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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СОДЕРЖАНИЕ

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 NLRIs 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 NLRIs 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
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    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

                                     Outbound    Inbound
      Local Policy Denied Prefixes:  --------    -------
        Total:                              0          0
      Number of NLRIs 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.

Существует несколько критериев, которые BGP использует для выбора наилучшего пути.

Например:

- Наибольший вес (устанавливается локальным маршрутизатором)
- Кратчайший AS-путь

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.