

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ
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Лабораторная работа №5
По дисциплине «Телекоммуникационные системы и технологии»
Маршрутизация в IP сетях

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АРТЕФАКТЫ

1. Команды для настройки маршрутизатора, помеченного звездочкой, из части 2 и части 3.

Router1

```
en
conf t
ip route 192.168.0.0 255.255.255.192 192.168.0.65
ip route 192.168.0.192 255.255.255.224 192.168.0.130
ip route 192.168.0.224 255.255.255.224 192.168.0.131
```

Router1(1)

```
en
conf t
router rip
version 2
passive-interface fa1/0
network 192.168.1.0
no auto-summary
```

2. Команды настройки BGP на этих маршрутизаторах из части 5

Router1

```
en
conf t
router bgp 100
bgp log-neighbor-changes
neighbor 10.0.0.2 remote-as 101
neighbor 10.0.64.2 remote-as 102
neighbor 10.0.128.2 remote-as 103
network 192.168.0.0 mask 255.255.255.192
network 10.0.0.0 mask 255.255.192.0
network 192.168.0.128 mask 255.255.255.192
network 192.168.0.224 mask 255.255.255.224
```

```
network 192.168.0.192 mask 255.255.255.224
network 192.168.0.64 mask 255.255.255.192
network 10.0.64.0 mask 255.255.192.0
network 10.0.128.0 mask 255.255.192.0
```

Router1(1)

```
en
conf t
router bgp 101
bgp log-neighbor-changes
neighbor 10.0.0.1 remote-as 100
neighbor 10.0.192.2 remote-as 102
neighbor 10.0.224.2 remote-as 103
network 10.0.0.0 mask 255.255.192.0
network 192.168.1.0
network 10.0.192.0 mask 255.255.224.0
network 10.0.224.0 mask 255.255.224.0
```

3. Итоговые таблицы маршрутизации из части 5.

Router1

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C    10.0.0.0/18 is directly connected, FastEthernet4/0
C    10.0.64.0/18 is directly connected, FastEthernet5/0
C    10.0.128.0/18 is directly connected, FastEthernet6/0
B    10.0.192.0/19 [20/0] via 10.0.0.2, 00:00:00
B    10.0.224.0/19 [20/0] via 10.0.0.2, 00:00:00
192.168.0.0/24 is variably subnetted, 5 subnets, 2 masks
S    192.168.0.0/26 [1/0] via 192.168.0.65
C    192.168.0.64/26 is directly connected, FastEthernet0/0
C    192.168.0.128/26 is directly connected, FastEthernet1/0
S    192.168.0.192/27 [1/0] via 192.168.0.130
S    192.168.0.224/27 [1/0] via 192.168.0.131
B    192.168.1.0/24 [20/0] via 10.0.0.2, 00:00:00
B    192.168.2.0/24 [20/0] via 10.0.64.2, 00:00:00
B    192.168.3.0/24 [20/0] via 10.0.128.2, 00:00:00
```

Router1(1)

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C    10.0.0.0/18 is directly connected, FastEthernet4/0
B    10.0.64.0/18 [20/0] via 10.0.0.1, 00:00:00
B    10.0.128.0/18 [20/0] via 10.0.0.1, 00:00:00
C    10.0.192.0/19 is directly connected, FastEthernet5/0
C    10.0.224.0/19 is directly connected, FastEthernet6/0
192.168.0.0/24 is variably subnetted, 5 subnets, 2 masks
B    192.168.0.0/26 [20/0] via 10.0.0.1, 00:00:00
B    192.168.0.64/26 [20/0] via 10.0.0.1, 00:00:00
B    192.168.0.128/26 [20/0] via 10.0.0.1, 00:00:00
B    192.168.0.192/27 [20/0] via 10.0.0.1, 00:00:00
B    192.168.0.224/27 [20/0] via 10.0.0.1, 00:00:00
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
S    192.168.1.0/24 is directly connected, Null0
C    192.168.1.0/26 is directly connected, FastEthernet1/0
C    192.168.1.64/26 is directly connected, FastEthernet0/0
R    192.168.1.128/26 [120/1] via 192.168.1.66, 00:00:10, FastEthernet0/0
R    192.168.1.192/27 [120/2] via 192.168.1.66, 00:00:10, FastEthernet0/0
R    192.168.1.224/27 [120/2] via 192.168.1.66, 00:00:10, FastEthernet0/0
B    192.168.2.0/24 [20/0] via 10.0.192.2, 00:00:00
B    192.168.3.0/24 [20/0] via 10.0.224.2, 00:00:00
```

4. Вывод информации о пирах (neighbor) с edge маршрутизатора AS 100

```
Router#sh ip bgp neighbors
BGP neighbor is 10.0.0.2, remote AS 101, external link
  BGP version 4, remote router ID 192.168.1.65
  BGP state = Established, up for 01:34:03
  Last read 01:34:03, last write 01:34:03, hold time is 180, keepalive interval is 60
seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

      Sent      Rcvd
Opens:          1          1
Notifications:  0          0
Updates:        16         31
Keepalives:     95         95
Route Refresh:  0          16
Total:         112        143
  Default minimum time between advertisements runs is 30 seconds

For address family: IPv4 Unicast
  BGP table version 24, neighbor version 6/0
--More--

For address family: IPv4 Unicast
  BGP table version 24, neighbor version 6/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member

      Sent      Rcvd
Prefix activity:  ----  ----
Prefixes Current:    16     13 (Consumes 667 bytes)
Prefixes total:      16     13
Implicit Withdraw:    0      0
Explicit Withdraw:    0      0
Used as bestpath:     n/a     1
Used as multipath:     n/a     0

      Outbound   Inbound
Local Policy Denied Prefixes:  -----
Total:                          0          0
  Number of NLRI's in the update sent: max 3, min 1

Address tracking is enabled, the RIB does have a route to 10.0.0.2
Connections established 1; dropped 0
Last reset never
Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Minimum incoming TTL 0, Outgoing TTL 1
Local host: 10.0.0.1, Local port: 179
Foreign host: 10.0.0.2, Foreign port: 1026
Connection tableid (VRF): 0

Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)

Event Timers (current time is 0xC69F4):
Timer      Starts    Wakeups      Next
--More--
```

```

Event Timers (current time is 0xC69F4):
Timer      Starts    Wakeups    Next
Retrans    0           0          0x0
TimeWait   0           0          0x0
AckHold    126         0          0x0
SendWnd    0           0          0x0
KeepAlive  95          0          0x0
GiveUp     0           0          0x0
PmtuAger   0           0          0x0
DeadWait   0           0          0x0
Linger     0           0          0x0
ProcessQ   0           0          0x0

iss: 2057115318  snduna: 2057115748  sndnxt: 2057115748  sndwnd: 15955
irs: 3480424370  rcvnxt: 3480424751  rcvwnd: 16004  delrcvwnd: 380

SRTT: 259 ms, RTTO: 579 ms, RTV: 320 ms, KRTT: 0 ms
minRTT: 16 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: passive open, gen tcbs
Option Flags: nagle, path mtu capable
IP Precedence value : 6

Datagrams (max data segment is 1460 bytes):
Rcvd: 127 (out of order: 0), with data: 17, total data bytes: 408
Sent: 96 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with
data: 16, total data bytes: 384
  Packets received in fast path: 0, fast processed: 0, slow path: 0
  fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 10.0.64.2, remote AS 102, external link
  BGP version 4, remote router ID 192.168.2.1
  BGP state = Established, up for 00:52:50
  Last read 00:52:50, last write 00:52:50, hold time is 180, keepalive interval is 60
seconds
--More-- |

Neighbor capabilities:
  Route refresh: advertised and received(new)
  Address family IPv4 Unicast: advertised and received
Message statistics:
  InQ depth is 0
  OutQ depth is 0

      Sent      Rcvd
Opens:      1      1
Notifications: 0      0
Updates:    17     15
Keepalives: 53     53
Route Refresh: 0      2
Total:      71     71

Default minimum time between advertisements runs is 30 seconds

For address family: IPv4 Unicast
BGP table version 24, neighbor version 6/0
Output queue size : 0
Index 1, Offset 0, Mask 0x2
1 update-group member

      Sent      Rcvd
Prefix activity:  ----
Prefixes Current:      17      13 (Consumes 690 bytes)
Prefixes total:        17      13
Implicit Withdraw:      0      0
Explicit Withdraw:      0      0
Used as bestpath:      n/a      1
Used as multipath:      n/a      0

      Outbound  Inbound
Local Policy Denied Prefixes:  -----
Total:                        0      0
--More--

```

```

Total:                                0          0
Number of NLRI's in the update sent: max 3, min 1

Address tracking is enabled, the RIB does have a route to 10.0.64.2
Connections established 1; dropped 1
Last reset never
Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Minimum incoming TTL 0, Outgoing TTL 1
Local host: 10.0.64.1, Local port: 179
Foreign host: 10.0.64.2, Foreign port: 1025
Connection tableid (VRF): 0

Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)

Event Timers (current time is 0xC69F4):
Timer           Starts      Wakeups          Next
Retrans         0           0           0x0
TimeWait        0           0           0x0
AckHold         68           0           0x0
SendWnd         0           0           0x0
KeepAlive       53           0           0x0
GiveUp          0           0           0x0
PmtuAger        0           0           0x0
DeadWait        0           0           0x0
Linger          0           0           0x0
ProcessQ        0           0           0x0

iss: 2057115318  snduna: 2057115748  sndnxt: 2057115748      sndwnd: 15955
irs: 3480424370  rcvnxt: 3480424751  rcvwnd: 16004  delrcvwnd: 380

SRTT: 259 ms, RTTO: 579 ms, RTV: 320 ms, KRTT: 0 ms
minRTT: 16 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: passive open, gen tcbs
--More--

Status Flags: passive open, gen tcbs
Option Flags: nagle, path mtu capable
IP Precedence value : 6

Datagrams (max data segment is 1460 bytes):
Rcvd: 69 (out of order: 0), with data: 2, total data bytes: 48
Sent: 54 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with
data: 17, total data bytes: 408
Packets received in fast path: 0, fast processed: 0, slow path: 0
fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 10.0.128.2, remote AS 103, external link
BGP version 4, remote router ID 192.168.3.1
BGP state = Established, up for 00:47:52
Last read 00:47:52, last write 00:47:52, hold time is 180, keepalive interval is 60
seconds
Neighbor capabilities:
Route refresh: advertised and received(new)
Address family IPv4 Unicast: advertised and received
Message statistics:
InQ depth is 0
OutQ depth is 0

              Sent      Rcvd
Opens:         1         1
Notifications: 0         0
Updates:       19        15
Keepalives:    48        48
Route Refresh: 0         2
Total:        68        66
Default minimum time between advertisements runs is 30 seconds

For address family: IPv4 Unicast
BGP table version 24, neighbor version 6/0
--More--

```



```

BGP table version 24, neighbor version 6/0
Output queue size : 0
Index 1, Offset 0, Mask 0x2
1 update-group member

Prefix activity:
Sent      Rcvd
----      ----
Prefixes Current:      19      13 (Consumes 736 bytes)
Prefixes total:        19      13
Implicit Withdraw:      0       0
Explicit Withdraw:      0       0
Used as bestpath:      n/a      1
Used as multipath:      n/a      0

Local Policy Denied Prefixes:
Outbound  Inbound
-----
Total:      0       0
Number of NLRI in the update sent: max 3, min 1

Address tracking is enabled, the RIB does have a route to 10.0.128.2
Connections established 1; dropped 1
Last reset never
Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Minimum incoming TTL 0, Outgoing TTL 1
Local host: 10.0.128.1, Local port: 179
Foreign host: 10.0.128.2, Foreign port: 1025
Connection tableid (VRF): 0

Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)

Event Timers (current time is 0xC69F4):
Timer      Starts  Wakeups  Next
Retrans      0       0      0x0
TimeWait      0       0      0x0
--More--
TimeWait      0       0      0x0
AckHold      63       0      0x0
SendWnd       0       0      0x0
KeepAlive     48       0      0x0
GiveUp        0       0      0x0
PmtuAger      0       0      0x0
DeadWait      0       0      0x0
Linger        0       0      0x0
ProcessQ      0       0      0x0

iss: 2057115318  snduna: 2057115748  sndnxt: 2057115748  sndwnd: 15955
irs: 3480424370  rcvnxt: 3480424751  rcvwnd: 16004  delrcvwnd: 380

SRTT: 259 ms, RTTO: 579 ms, RTV: 320 ms, KRTT: 0 ms
minRTT: 16 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: passive open, gen tcbs
Option Flags: nagle, path mtu capable
IP Precedence value : 6

Datagrams (max data segment is 1460 bytes):
Rcvd: 64 (out of order: 0), with data: 2, total data bytes: 48
Sent: 49 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with
data: 19, total data bytes: 456
Packets received in fast path: 0, fast processed: 0, slow path: 0
fast lock acquisition failures: 0, slow path: 0

Router#
Router#

```

ВОПРОСЫ И ЗАДАНИЯ

1. Поясните результаты, полученные в Части 5, п.8.

Поток пакетов будет направляться непосредственно в нужную сеть по кратчайшему пути.

2. Как, имея доступ к консоли маршрутизатора узнать, что проходят обновления информации bgp?

Команда `bgp log-neighbor-changes` в режиме конфигурации BGP позволяет включить/выключить сообщения, генерируемые при изменении статуса BGP-соседа: сброс, подъем или падение.