0	110 i
* 10.255.255.5/32	200.110.255.250			0	110 4502 i
*	200.33.255.254			0	330 4502 i
*>	64.34.255.254	0		0	4502 i
* 10.255.255.6/32	200.110.255.250			0	110 4502 330 i
*	64.34.255.254			0	4502 330 i
*>	200.33.255.254	0		0	330 i
* 10.255.255.7/32	200.110.255.250			0	110 4502 330 i
*	64.34.255.254			0	4502 330 i
*>	200.33.255.254			0	330 i
* 10.255.255.8/32	64.34.255.254			0	4502 110 65001 i
Network	Next Hop	Metric	LocPrf	Weight	Path
*	200.33.255.254			0	330 4502 110 65001
*>	200.110.255.250			0	110 65001 i
* 10.255.255.9/32	64.34.255.254			0	4502 110 65001 i
*	200.33.255.254			0	330 4502 110 65001
*>	200.110.255.250			0	110 65001 i

```

* 10.255.255.10/32 64.34.255.254 0 4502 110 5005 i
* 200.110.255.250 0 110 5005 i
*> 200.33.255.254 0 330 5005 i
*> 64.34.0.0/16 0.0.0.0 32768 i
s> 64.34.1.0/25 0.0.0.0 0 32768 i
* 128.45.0.0 200.110.255.250 0 110 4502 i
* 200.33.255.254 0 330 4502 i
*> 64.34.255.254 0 4502 i
* 200.33.0.0/16 64.34.255.254 0 4502 330 i
*> 200.33.255.254 0 330 i
* 200.110.0.0/16 200.33.255.254 0 330 4502 110 i
* 64.34.255.254 0 4502 110 i
*> 200.110.255.250 0 110 i
* 223.255.255.0 64.34.255.254 0 4502 330 5005 i
* 200.110.255.250 0 110 5005 i
Network Next Hop Metric LocPrf Weight Path
*> 200.33.255.254 0 330 5005 i

```

R1#show 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

```

B    223.255.255.0/24 [20/0] via 200.33.255.254, 00:32:37
    64.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
C    64.34.255.252/30 is directly connected, FastEthernet0/1
B    64.34.0.0/16 [200/0] via 0.0.0.0, 00:28:12, Null0
C    64.34.1.0/25 is directly connected, Loopback1
    200.110.255.0/30 is subnetted, 1 subnets
C    200.110.255.248 is directly connected, FastEthernet0/0
    200.33.255.0/30 is subnetted, 1 subnets
C    200.33.255.252 is directly connected, Serial1/0
B    128.45.0.0/16 [20/0] via 64.34.255.254, 00:27:42
    10.0.0.0/32 is subnetted, 10 subnets
B    10.255.255.10 [20/0] via 200.33.255.254, 00:54:15
B    10.255.255.8 [20/0] via 200.110.255.250, 00:54:15
B    10.255.255.9 [20/0] via 200.110.255.250, 00:54:16
B    10.255.255.2 [20/0] via 200.110.255.250, 00:57:51
B    10.255.255.3 [20/0] via 200.110.255.250, 00:56:19
C    10.255.255.1 is directly connected, Loopback0
B    10.255.255.6 [20/0] via 200.33.255.254, 00:55:18

```

```

B      10.255.255.7 [20/0] via 200.33.255.254, 00:54:47
B      10.255.255.4 [20/0] via 200.110.255.250, 00:55:48
B      10.255.255.5 [20/0] via 64.34.255.254, 00:55:32
B      200.33.0.0/16 [20/0] via 200.33.255.254, 00:28:44
B      200.110.0.0/16 [20/0] via 200.110.255.250, 00:27:13

```

Z druhého výpisu BGP tabuľky vidíme, že počet prefixov sa v dôsledku summarizácie sietí znížil. A z druhého výpisu smerovacej tabuľky vidíme, že interné adresy autonómnych systémov nie sú ohlasované.

1.2.5 Prepísať privátne AS65001

Popis

na konci AS PATH máme pre 10.255.255.8 máme privátne ASko. provider musí privátne ASko odstrániť, lebo také sa nemôžu dostať do internetu, inak by zblbalo smerovanie. Odstraňovanie sa bude diať na smerovačoch R2 (v smere k R1 a R5) a R4 (v smere k R10), pretože R2 a R4 tie sú hraničné smerovače v AS 110.

Konfigurácia

Na smerovačoch R2 a R4 vykonáme tieto príkazy (v globálnom konfiguračnom móde):

R2

```

router bgp 110
neighbor 200.110.255.249 remove-private-as
neighbor 200.110.255.254 remove-private-as

```

R4

```

router bgp 110
neighbor 200.110.255.246 remove-private-as

```

Overenie

potom príkazom `show ip bgp` overiť AS PATH overiť, že AS 65001 zmizne z AS PATH

Predtým ...

R1

Predtým...

```

R1#show ip bgp 10.255.255.8
BGP routing table entry for 10.255.255.8/32, version 154
Paths: (2 available, best #1, table Default-IP-Routing-Table)

```

```

Advertised to update-groups:
  1
110 65001
  200.110.255.250 from 200.110.255.250 (10.255.255.2)
    Origin IGP, localpref 100, valid, external, best
4502 110 65001
  64.34.255.254 from 64.34.255.254 (10.255.255.5)
    Origin IGP, localpref 100, valid, external

```

Potom...

```

R1#show ip bgp 10.255.255.8
BGP routing table entry for 10.255.255.8/32, version 157
Paths: (2 available, best #1, table Default-IP-Routing-Table)
Flag: 0x820
  Advertised to update-groups:
    1
110
  200.110.255.250 from 200.110.255.250 (10.255.255.2)
    Origin IGP, localpref 100, valid, external, best
4502 110
  64.34.255.254 from 64.34.255.254 (10.255.255.5)
    Origin IGP, localpref 100, valid, external

```

=====

R10

Predtým...

```

R10#show ip bgp 10.255.255.8
BGP routing table entry for 10.255.255.8/32, version 56
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Not advertised to any peer
330 3401 110
  200.33.255.245 from 200.33.255.245 (10.255.255.7)
    Origin IGP, localpref 100, valid, external
110 65001
  200.110.255.245 from 200.110.255.245 (10.255.255.4)
    Origin IGP, localpref 100, valid, external, best

```

Potom ...

```
R10#show ip bgp 10.255.255.8
BGP routing table entry for 10.255.255.8/32, version 59
Paths: (2 available, best #2, table Default-IP-Routing-Table)
Flag: 0x820
  Not advertised to any peer
  330 3401 110
    200.33.255.245 from 200.33.255.245 (10.255.255.7)
      Origin IGP, localpref 100, valid, external
  110
    200.110.255.245 from 200.110.255.245 (10.255.255.4)
      Origin IGP, localpref 100, valid, external, best
```

Z výpisov AS_PATH vidíme, že privátny AS 65001 nie je ohlasovaný do internetu ani cez R2, ani cez R4.

1.2.6 ISP politika

Definovať vlastnú politiku – použiť community, community alter LP, AS–PATH filtering, prepending, atď

1.2.7 Primárna linka R3–R8

Popis

Na R4 sa z R9 máme dopíňať cez R8 t.j. namiesto **R9 -> R4** to pôjde **R9 -> R8 -> R3 -> R4**. Rovnako aj v spätnom smere.

Komunity -nastavujeme cez route mapy - cez routemapu vieme ovplyvňovať smerovanie NA ZAKLADE UPDATEOV z iných routrov. MOŽEME MAŤ IBA JEDNU ROUTEMAPU V SMERE INÁ JEDNU V SMERE OUT NA INTERFEJSI. Na R8 a R9 spravíme routemapu s názvom "AS_KAM_TO_IDE:AS_ODKIAL_TO_IDE".

Local preference nastavíme routemapou na R8 a R9. Chceme aby aj R9 išla cez R8, nie cez R4. R8 si musí zdvihnúť local preference smerom na R9 a ohlasovať zvyšnú local pref na R9.

Pri akejkoľvek zmene politiky musíme reštartovať BGP proces, aby sa prejavili zmeny.

Keď si teraz zobrazíme informácie o prefixe 10.255.255.8 príkazom "show ip bgp 10.255.255.8", vidíme, že číslo komunity "community" je nejaké vysoké číslo. Aby sme mohli precitať číslo community, na všetkých 4 routroch v globálnom konfig. režime musíme na smerovačoch R3 a R4 zmeniť formát, v akom sa číslo komunity zobrazuje príkazom "ip bgp-community new-format" v globálnom konfiguračnom režime.

LENZE to je iba riešenie v smere z AS 65001 VON. Teraz musíme zabezpečiť spätný smer DO AS 65001 da sa to riešiť MEDom alebo cez routemapu a nastavovanie local preference. r8 a r9 routemapu out na susedne routre v AS 110 -všetko sa má riešiť komunitami -zvysíme routemapou local preference na R3 v smere IN (lebo sa musíme pozerieť odkiaľ idu updaty) na suseda R8. dať tam match na community, keď sa zhoduje s 65001:110 -na R3 bude routemapu CUSTOMER

ACLko "PREFER" sme mohli na R8 dať buď na suseda R3 v smere IN, alebo na suseda R9 v smere OUT, ale v takom prípade, keby sa do AS 65001 pridala ďalšia smerovač pripojený k R8, museli by sme routemapu aplikovať aj na rozhranie na R8, ktorým by bol nový smerovač pripojený ku R8.

Konfigurácia


```
=====
!SMEROM VON
=====
```

```
!R8
!Nastavenie komunity
ip bgp-community new-format
route-map OUT permit 10
    set community 65001:110
router bgp 65001
    neighbor 200.110.255.241 route-map OUT out
    neighbor 200.110.255.241 send-community

!Nastavenie priority pre R3 smerom von
route-map PREFER permit 10
    set local-preference 110
router bgp 65001
    !neighbor 200.110.255.241 route-map PREFER out
    neighbor 200.110.255.241 route-map PREFER in
end
clear ip bgp * out
```

```
-----

!R9
ip bgp-community new-format
route-map OUT permit 10
    set community 65001:110
router bgp 65001
    neighbor 200.110.255.237 route-map OUT out
    neighbor 200.110.255.237 send-community
end
clear ip bgp * out

-----
```

```
!R3, R4
ip bgp-community new-format
```

```
=====
!SMEROM DNU
```

```
=====

!R3
!vytvoríme ACL pre komunitu
ip community 1 permit 65001:110

route-map CUSTOMER permit 10
  match community 1
  set local-preference 110
router bgp 110
  neighbor 200.110.255.242 route-map CUSTOMER in
end
clear ip bgp * in
```

Overenie

```
smerom von
!R8 alebo R9
show route-map
traceroute 10.255.255.1
```

```
PREDTYM
!R9 - sledovat next hop na R1 loop
show ip bgp
```

```
!R2
show ip bgp
traceroute 10.255.255.8
show ip bgp 10.255.255.8
```

1.2.8 Primárna linka R4–R10

Popis

Zákazník 2 chce primárne využívať linku ku R4 pre vstup aj výstup t.j. ping z R5 na R7 nepôjde cez AS 330 (R5 -> R6 -> R7), ale cez **R5 -> R2 -> R4 -> R10 -> R7**. Rovnako aj v spätnom smere.

OBRAŽŽTEEEK (R4-R10) :D :D

Konfigurácia

riesenie VON k r10

bud cez vahu, alebo route mapa local preference v smere OUT - updaty, ktore dos

riesenie DNU k r10

Prepending - prependujeme smerom k R7

^\$ - nase ASko - lokalne

_5005\$ - AS PATH konci ASkom 5005

Komunity

R10 musi odosielat komunitu, na ktoru bude zvysook sveta reagovat

R10 bude mat komunitu 5005:110

R4

match na komunitu z r10 a dame set local preference vyssi ako default (110)

R7

match na komunitu z r10 a dame set local preference musi byt medzi 60 a 70

R2 a r6

route mapy

treba dat send-community a by sa komunita zachoval

R5

2 routemapy v smere in od susedov r2 a r6, v ktorej nastavim r2 vyssiu local pr

Popis

pre router R10 v AS 5005 spravit linku ku R4 primarnu v smere von z AS 5005

Konfiguracia

!Zakaznik 2

!R10

-route mapa local preference v smere OUT - updaty, ktore dostanem od r4 maju vy

-R10 bude mat komunitu 5005:110

NASTAVIME SIRENIE KOMUNITY STRINGU Z AS 5005 NA ROUTRE R2, R4, R5, R6 a R7

!R4

conf t

ip bgp-community new-format

router bgp 110

neighbor 10.255.255.2 send-community

end

clear ip bgp * out

!R7

```
conf t
ip bgp-community new-format
router bgp 330
  neighbor 10.255.255.6 send-community
end
clear ip bgp * out
```

```
!R6
conf t
ip bgp-community new-format
router bgp 330
  neighbor 200.33.255.249 send-community
end
clear ip bgp * out
```

```
!R2
conf t
ip bgp-community new-format
router bgp 110
  neighbor 200.110.255.254 send-community
end
clear ip bgp * out
```

```
!R5
conf t
ip bgp-community new-format

end
clear ip bgp * out
```

```
!R10
conf t
ip bgp-community new-format

!komunity string pre r4
```

```

route-map OUT_110 permit 10
  set community 5005:110
router bgp 5005
  neighbor 200.110.255.245 route-map OUT_110 out
  neighbor 200.110.255.245 send-community

!komunity string pre r7
route-map OUT_330 permit 20
  set community 5005:330
router bgp 5005
  neighbor 200.33.255.245 route-map OUT_330 out
  neighbor 200.33.255.245 send-community

!ak zmenime politiku, musime reloadnut bgp politiku
end
clear ip bgp * out

```

Overime, ci sa komunity string odosiela (na routri inom ako r10, napr r2)

```
show ip bgp 10.255.255.10
```

mali by sme vidiet "community"

Nastavime R4 ako preferovany router na vystup od zakaznika 2.

```

conf t
route-map PREFER_R4 permit 10
  set local-preference 110
router bgp 65001
  neighbor 200.110.255.241 route-map PREFER out
end
clear ip bgp * out

```

```
=====
=====
```

Popis

pre router R10 v AS 5005 spravit linku ku R4 primarnu v smere DNU do AS 5005

Konfiguracia

!Zakaznik 2

!R10

! T-Com

!R4

!Orange

!R7

!T-Com

!R2

!Orange

!R6

!SIX

!R5

Overenie

1.2.9 Distribúovať iba default, AS5005 a peering prefixy do AS65001

Popis

Konfigurácia

Overenie

1.2.10 AS5005 nesme byť nikdy transit

Popis

Konfigurácia

```
-urob aclko  
ip as-path access-list 1 permit ^$
```

```
komunitou  
do COMMUNITY routemapy na r10 dat:
```

```
route-map OUT_110  
  match as-path 1
```

```
route-map OUT_330  
  match as-path 1
```

Overenie

1.2.11 Peering iba pre ISP1 a ISP2, nie pre prefixy naučené z Upstream ISP

Popis

Konfigurácia

Overenie

1.2.12 Overiť funkčnosť nastavenia politiky vhodnými výpadkami liniek a smerovačov

Popis

Konfigurácia

Overenie

1.2.13 Overiť, či je možné odkloniť celú prevádzku (upstream, downstream) na linke R4–R10 v prípade plánovanej údržby (linka musí byť plne funkčná a BGP spojenie propaguje všetky prefixy)

Popis

Konfigurácia

Overenie