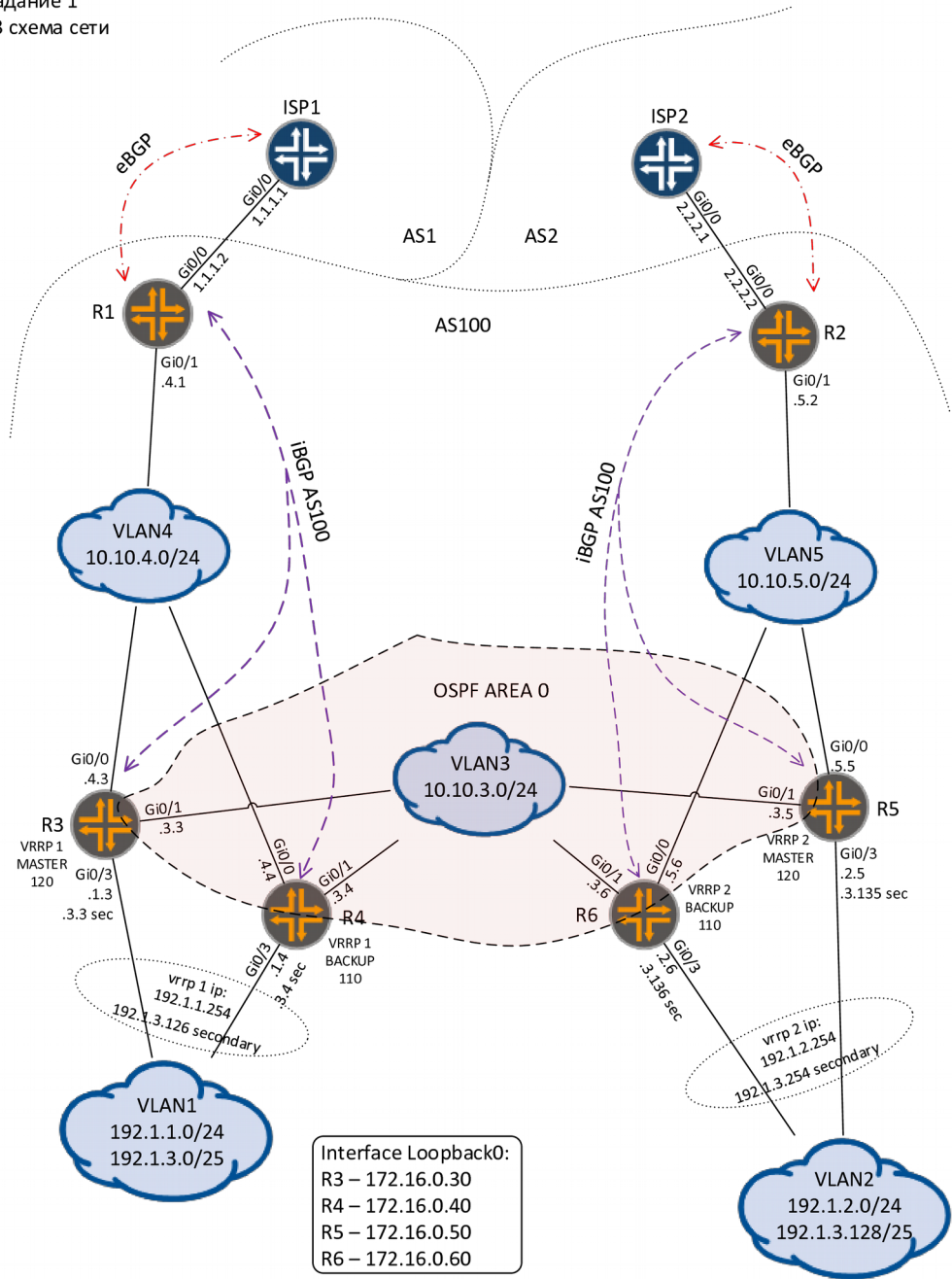


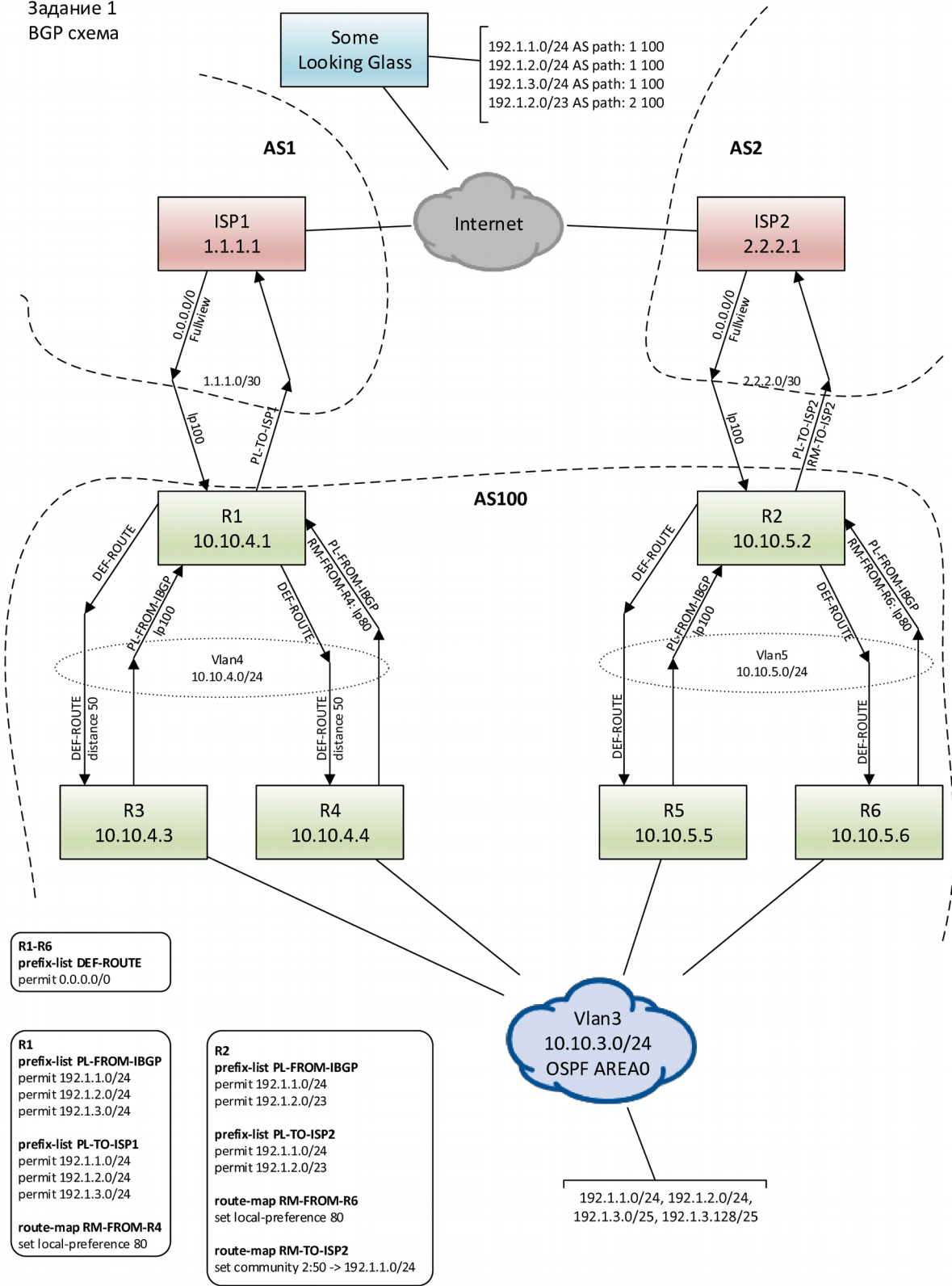
1 L3 схема сети.

20170910
Задание 1
L3 схема сети



2 BGP схема

20170910
Задание 1
BGP схема



3 Концепция

3.1 Сети в VLAN1 и VLAN2.

В качестве шлюзов по умолчанию, для клиентов в VLAN1 и VLAN2, выступают пары маршрутизаторов R3-R4 и R5-R6 соответственно. Пары маршрутизаторов работают по протоколу VRRP и публикуют для клиентов виртуальные ip шлюзов по умолчанию.

R3-R4

R3 – master, R4 – backup

Виртуальные ip – 192.1.1.254 и 192.1.3.126 (secondary)

R5-R6

R5 – master, R6 – backup

Виртуальные ip – 192.1.2.254 и 192.1.3.254 (secondary)

3.2 OSPF

OSPF (area 0) работает в VLAN3 (10.10.3.0/24) между 4 маршрутизаторами – R3-R6. Маршрутизаторы R3 и R5 считаются основными, R4 и R6 резервными.

Каждый маршрутизатор анонсирует в area 0 сети подключенные к интерфейсу gi0/3.

На резервных R4 и R6 увеличена матрица\стоимость интерфейсов gi0/3 - **ip ospf cost 10**

Каждый маршрутизатор анонсирует в area0 маршрут по умолчанию.

На резервных R4 и R6 увеличена метрика маршрута по умолчанию - **default-information originate metric 60\70**

На маршрутизаторах R3 и R4, для маршрута по умолчанию, полученному по iBGP от R1, меняется administrative distance с 200 на 50 (**distance 50 10.10.4.1 0.0.0.0**). Это нужно, чтобы перебить маршруты по умолчанию от R5-R6 (ospf AD 110).

3.3 BGP

iBGP

Поднято 4 iBGP сессии – R1 → R3, R1 → R4, R2 → R5, R2 → R6.

От R1 и R2 “вниз” спускаются маршруты по умолчанию полученные от ISP1 и IPS2.

От R3-R6 “поднимаются” маршруты клиентских сетей, часть из них агрегируются.

На R1 приходят сети 192.1.1.0/24, 192.1.2.0/24, 192.1.3.0/24

(**aggregate-address 192.1.3.0 255.255.255.0 summary-only**)

На R2 приходят сети 192.1.1.0/24, 192.1.2.0/23

(**aggregate-address 192.1.2.0 255.255.254.0 summary-only**)

На маршруты, пришедшие от резервных маршрутизаторов R4 и R6, на R1 и R2 ставится local preference 80.

На R3-R6 настроена редистрибуция connected и ospf маршрутов.

Connected маршруты берутся только от интерфейсов gi0/3.

От ospf берутся все маршруты которые потом режут на R1 и R2.

FV, полученные от ISP1 и IPS2, в iBGP не анонсятся и режутся префикс листами DEF-ROUTE. DEF-ROUTE висит как на выходе из R1,R2, так и на входе R3-R6. Так сделано, что бы случайно не проанонсировать FV в OSPF.

eBGP

Есть два стыка, от провайдеров получаем 0.0.0.0/0 и FV.

В ISP1, с R1, анонсим три сети /24 – 192.1.1.0/24, 192.1.2.0/24, 192.1.3.0/24.

В ISP2, с R2, анонсим две сети – 192.1.1.0/24, 192.1.2.0/23.

R2 на анонс 192.1.1.0/24 вешает “backup bgp community” 2:50. Этим комьюнити мы просим ISP2 поставить на 192.1.1.0/24 local preference 50 который будет самым низким внутри AS2. После этого анонс сети 192.1.1.0/24 не выйдет за границы AS2 пока ISP2 видит такой же анонс пришедший со стороны AS1. Если ISP1 падает, ISP2 начинает анонсировать 192.1.1.0/24 в интернет. Внутри AS2 анонс так же не будет распространяться пока работает ISP1.

Сеть 192.1.2.0/23 анонсим в ISP2 без комьюнити, т.к. анонс менее специфичный, пока все хорошо с ISP1, трафик в него пойти не должен.

Вместе с тем, анонс /23 позволит следить за состоянием ISP2. Если с какого-нибудь looking glass видим /23 через AS2, значит ISP2 работает.

Если через ISP2 в /23 будет просачиваться трафик, то можно /23 разбить на два /24 и так же повесить “backup bgp community”.

4 Конфигурации

4.1 R1

```
hostname R1
!
interface GigabitEthernet0/0
description ISP1/gi0/0
ip address 1.1.1.2 255.255.255.252
no ip redirects
duplex auto
speed auto
media-type rj45
bfd interval 500 min_rx 500 multiplier 3
!
interface GigabitEthernet0/1
description ROUTER-LINKNET-4
ip address 10.10.4.1 255.255.255.0
duplex auto
speed auto
media-type rj45
!
router bgp 100
bgp log-neighbor-changes
neighbor 1.1.1.1 remote-as 1
neighbor 1.1.1.1 description ISP1
neighbor 1.1.1.1 fall-over bfd
neighbor 1.1.1.1 prefix-list PL-TO-ISP1 out
neighbor 10.10.4.3 remote-as 100
neighbor 10.10.4.3 description R3
neighbor 10.10.4.3 next-hop-self
neighbor 10.10.4.3 prefix-list PL-FROM-IBGP in
neighbor 10.10.4.3 prefix-list DEF-ROUTE out
neighbor 10.10.4.4 remote-as 100
neighbor 10.10.4.4 description R4
neighbor 10.10.4.4 next-hop-self
neighbor 10.10.4.4 prefix-list PL-FROM-IBGP in
neighbor 10.10.4.4 prefix-list DEF-ROUTE out
neighbor 10.10.4.4 route-map RM-FROM-R4 in
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip route 192.1.1.0 255.255.255.0 Null0 240
ip route 192.1.2.0 255.255.254.0 Null0 240
!
!
ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0
```

```
!  
ip prefix-list PL-FROM-IBGP seq 5 permit 192.1.1.0/24  
ip prefix-list PL-FROM-IBGP seq 10 permit 192.1.2.0/24  
ip prefix-list PL-FROM-IBGP seq 15 permit 192.1.3.0/24  
!  
ip prefix-list PL-TO-ISP1 seq 5 permit 192.1.1.0/24  
ip prefix-list PL-TO-ISP1 seq 10 permit 192.1.2.0/24  
ip prefix-list PL-TO-ISP1 seq 15 permit 192.1.3.0/24  
!  
route-map RM-FROM-R4 permit 10  
  set local-preference 80  
!
```

4.2 R2

```
hostname R2
```

```
service password-encryption
```

```
no banner exec
```

```
no banner incoming
```

```
no banner login
```

```
interface GigabitEthernet0/0
```

```
description ISP2/gi0/0
```

```
ip address 2.2.2.2 255.255.255.252
```

```
duplex auto
```

```
speed auto
```

```
media-type rj45
```

```
!
```

```
interface GigabitEthernet0/1
```

```
description ROUTER-LINKNET-5
```

```
ip address 10.10.5.2 255.255.255.0
```

```
duplex auto
```

```
speed auto
```

```
media-type rj45
```

```
!
```

```
interface GigabitEthernet0/2
```

```
no ip address
```

```
shutdown
```

```
duplex auto
```

```
speed auto
```

```
media-type rj45
```

```
!
```

```
interface GigabitEthernet0/3
```

```
no ip address
```

```
shutdown
```

```
duplex auto
```

```
speed auto
```

```
media-type rj45
```

```
!
```

```
router bgp 100
```

```
bgp log-neighbor-changes
```

```
neighbor 2.2.2.1 remote-as 2
```

```
neighbor 2.2.2.1 description ISP2
```

```
neighbor 10.10.5.5 remote-as 100
```

```
neighbor 10.10.5.5 description R5
```

```
neighbor 10.10.5.6 remote-as 100
```

```
neighbor 10.10.5.6 description R6
```

```
!
```

```
address-family ipv4
```

```
neighbor 2.2.2.1 activate
```

```
neighbor 2.2.2.1 send-community
```

```
neighbor 2.2.2.1 prefix-list PL-TO-ISP2 out
neighbor 2.2.2.1 route-map RM-TO-ISP2 out
neighbor 10.10.5.5 activate
neighbor 10.10.5.5 next-hop-self
neighbor 10.10.5.5 prefix-list PL-FROM-IBGP in
neighbor 10.10.5.5 prefix-list DEF-ROUTE out
neighbor 10.10.5.6 activate
neighbor 10.10.5.6 next-hop-self
neighbor 10.10.5.6 prefix-list PL-FROM-IBGP in
neighbor 10.10.5.6 prefix-list DEF-ROUTE out
neighbor 10.10.5.6 route-map RM-FROM-R6 in
exit-address-family
!
ip forward-protocol nd
!
ip bgp-community new-format
!
no ip http server
no ip http secure-server
ip route 192.1.1.0 255.255.255.0 Null0 240
ip route 192.1.2.0 255.255.254.0 Null0 240
!
!
ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0
!
ip prefix-list PL-FROM-IBGP seq 5 permit 192.1.1.0/24
ip prefix-list PL-FROM-IBGP seq 10 permit 192.1.2.0/23
!
ip prefix-list PL-TO-ISP2 seq 5 permit 192.1.1.0/24
ip prefix-list PL-TO-ISP2 seq 10 permit 192.1.2.0/23
!
ip prefix-list PL-TO-ISP2-W-COMMUNITY seq 5 permit 192.1.1.0/24
!
ip prefix-list PL-TO-ISP2-WO-COMMUNITY seq 5 permit 192.1.2.0/23
!
route-map RM-FROM-R6 permit 10
set local-preference 80
!
route-map RM-TO-ISP2 permit 5
match ip address prefix-list PL-TO-ISP2-WO-COMMUNITY
continue
!
route-map RM-TO-ISP2 permit 10
match ip address prefix-list PL-TO-ISP2-W-COMMUNITY
set community 2:50
!
```


4.3 R3

hostname R3

service password-encryption

no banner exec

no banner incoming

no banner login

interface Loopback0

ip address 172.16.0.30 255.255.255.255

!

interface GigabitEthernet0/0

description ROUTER-LINKNET-4

ip address 10.10.4.3 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/1

description ROUTER-LINKNET-3

ip address 10.10.3.3 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/2

no ip address

shutdown

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/3

description VLAN1

ip address 192.1.3.3 255.255.255.128 secondary

ip address 192.1.1.3 255.255.255.0

duplex auto

speed auto

media-type rj45

vrrp 1 description VRRP-MASTER-FOR-VLAN1-CUSTOMER-NETS

vrrp 1 ip 192.1.1.254

vrrp 1 ip 192.1.3.126 secondary

vrrp 1 preempt delay minimum 15

vrrp 1 priority 120

vrrp 1 authentication md5 key-string 7 051D141D31015E080A16

!

router ospf 1

router-id 172.16.0.30

```
passive-interface GigabitEthernet0/3
network 10.10.3.0 0.0.0.255 area 0
network 192.1.1.0 0.0.0.255 area 0
network 192.1.3.0 0.0.0.127 area 0
default-information originate
!
router bgp 100
  bgp log-neighbor-changes
  bgp redistribute-internal
  aggregate-address 192.1.3.0 255.255.255.0 summary-only
  redistribute connected route-map CONNECTED-TO-BGP
  redistribute ospf 1
  neighbor 10.10.4.1 remote-as 100
  neighbor 10.10.4.1 description R1
  neighbor 10.10.4.1 next-hop-self
  neighbor 10.10.4.1 prefix-list DEF-ROUTE in
  distance 50 10.10.4.1 0.0.0.0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
!
ip prefix-list CONNECTED-NET seq 5 permit 192.1.1.0/24
ip prefix-list CONNECTED-NET seq 10 permit 192.1.3.0/25
!
ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0
!
route-map CONNECTED-TO-BGP permit 10
  match ip address prefix-list CONNECTED-NET
!
!
```

4.4 R4

```
hostname R4
service password-encryption
interface Loopback0
 ip address 172.16.0.40 255.255.255.255
!
interface GigabitEthernet0/0
 description ROUTER-LINKNET-4
 ip address 10.10.4.4 255.255.255.0
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description ROUTER-LINKNET-3
 ip address 10.10.3.4 255.255.255.0
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/2
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/3
 description VLAN1
 ip address 192.1.3.4 255.255.255.128 secondary
 ip address 192.1.1.4 255.255.255.0
 ip ospf cost 10
 duplex auto
 speed auto
 media-type rj45
 vrrp 1 description VRRP-BACKUP-FOR-VLAN1-CUSTOMER-NETS
 vrrp 1 ip 192.1.1.254
 vrrp 1 ip 192.1.3.126 secondary
 vrrp 1 preempt delay minimum 15
 vrrp 1 priority 110
 vrrp 1 authentication md5 key-string 7 0719335E5E4409040401
!
router ospf 1
 router-id 172.16.0.40
 passive-interface GigabitEthernet0/3
 network 10.10.3.0 0.0.0.255 area 0
 network 192.1.1.0 0.0.0.255 area 0
 network 192.1.3.0 0.0.0.127 area 0
 default-information originate metric 60
```

```
!  
router bgp 100  
  bgp log-neighbor-changes  
  bgp redistribute-internal  
  aggregate-address 192.1.3.0 255.255.255.0 summary-only  
  redistribute connected route-map CONNECTED-TO-BGP  
  redistribute ospf 1  
  neighbor 10.10.4.1 remote-as 100  
  neighbor 10.10.4.1 description R1  
  neighbor 10.10.4.1 next-hop-self  
  neighbor 10.10.4.1 prefix-list DEF-ROUTE in  
  distance 50 10.10.4.1 0.0.0.0  
!  
ip forward-protocol nd  
!  
!  
no ip http server  
no ip http secure-server  
!  
!  
ip prefix-list CONNECTED-NET seq 5 permit 192.1.1.0/24  
ip prefix-list CONNECTED-NET seq 10 permit 192.1.3.0/25  
!  
ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0  
!  
route-map CONNECTED-TO-BGP permit 10  
  match ip address prefix-list CONNECTED-NET
```

4.5 R5

hostname R5

service password-encryption

interface Loopback0

ip address 172.16.0.50 255.255.255.255

!

interface GigabitEthernet0/0

description ROUTER-LINKNET-5

ip address 10.10.5.5 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/1

description ROUTER-LINKNET-3

ip address 10.10.3.5 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/2

no ip address

shutdown

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/3

description VLAN2

ip address 192.1.3.135 255.255.255.128 secondary

ip address 192.1.2.5 255.255.255.0

duplex auto

speed auto

media-type rj45

vrrp 2 description VRRP-MASTER-FOR-VLAN2-CUSTOMER-NETS

vrrp 2 ip 192.1.2.254

vrrp 2 ip 192.1.3.254 secondary

vrrp 2 preempt delay minimum 15

vrrp 2 priority 120

vrrp 2 authentication md5 key-string 7 095A5C1B09480713181F55

!

router ospf 1

router-id 172.16.0.50

passive-interface GigabitEthernet0/3

network 10.10.3.0 0.0.0.255 area 0

network 192.1.2.0 0.0.0.255 area 0

network 192.1.3.128 0.0.0.127 area 0

```
default-information originate
!
router bgp 100
  bgp log-neighbor-changes
  bgp redistribute-internal
  aggregate-address 192.1.2.0 255.255.254.0 summary-only
  redistribute connected route-map CONNECTED-NET
  redistribute ospf 1
  neighbor 10.10.5.2 remote-as 100
  neighbor 10.10.5.2 description R2
  neighbor 10.10.5.2 next-hop-self
  neighbor 10.10.5.2 prefix-list DEF-ROUTE in
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
!
ip prefix-list CONNECTED-NET seq 5 permit 192.1.2.0/24
ip prefix-list CONNECTED-NET seq 10 permit 192.1.3.128/25
!
ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0
!
route-map CONNECTED-TO-BGP permit 10
  match ip address prefix-list CONNECTED-NET
!
!
!
```

4.6 R6

hostname R6

service password-encryption

interface Loopback0

ip address 172.16.0.60 255.255.255.255

!

interface GigabitEthernet0/0

description ROUTER-LINKNET-5

ip address 10.10.5.6 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/1

description ROUTER-LINKNET-3

ip address 10.10.3.6 255.255.255.0

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/2

no ip address

shutdown

duplex auto

speed auto

media-type rj45

!

interface GigabitEthernet0/3

description VLAN1

ip address 192.1.3.136 255.255.255.128 secondary

ip address 192.1.2.6 255.255.255.0

ip ospf cost 10

duplex auto

speed auto

media-type rj45

vrrp 2 description VRRP-BACKUP-FOR-VLAN1-CUSTOMER-NETS

vrrp 2 ip 192.1.2.254

vrrp 2 ip 192.1.3.126 secondary

vrrp 2 preempt delay minimum 15

vrrp 2 priority 110

vrrp 2 authentication md5 key-string 7 031249191642314D5D1A48

!

router ospf 1

router-id 172.16.0.60

passive-interface GigabitEthernet0/3

network 10.10.3.0 0.0.0.255 area 0

network 192.1.2.0 0.0.0.255 area 0

```
network 192.1.3.128 0.0.0.127 area 0
default-information originate metric 70
!
router bgp 100
  bgp log-neighbor-changes
  bgp redistribute-internal
  aggregate-address 192.1.2.0 255.255.254.0 summary-only
  redistribute ospf 1
  neighbor 10.10.5.2 remote-as 100
  neighbor 10.10.5.2 description R2
  neighbor 10.10.5.2 next-hop-self
  neighbor 10.10.5.2 prefix-list DEF-ROUTE in
  !
  ip forward-protocol nd
  !
  !
  no ip http server
  no ip http secure-server
  !
  !
  ip prefix-list CONNECTED-NET seq 5 permit 192.1.2.0/24
  ip prefix-list CONNECTED-NET seq 10 permit 192.1.3.128/25
  !
  ip prefix-list DEF-ROUTE seq 5 permit 0.0.0.0/0
  !
  route-map CONNECTED-TO-BGP permit 10
  match ip address prefix-list CONNECTED-NET
  !
```


4.7 ISP1

```
hostname R6
service password-encryption

interface GigabitEthernet0/0
description R1/gi0/0
ip address 1.1.1.1 255.255.255.252
no ip redirects
duplex auto
speed auto
media-type rj45
bfd interval 500 min_rx 500 multiplier 3
!
interface GigabitEthernet0/1
no ip address
shutdown
duplex auto
speed auto
media-type rj45
!
router bgp 1
bgp log-neighbor-changes
network 200.0.0.0 mask 255.0.0.0
network 201.0.0.0 mask 255.0.0.0
neighbor 1.1.1.2 remote-as 100
neighbor 1.1.1.2 description R1
neighbor 1.1.1.2 fall-over bfd
neighbor 1.1.1.2 default-originate
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip route 200.0.0.0 255.0.0.0 Null0
ip route 201.0.0.0 255.0.0.0 Null0
!
```

4.8 ISP2

```
service password-encryption
!
hostname R6
interface GigabitEthernet0/0
description R2/gi0/0
ip address 2.2.2.1 255.255.255.252
duplex auto
speed auto
media-type rj45
!
router bgp 2
bgp log-neighbor-changes
network 50.0.0.0
network 51.0.0.0
network 200.0.0.0 mask 255.0.0.0
network 201.0.0.0 mask 255.0.0.0
neighbor 2.2.2.2 remote-as 100
neighbor 2.2.2.2 description R2
neighbor 2.2.2.2 default-originate
neighbor 2.2.2.2 route-map RM-FROM-GORGEOUS-CUSTOMER in
!
ip forward-protocol nd
!
ip bgp-community new-format
ip community-list standard OUR-BACKUP-COMMUNITY permit 2:50
!
no ip http server
no ip http secure-server
ip route 50.0.0.0 255.0.0.0 Null0
ip route 51.0.0.0 255.0.0.0 Null0
ip route 200.0.0.0 255.0.0.0 Null0
ip route 201.0.0.0 255.0.0.0 Null0
!
!
route-map RM-FROM-GORGEOUS-CUSTOMER permit 10
match community OUR-BACKUP-COMMUNITY
set local-preference 50
!
route-map RM-FROM-GORGEOUS-CUSTOMER permit 20
!
!
```

5 ВЫВОДЫ КОМАНД

5.1 ISP1

ISP1#sh ip bgp

BGP table version is 22, local router ID is 1.1.1.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
0.0.0.0	0.0.0.0		0	i	
*> 192.1.1.0	1.1.1.2		0	100	?
*> 192.1.2.0	1.1.1.2		0	100	?
*> 192.1.3.0	1.1.1.2		0	100	i
*> 200.0.0.0/8	0.0.0.0	0	32768	i	
*> 201.0.0.0/8	0.0.0.0	0	32768	i	

5.2 ISP2

ISP2#sh ip bgp

BGP table version is 20, local router ID is 2.2.2.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
0.0.0.0	0.0.0.0		0	i	
*> 50.0.0.0	0.0.0.0	0	32768	i	
*> 51.0.0.0	0.0.0.0	0	32768	i	
*> 192.1.1.0	2.2.2.2	50	0	100	?
*> 192.1.2.0/23	2.2.2.2		0	100	i
*> 200.0.0.0/8	0.0.0.0	0	32768	i	
*> 201.0.0.0/8	0.0.0.0	0	32768	I	

5.3 R1

R1#sh ip bgp

BGP table version is 24, local router ID is 10.10.4.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 0.0.0.0	1.1.1.1		0	1	i
* i 192.1.1.0	10.10.4.4	0	80	0	?
*>i	10.10.4.3	0	100	0	?
*>i 192.1.2.0	10.10.4.3	2	100	0	?
* i	10.10.4.4	2	80	0	?
* i 192.1.3.0	10.10.4.4	0	80	0	i
*>i	10.10.4.3	0	100	0	i
*> 200.0.0.0/8	1.1.1.1	0		0	1 i
*> 201.0.0.0/8	1.1.1.1	0		0	1 i

R1#sh ip ro

R1#sh ip route

Codes: L - local, 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, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 1.1.1.1 to network 0.0.0.0

B* 0.0.0.0/0 [20/0] via 1.1.1.1, 04:23:06

1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 1.1.1.0/30 is directly connected, GigabitEthernet0/0

L 1.1.1.2/32 is directly connected, GigabitEthernet0/0

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 10.10.4.0/24 is directly connected, GigabitEthernet0/1

L 10.10.4.1/32 is directly connected, GigabitEthernet0/1

B 192.1.1.0/24 [200/0] via 10.10.4.3, 04:28:07

S 192.1.2.0/23 is directly connected, Null0

B 192.1.2.0/24 [200/2] via 10.10.4.3, 04:13:03

B 192.1.3.0/24 [200/0] via 10.10.4.3, 04:28:07

B 200.0.0.0/8 [20/0] via 1.1.1.1, 04:23:06

B 201.0.0.0/8 [20/0] via 1.1.1.1, 04:23:06

5.4 R2

R2#sh ip bgp

BGP table version is 78, local router ID is 2.2.2.2

Status codes:

```
...
  Network        Next Hop        Metric LocPrf Weight Path
*> 0.0.0.0        2.2.2.1            0      0 2 i
*> 50.0.0.0        2.2.2.1            0      0 2 i
*> 51.0.0.0        2.2.2.1            0      0 2 i
* i 192.1.1.0      10.10.5.6          2    80  0 ?
*>i               10.10.5.5          2   100  0 ?
* i 192.1.2.0/23   10.10.5.6          0    80  0 i
*>i               10.10.5.5          0   100  0 i
*> 200.0.0.0/8     2.2.2.1            0      0 2 i
*> 201.0.0.0/8     2.2.2.1            0      0 2 i
```

R2#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

```
...
Gateway of last resort is 2.2.2.1 to network 0.0.0.0
```

B* 0.0.0.0/0 [20/0] via 2.2.2.1, 06:34:58

2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 2.2.2.0/30 is directly connected, GigabitEthernet0/0

L 2.2.2.2/32 is directly connected, GigabitEthernet0/0

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 10.10.5.0/24 is directly connected, GigabitEthernet0/1

L 10.10.5.2/32 is directly connected, GigabitEthernet0/1

B 50.0.0.0/8 [20/0] via 2.2.2.1, 06:34:58

B 51.0.0.0/8 [20/0] via 2.2.2.1, 06:34:58

B 192.1.1.0/24 [200/2] via 10.10.5.5, 07:24:49

B 192.1.2.0/23 [200/0] via 10.10.5.5, 07:24:49

B 200.0.0.0/8 [20/0] via 2.2.2.1, 06:34:58

B 201.0.0.0/8 [20/0] via 2.2.2.1, 06:34:58

5.5 R3

R3#sh ip bgp

BGP table version is 24, local router ID is 172.16.0.30

..

Network	Next Hop	Metric	LocPrf	Weight	Path
*>i 0.0.0.0	10.10.4.1	0	100	0 1	i
*> 192.1.1.0	0.0.0.0	0		32768	?
*> 192.1.2.0	10.10.3.5	2		32768	?
s> 192.1.3.0/25	0.0.0.0	0		32768	?
*> 192.1.3.0	0.0.0.0			32768	i
s> 192.1.3.128/25	10.10.3.5	2		32768	?

R3#sh ip rout

R3#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

...

Gateway of last resort is 10.10.4.1 to network 0.0.0.0

B* 0.0.0.0/0 [50/0] via 10.10.4.1, 05:14:34

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.10.3.0/24 is directly connected, GigabitEthernet0/1

L 10.10.3.3/32 is directly connected, GigabitEthernet0/1

C 10.10.4.0/24 is directly connected, GigabitEthernet0/0

L 10.10.4.3/32 is directly connected, GigabitEthernet0/0

172.16.0.0/32 is subnetted, 1 subnets

C 172.16.0.30 is directly connected, Loopback0

192.1.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.1.1.0/24 is directly connected, GigabitEthernet0/3

L 192.1.1.3/32 is directly connected, GigabitEthernet0/3

O 192.1.2.0/24 [110/2] via 10.10.3.5, 05:02:30, GigabitEthernet0/1

192.1.3.0/24 is variably subnetted, 4 subnets, 3 masks

B 192.1.3.0/24 [200/0], 08:00:10, Null0

C 192.1.3.0/25 is directly connected, GigabitEthernet0/3

L 192.1.3.3/32 is directly connected, GigabitEthernet0/3

O 192.1.3.128/25 [110/2] via 10.10.3.5, 05:02:30, GigabitEthernet0/1

5.6 R4

R4#sh ip bgp

BGP table version is 24, local router ID is 172.16.0.40

...

Network	Next Hop	Metric	LocPrf	Weight	Path
*>i 0.0.0.0	10.10.4.1	0	100	0	1 i
*> 192.1.1.0	0.0.0.0	0		32768	?
*> 192.1.2.0	10.10.3.5	2		32768	?
s> 192.1.3.0/25	0.0.0.0	0		32768	?
*> 192.1.3.0	0.0.0.0			32768	i
s> 192.1.3.128/25	10.10.3.5	2		32768	?

R4#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

...

Gateway of last resort is 10.10.4.1 to network 0.0.0.0

B* 0.0.0.0/0 [50/0] via 10.10.4.1, 05:14:25

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.10.3.0/24 is directly connected, GigabitEthernet0/1

L 10.10.3.4/32 is directly connected, GigabitEthernet0/1

C 10.10.4.0/24 is directly connected, GigabitEthernet0/0

L 10.10.4.4/32 is directly connected, GigabitEthernet0/0

172.16.0.0/32 is subnetted, 1 subnets

C 172.16.0.40 is directly connected, Loopback0

192.1.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.1.1.0/24 is directly connected, GigabitEthernet0/3

L 192.1.1.4/32 is directly connected, GigabitEthernet0/3

O 192.1.2.0/24 [110/2] via 10.10.3.5, 05:02:29, GigabitEthernet0/1

192.1.3.0/24 is variably subnetted, 4 subnets, 3 masks

B 192.1.3.0/24 [200/0], 07:53:23, Null0

C 192.1.3.0/25 is directly connected, GigabitEthernet0/3

L 192.1.3.4/32 is directly connected, GigabitEthernet0/3

O 192.1.3.128/25 [110/2] via 10.10.3.5, 05:02:29, GigabitEthernet0/1

5.7 R5

R5#sh ip bgp

BGP table version is 30, local router ID is 172.16.0.50

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
r>i 0.0.0.0	10.10.5.2	0	100	0 2	i
*> 192.1.1.0	10.10.3.3	2		32768	?
*> 192.1.2.0/23	0.0.0.0			32768	i
s> 192.1.3.0/25	10.10.3.3	2		32768	?

R5#

R5#sh ip ro

R5#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

...

Gateway of last resort is 10.10.3.3 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 10.10.3.3, 05:22:39, GigabitEthernet0/1

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.10.3.0/24 is directly connected, GigabitEthernet0/1

L 10.10.3.5/32 is directly connected, GigabitEthernet0/1

C 10.10.5.0/24 is directly connected, GigabitEthernet0/0

L 10.10.5.5/32 is directly connected, GigabitEthernet0/0

172.16.0.0/32 is subnetted, 1 subnets

C 172.16.0.50 is directly connected, Loopback0

O 192.1.1.0/24 [110/2] via 10.10.3.3, 07:59:56, GigabitEthernet0/1

B 192.1.2.0/23 [200/0], 07:55:04, Null0

192.1.2.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.1.2.0/24 is directly connected, GigabitEthernet0/3

L 192.1.2.5/32 is directly connected, GigabitEthernet0/3

192.1.3.0/24 is variably subnetted, 3 subnets, 2 masks

O 192.1.3.0/25 [110/2] via 10.10.3.3, 07:59:56, GigabitEthernet0/1

C 192.1.3.128/25 is directly connected, GigabitEthernet0/3

L 192.1.3.135/32 is directly connected, GigabitEthernet0/3

5.8 R6

R6#sh ip bgp

BGP table version is 23, local router ID is 172.16.0.60

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
r>i 0.0.0.0	10.10.5.2	0	100	0 2	i
*> 192.1.1.0	10.10.3.3	2		32768	?
*> 192.1.2.0/23	0.0.0.0			32768	i
s> 192.1.3.0/25	10.10.3.3	2		32768	?

R6#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

...

Gateway of last resort is 10.10.3.3 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 10.10.3.3, 05:26:51, GigabitEthernet0/1

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.10.3.0/24 is directly connected, GigabitEthernet0/1

L 10.10.3.6/32 is directly connected, GigabitEthernet0/1

C 10.10.5.0/24 is directly connected, GigabitEthernet0/0

L 10.10.5.6/32 is directly connected, GigabitEthernet0/0

172.16.0.0/32 is subnetted, 1 subnets

C 172.16.0.60 is directly connected, Loopback0

O 192.1.1.0/24 [110/2] via 10.10.3.3, 07:59:48, GigabitEthernet0/1

B 192.1.2.0/23 [200/0], 07:54:56, Null0

192.1.2.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.1.2.0/24 is directly connected, GigabitEthernet0/3

L 192.1.2.6/32 is directly connected, GigabitEthernet0/3

192.1.3.0/24 is variably subnetted, 3 subnets, 2 masks

O 192.1.3.0/25 [110/2] via 10.10.3.3, 07:59:48, GigabitEthernet0/1

C 192.1.3.128/25 is directly connected, GigabitEthernet0/3

L 192.1.3.136/32 is directly connected, GigabitEthernet0/3