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ФАКУЛЬТЕТ ИНФОРМАТИКА И СИСТЕМЫ УПРАВЛЕНИЯ
КАФЕДРА КОМПЬЮТЕРНЫЕ СИСТЕМЫ И СЕТИ (ИУ6)
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Дисциплина: Сети и телекоммуникации

Название лабораторной работы: Базовая настройка сетевых сервисов
и приложений.

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Цель работы - Научиться настраивать статические маршруты и IP адреса для роутеров используя консоль, а также, настраивать запасные маршруты в случае обрыва кабеля. Научиться пользоваться технологией OSPF, изменять hello и dead интервалы и менять приоритет для управления DR.

Ход работы:

1.) Настроил имена устройств и IP адреса роутеров (аналогично для роутеров R2, R3). (Рисунок 1)

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]
Oct  4 2021 13:35:11-08:00 R1 %%01IFNET/4/LINK_STATE(1)[2]:The line protocol IP
on the interface GigabitEthernet0/0/0 has entered the UP state.
Oct  4 2021 13:35:13-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 2, the ch
ange loop count is 0, and the maximum number of records is 4095.
[R1-GigabitEthernet0/0/0]quit
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.12.1 24
[R1-GigabitEthernet0/0/1]
Oct  4 2021 13:35:39-08:00 R1 %%01IFNET/4/LINK_STATE(1)[3]:The line protocol IP
on the interface GigabitEthernet0/0/1 has entered the UP state.
[R1-GigabitEthernet0/0/1]quit
[R1]
Oct  4 2021 13:35:43-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 3, the ch
ange loop count is 0, and the maximum number of records is 4095.
[R1]interface LoopBack 0
[R1-LoopBack0]ip address 10.0.12.1 24
Oct  4 2021 13:36:03-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 4, the ch
ange loop count is 0, and the maximum num
[R1-LoopBack0]ip address 10.0.1.1 24
[R1-LoopBack0]quit
```

Рисунок 1 – Процесс настройки имен устройств и IP адресов

2.) Вывел информацию о роутере R1 (аналогично для R2, R3). (Рисунок2)

```
<R1>display ip interface brief
*down: administratively down
!down: FIB overload down
^down: standby
(l): loopback
(s): spoofing
(d): Dampening Suppressed
The number of interface that is UP in Physical is 4
The number of interface that is DOWN in Physical is 8
The number of interface that is UP in Protocol is 4
The number of interface that is DOWN in Protocol is 8

Interface                IP Address/Mask      Physical  Protocol
Ethernet0/0/0            unassigned           down      down
Ethernet0/0/1            unassigned           down      down
GigabitEthernet0/0/0     10.0.13.1/24         up        up
GigabitEthernet0/0/1     10.0.12.1/24         up        up
GigabitEthernet0/0/2     unassigned           down      down
GigabitEthernet0/0/3     unassigned           down      down
LoopBack0                10.0.1.1/24          up        up(s)
NULL0                   unassigned           up        up(s)
```

Рисунок 2 – Данные роутера R1

3.) Проверили связь между роутерами с помощью команды ping для роутера R1(то же самое делаем для роутера R2). (Рисунок 3).

```
<R1>ping 10.0.12.2
PING 10.0.12.2: 56 data bytes, press CTRL_C to break
  Reply from 10.0.12.2: bytes=56 Sequence=1 ttl=255 time=100 ms
  Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=30 ms
  Reply from 10.0.12.2: bytes=56 Sequence=3 ttl=255 time=50 ms
  Reply from 10.0.12.2: bytes=56 Sequence=4 ttl=255 time=50 ms
  Reply from 10.0.12.2: bytes=56 Sequence=5 ttl=255 time=50 ms

--- 10.0.12.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 30/56/100 ms

<R1>ping 10.0.13.3
PING 10.0.13.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=70 ms
  Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=50 ms
  Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=30 ms
  Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=30 ms
  Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=30 ms

--- 10.0.13.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 30/42/70 ms
```

Рисунок 3 – применение команды ping

4.) Вывел информацию о связях роутера R2. (Рисунок 4).

```
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 8          Routes : 8

Destination/Mask    Proto   Pre  Cost           Flags NextHop         Interface
-----
      10.0.2.0/24    Direct  0    0             D    10.0.2.2           LoopBack0
      10.0.2.2/32    Direct  0    0             D    127.0.0.1          LoopBack0
      10.0.12.0/24   Direct  0    0             D    10.0.12.2          GigabitEthernet
0/0/1
      10.0.12.2/32   Direct  0    0             D    127.0.0.1          GigabitEthernet
0/0/1
      10.0.23.0/24   Direct  0    0             D    10.0.23.2          GigabitEthernet
0/0/2
      10.0.23.2/32   Direct  0    0             D    127.0.0.1          GigabitEthernet
0/0/2
      127.0.0.0/8     Direct  0    0             D    127.0.0.1          InLoopBack0
      127.0.0.1/32   Direct  0    0             D    127.0.0.1          InLoopBack0
```

Рисунок 4 – Связи роутера

5.) Настроил статические маршруты для второго роутера и вывел информацию. (Рисунок 5).

```
[R2]ip route-static 10.0.13.0 24 10.0.23.3
[R2]ip route-static 10.0.
Oct  4 2021 14:43:17-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 6, the ch
ange loop count is 0, and the maximum number of records is 4095.3.0 24 10.0.23.3

[R2]ip route-static 10.0.3.0 24 10.0.23.3
Error: The route already exists.
[R2]
Oct  4 2021 14:43:27-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 7, the ch
ange loop count is 0, and the maximum number of records is 4095.
[R2]quit
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 10         Routes : 10

Destination/Mask    Proto   Pre  Cost           Flags NextHop         Interface
-----
      10.0.2.0/24    Direct  0    0             D    10.0.2.2           LoopBack0
      10.0.2.2/32    Direct  0    0             D    127.0.0.1          LoopBack0
      10.0.3.0/24    Static  60    0            RD    10.0.23.3          GigabitEthernet
0/0/2
      10.0.12.0/24   Direct  0    0             D    10.0.12.2          GigabitEthernet
0/0/1
      10.0.12.2/32   Direct  0    0             D    127.0.0.1          GigabitEthernet
0/0/1
      10.0.13.0/24   Static  60    0            RD    10.0.23.3          GigabitEthernet
0/0/2
      10.0.23.0/24   Direct  0    0             D    10.0.23.2          GigabitEthernet
0/0/2
      10.0.23.2/32   Direct  0    0             D    127.0.0.1          GigabitEthernet
0/0/2
      127.0.0.0/8     Direct  0    0             D    127.0.0.1          InLoopBack0
      127.0.0.1/32   Direct  0    0             D    127.0.0.1          InLoopBack0
```

Рисунок 5 – Список маршрутов второго роутера

6.) Настроил запасные статические маршруты для роутера R2. (Рисунок 6).

```
[R2]ip route-static 10.0.3.0 24 10.0.13.3
[R2]ip route-static 10.0.3.0 24 10.0.13.
Oct  4 2021 14:48:17-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25
191.3.1 configurations have been changed. The current change number is 8, the c
ange loop count is 0, and the maximum number of records is 4095.
      ^
Error: Wrong parameter found at '^' position.
[R2]ip route-static 10.0.13.0 255.255.255.0 10.0.12.1 preference 80
[R2]ip route-static 10.0.13.0 255.255.255.0 10.0.12.1 pref
Oct  4 2021 14:49:07-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25
191.3.1 configurations have been changed. The current change number is 9, the c
ange loop count is 0, and the maximum number of records is 4095.
Error: The route already exists.
[R2]ip route-static 10.0.3.0 24 10.0.12.1 preference 80
[R2]ip route
Oct  4 2021 14:49:37-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25
191.3.1 configurations have been changed. The current change number is 10, the
hange loop count is 0, and the maximum number of records is 4095.
      ^
Error:Incomplete command found at '^' position.
[R2]ip route-static 10.0.12.0 24 10.0.13.1
```

Рисунок 6 – Назначение новых запасных маршрутов для роутера R2

7.) Вывел информацию о роутере R2 после внесенных изменений.

(Рисунок 7).

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.2.0/24	Direct	0	0	D	10.0.2.2	LoopBack0
10.0.2.2/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.3.0/24	Static	60	0	RD	10.0.23.3	GigabitEthernet
0/0/2	Static	60	0	RD	10.0.13.3	GigabitEthernet
0/0/2	Static	60	0	RD	10.0.13.3	GigabitEthernet
10.0.12.0/24	Direct	0	0	D	10.0.12.2	GigabitEthernet
0/0/1	Direct	0	0	D	127.0.0.1	GigabitEthernet
10.0.12.2/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/1	Direct	0	0	D	127.0.0.1	GigabitEthernet
10.0.13.0/24	Static	60	0	RD	10.0.23.3	GigabitEthernet
0/0/2	Static	60	0	RD	10.0.23.3	GigabitEthernet
10.0.23.0/24	Direct	0	0	D	10.0.23.2	GigabitEthernet
0/0/2	Direct	0	0	D	10.0.23.2	GigabitEthernet
10.0.23.2/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/2	Direct	0	0	D	127.0.0.1	GigabitEthernet
127.0.0.0/8	Direct	0	0	D	127.0.0.1	InLoopBack0
127.0.0.1/32	Direct	0	0	D	127.0.0.1	InLoopBack0

<R2> User interface con0 is available

Рисунок 7 – Подключения R2

8.) Проверил с помощью команд ping и tracert, всё работает корректно.
(Рисунок 8).

```
<R2>ping 10.0.13.3
PING 10.0.13.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=210 ms
  Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=30 ms
  Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=50 ms
  Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=30 ms
  Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=40 ms

--- 10.0.13.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 30/72/210 ms

<R2>ping 10.0.3.3
PING 10.0.3.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=255 time=30 ms
  Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=255 time=30 ms
  Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=255 time=20 ms
  Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=255 time=40 ms
  Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=255 time=50 ms

--- 10.0.3.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 20/34/50 ms

<R2>tracert 10.0.13.3

  traceroute to 10.0.13.3(10.0.13.3), max hops: 30 ,packet length: 40,press CTRL
_C to break

  1 10.0.23.3 110 ms 40 ms 50 ms
<R2>tracert 10.0.3.3

  traceroute to 10.0.3.3(10.0.3.3), max hops: 30 ,packet length: 40,press CTRL_C
to break

  1 10.0.23.3 30 ms 50 ms 50 ms
```

Рисунок 8 – Проверка с помощью команд ping и tracert

9.) Выключил G 0/0/2, вывел информацию по которой видно, что запасные маршруты взяли на себя задачи удаленного G0/0/2. (Рисунок 9)

```
[R2]interface GigabitEthernet0/0/2
[R2-GigabitEthernet0/0/2]shutdown
[R2-GigabitEthernet0/0/2]
Oct  4 2021 16:47:26-08:00 R2 %%01PHY/1/PHY(1)[2]:    GigabitEthernet0/0/2: chan
ge status to down
Oct  4 2021 16:47:26-08:00 R2 %%01IFNET/4/LINK_STATE(1)[3]:The line protocol IP
on the interface GigabitEthernet0/0/2 has entered the DOWN state.quit
[R2]quit
<R2>display
Oct  4 2021 16:47:34-08:00 R2 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 10, the c
hange loop count is 0, and the maximum number of records is 4095.ip-routing tabl
e
^
Error: Unrecognized command found at '^' position.
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 8          Routes : 8

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
-----
10.0.2.0/24         Direct   0    0              D    10.0.2.2           LoopBack0
10.0.2.2/32         Direct   0    0              D    127.0.0.1          LoopBack0
10.0.3.0/24         Static   80    0             RD    10.0.12.1          GigabitEthernet
0/0/1
10.0.12.0/24        Direct   0    0              D    10.0.12.2          GigabitEthernet
0/0/1
10.0.12.2/32        Direct   0    0              D    127.0.0.1          GigabitEthernet
0/0/1
10.0.13.0/24        Static   80    0             RD    10.0.12.1          GigabitEthernet
0/0/1
127.0.0.0/8         Direct   0    0              D    127.0.0.1          InLoopBack0
127.0.0.1/32        Direct   0    0              D    127.0.0.1          InLoopBack0
```

Рисунок 9 – Информация о маршрутах

С помощью команды ping проверяю выбранные IP адреса, все работает как надо. (Рисунок 10).

```
Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=254 time=60 ms
Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=254 time=50 ms
Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=254 time=80 ms
Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=254 time=40 ms

--- 10.0.3.3 ping statistics ---
 5 packet(s) transmitted
 5 packet(s) received
 0.00% packet loss
 round-trip min/avg/max = 40/78/160 ms

<R2>ping 10.0.13.3
 PING 10.0.13.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=254 time=100 ms
  Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=254 time=60 ms
  Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=254 time=50 ms
  Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=254 time=60 ms
  Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=254 time=80 ms

--- 10.0.13.3 ping statistics ---
 5 packet(s) transmitted
 5 packet(s) received
 0.00% packet loss
 round-trip min/avg/max = 50/70/100 ms

<R2>tracert 10.0.13.3

 traceroute to 10.0.13.3(10.0.13.3), max hops: 30 ,packet length: 40,press CTRL
_C to break
 1 10.0.12.1 90 ms 50 ms 30 ms
 2 10.0.13.3 60 ms 50 ms 60 ms
<R2>tracert 10.0.3.3

 traceroute to 10.0.3.3(10.0.3.3), max hops: 30 ,packet length: 40,press CTRL_C
to break
 1 10.0.12.1 70 ms 30 ms 40 ms
 2 10.0.13.3 80 ms 80 ms 60 ms
```

Рисунок 10 – Проверка с помощью команды ping

10.) Маршрут 10.0.23.3 недоступен для первого роутера, чтобы это исправить я использовал default маршруты. После этого все работает. (Рисунок 11).

```
<R1>system
Enter system view, return user view with Ctrl+Z.
[R1]ping 10.0.23.3
  PING 10.0.23.3: 56 data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

--- 10.0.23.3 ping statistics ---
  5 packet(s) transmitted
  0 packet(s) received
 100.00% packet loss

[R1]ip route-static 0.0.0.0 0.0.0.0 10.0.13.3
[R1]ping 10.0.23.3
  PING 10.0.23.3: 56 data bytes, press CTRL_C to break
    Reply from 10.0.23.3: bytes=56 Sequence=1 ttl=255 time=80 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=255 time=60 ms
    Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=255 time=50 ms
    Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=255 time=50 ms

--- 10.0.23.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
 round-trip min/avg/max = 30/54/80 ms
```

Рисунок 11 – Настройка default маршрута

11.) Настроил запасной default маршрут для первого роутера. (Рисунок 12).

```
[R1]ip route-static 0.0.0.0 0.0.0.0 10.0.12.2 preference 80
[R1]
Oct  4 2021 17:08:56-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 8, the ch
ange loop count is 0, and the maximum number of records is 4095.
[R1]quit
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
  Destinations : 10          Routes : 10

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
0/0/0               0.0.0.0/0 Static   60    0              RD   10.0.13.3          GigabitEthernet
10.0.1.0/24         Direct    0     0              D    10.0.1.1           LoopBack0
10.0.1.1/32         Direct    0     0              D    127.0.0.1          LoopBack0
10.0.3.0/24         Static    60    0              RD   10.0.13.3          GigabitEthernet
0/0/0               10.0.12.0/24 Direct    0     0              D    10.0.12.1          GigabitEthernet
0/0/1               10.0.12.1/32 Direct    0     0              D    127.0.0.1          GigabitEthernet
0/0/1               10.0.13.0/24 Direct    0     0              D    10.0.13.1          GigabitEthernet
0/0/0               10.0.13.1/32 Direct    0     0              D    127.0.0.1          GigabitEthernet
0/0/0               127.0.0.0/8 Direct    0     0              D    127.0.0.1          InLoopBack0
0/0/0               127.0.0.1/32 Direct    0     0              D    127.0.0.1          InLoopBack0
```

Рисунок 12 – Вывод списка маршрутов

12.) Проверил запасной маршрут, а после, отключил на роутерах R1 и R3 G0/0/0 и выводим информацию. (Рисунок 13).

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]shutdown
[R1-GigabitEthernet0/0/0]
Oct  4 2021 17:13:15-08:00 R1 %%01PHY/1/PHY(1)[4]:    GigabitEthernet0/0/0: change status to down
Oct  4 2021 17:13:15-08:00 R1 %%01IFNET/4/LINK_STATE(1)[5]:The line protocol IP on the interface GigabitEthernet0/0/0 has entered the DOWN state.
Oct  4 2021 17:13:16-08:00 R1 %%01RM/4/IPV4_DEFT_RT_CHG(1)[6]:IPV4 default Route is changed. (ChangeType=Delete,InstanceId=0,Protocol=Static,ExitIf=Unknown,Next hop=10.0.13.3,Neighbour=0.0.0.0,Preference=60,Label=NULL,Metric=0)
Oct  4 2021 17:13:16-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.191.3.1 configurations have been changed. The current change number is 9, the change loop count is 0, and the maximum number of records is 4095.quit
[R1]quit
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 7              Routes : 7

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
-----
0/0/1               0.0.0.0/0 Static   80    0             RD   10.0.12.2         GigabitEthernet
                   10.0.1.0/24 Direct   0     0             D    10.0.1.1         LoopBack0
                   10.0.1.1/32 Direct   0     0             D    127.0.0.1        LoopBack0
0/0/1               10.0.12.0/24 Direct   0     0             D    10.0.12.1        GigabitEthernet
0/0/1               10.0.12.1/32 Direct   0     0             D    127.0.0.1        GigabitEthernet
0/0/1               127.0.0.0/8 Direct   0     0             D    127.0.0.1        InLoopBack0
                   127.0.0.1/32 Direct   0     0             D    127.0.0.1        InLoopBack0
<R1>
```

Рисунок 13 – Вывод таблицы связей

13.) Проверил корректность работы с помощью команд ping и tracert.
(Рисунок 14).

```
<R1>ping 10.0.23.3
  PING 10.0.23.3: 56 data bytes, press CTRL_C to break
    Reply from 10.0.23.3: bytes=56 Sequence=1 ttl=254 time=160 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=254 time=50 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=254 time=80 ms
    Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=254 time=60 ms
    Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=254 time=60 ms

  --- 10.0.23.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 50/82/160 ms

<R1>tracert 10.0.23.3

  traceroute to 10.0.23.3(10.0.23.3), max hops: 30 ,packet length: 40,press CTRL
  _C to break

  1 10.0.12.2 30 ms 50 ms 50 ms
  2 10.0.23.3 70 ms 70 ms 70 ms
```

Рисунок 14 – Использование команд ping и tracert

Итоговый результат:

```
interface GigabitEthernet0/0/0
 shutdown
 ip address 10.0.13.1 255.255.255.0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.1 255.255.255.0
#
interface GigabitEthernet0/0/2
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
ip route-static 0.0.0.0 0.0.0.0 10.0.13.3
ip route-static 0.0.0.0 0.0.0.0 10.0.12.2 preference 80
ip route-static 10.0.3.0 255.255.255.0 10.0.13.3
#
user-interface con 0
```

Рисунок 15 – Роутер R1

```
#
Oct  4 2021 17:23:54-08:00 R2 %%01PHY/1/PHY(1)[0]:    GigabitEthernet0/0/1: chan
ge status to down
Oct  4 2021 17:23:54-08:00 R2 %%01IFNET/4/LINK_STATE(1)[1]:The line protocol IP
on the interface GigabitEthernet0/0/1 has entered the DOWN state.interface Seria
l0/0/3
 link-protocol ppp
#
interface GigabitEthernet0/0/0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0

Oct  4 2021 17:23:55-08:00 R2 %%01PHY/1/PHY(1)[2]:    GigabitEthernet0/0/1: chan
ge status to up
Oct  4 2021 17:23:55-08:00 R2 %%01IFNET/4/LINK_STATE(1)[3]:The line protocol IP
on the interface GigabitEthernet0/0/1 has entered the UP state.#
interface GigabitEthernet0/0/2
 ip address 10.0.23.2 255.255.255.0
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
#
ip route-static 10.0.3.0 255.255.255.0 10.0.23.3
ip route-static 10.0.3.0 255.255.255.0 10.0.12.1 preference 80
ip route-static 10.0.13.0 255.255.255.0 10.0.23.3
ip route-static 10.0.13.0 255.255.255.0 10.0.12.1 preference 80
#
user-interface con 0
```

Рисунок 16 – Роутер R2

```
interface GigabitEthernet0/0/0
 shutdown
 ip address 10.0.13.3 255.255.255.0
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
 ip address 10.0.23.3 255.255.255.0
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
#
ip route-static 10.0.12.0 255.255.255.0 10.0.13.1
ip route-static 10.0.12.0 255.255.255.0 10.0.23.2 preference 80
#
user-interface con 0
```

Рисунок 17 – Роутер R3

14.) Настроил OSPF для роутера R1 (аналогично для R2 и R3).

(Рисунок 1).

```
[R1]ospf 1 router-id 10.0.1.1
[R1-ospf-1]area 0
[R1-ospf-1-area-0.0.0.0]net
Oct  4 2021 18:05:06-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5
191.3.1 configurations have been changed. The current change number is 3, th
ange loop count is 0, and the maximum number of records is 4095.quit
^
Error: Unrecognized command found at '^' position.
[R1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.2
Oct  4 2021 18:05:36-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5
191.3.1 configurations have been changed. The current change number is 4, th
ange loop count is 0, and the maximum nu
[R1-ospf-1-area-0.0.0.0]network 10.0.13.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.12
Oct  4 2021 18:06:06-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5
191.3.1 configurations have been changed. The current change number is 5, th
ange loop count is 0, and the maximum number of records is 4095..0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
```

Рисунок 18 – Настроенный OSPF

15.) Проверил корректность ввода и посмотрел информацию о роутере R1 (аналогично для R2 и R3). (Рисунок 2)

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 10          Routes : 10

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
-----
10.0.1.0/24         Direct   0    0              D    10.0.1.1          LoopBack0
10.0.1.1/32         Direct   0    0              D    127.0.0.1          LoopBack0
10.0.2.2/32         OSPF     10    1              D    10.0.12.2          GigabitEthernet
0/0/1
10.0.3.3/32         OSPF     10    1              D    10.0.13.3          GigabitEthernet
0/0/0
10.0.12.0/24        Direct   0    0              D    10.0.12.1          GigabitEthernet
0/0/1
10.0.12.1/32        Direct   0    0              D    127.0.0.1          GigabitEthernet
0/0/1
10.0.13.0/24        Direct   0    0              D    10.0.13.1          GigabitEthernet
0/0/0
10.0.13.1/32        Direct   0    0              D    127.0.0.1          GigabitEthernet
0/0/0
127.0.0.0/8         Direct   0    0              D    127.0.0.1          InLoopBack0
127.0.0.1/32        Direct   0    0              D    127.0.0.1          InLoopBack0
<R1>
```

Рисунок 19 – Данные роутера R1

16.) Проверил связь между роутерами R2 и R1 с помощью команды ping (Рисунок 3).

```
<R2>ping 10.0.1.1
PING 10.0.1.1: 56 data bytes, press CTRL_C to break
  Reply from 10.0.1.1: bytes=56 Sequence=1 ttl=255 time=80 ms
  Reply from 10.0.1.1: bytes=56 Sequence=2 ttl=255 time=60 ms
  Reply from 10.0.1.1: bytes=56 Sequence=3 ttl=255 time=50 ms
  Reply from 10.0.1.1: bytes=56 Sequence=4 ttl=255 time=40 ms
  Reply from 10.0.1.1: bytes=56 Sequence=5 ttl=255 time=50 ms

--- 10.0.1.1 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 40/56/80 ms

<R2>ping 10.0.3.3
PING 10.0.3.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=254 time=50 ms
  Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=254 time=60 ms
  Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=254 time=80 ms
  Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=254 time=40 ms
  Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=254 time=80 ms

--- 10.0.3.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 40/62/80 ms
```

Рисунок 20 – ping между роутерами R1 и R2

17.) С помощью команды display ospf peer проверил статус соседей OSPF (Рисунок 4).

```
<R1>display ospf peer

      OSPF Process 1 with Router ID 10.0.1.1
        Neighbors

Area 0.0.0.0 interface 10.0.12.1(GigabitEthernet0/0/1)'s neighbors
Router ID: 10.0.2.2      Address: 10.0.12.2
  State: Full  Mode:Nbr is Master  Priority: 1
  DR: 10.0.12.2  BDR: 10.0.12.1  MTU: 0
  Dead timer due in 32 sec
  Retrans timer interval: 5
  Neighbor is up for 00:02:43
  Authentication Sequence: [ 0 ]

        Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors
Router ID: 10.0.3.3      Address: 10.0.13.3
  State: Full  Mode:Nbr is Master  Priority: 1
  DR: 10.0.13.1  BDR: 10.0.13.3  MTU: 0
  Dead timer due in 31 sec
  Retrans timer interval: 5
  Neighbor is up for 00:08:04
  Authentication Sequence: [ 0 ]
```

Рисунок 21 – Вывод display ospf peer

- 18.) С помощью команды `display ospf peer brief` посмотрел информацию о роутерах R2 и R3. (Рисунки 5-6).

```
<R2>display ospf peer brief

      OSPF Process 1 with Router ID 10.0.2.2
      Peer Statistic Information
-----
Area Id          Interface          Neighbor id      State
0.0.0.0          GigabitEthernet0/0/1  10.0.1.1        Full
-----
```

Рисунок 22 – Вывод `display ospf peer` для R2

```
<R3>display ospf peer brief

      OSPF Process 1 with Router ID 10.0.3.3
      Peer Statistic Information
-----
Area Id          Interface          Neighbor id      State
0.0.0.0          GigabitEthernet0/0/0  10.0.1.1        Full
-----
```

Рисунок 23 – Вывод `display ospf peer` для R3

- 19.) Изменили hello и dead интервалы на первом роутере. (Рисунок 7).

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ospf timer hello 15
[R1-GigabitEthernet0/0/0]ospf
Oct  5 2021 21:30:24-08:00 R1 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.191.3.1 configurations have been changed. The current change number is 11, the change loop count is 0, and the maximum number of records is 4095. q
Error: Unrecognized command found at '^' position.
[R1-GigabitEthernet0/0/0]ospf timer dead 60
[R1-GigabitEthernet0/0/0]
[R1-GigabitEthernet0/0/0]quit
[R1]quit
<R1>quit User interface con0 is available

Please Press ENTER.

<R1>display ospf interface GigabitEthernet 0/0/0

      OSPF Process 1 with Router ID 10.0.1.1
      Interfaces

Interface: 10.0.13.1 (GigabitEthernet0/0/0)
Cost: 1          State: DR          Type: Broadcast    MTU: 1500
Priority: 1
Designated Router: 10.0.13.1
Backup Designated Router: 10.0.13.3
Timers: Hello 15 , Dead 60 , Poll 120 , Retransmit 5 , Transmit Delay 1
<R1>
Oct  5 2021 21:31:22-08:00 R1 %%01OSPF/3/NBR_CHG_DOWN(1)[0]:Neighbor event:neighbor state changed to Down. (ProcessId=1, NeighborAddress=10.0.3.3, NeighborEvent=InactivityTimer, NeighborPreviousState=Full, NeighborCurrentState=Down)
Oct  5 2021 21:31:22-08:00 R1 %%01OSPF/3/NBR_DOWN_REASON(1)[1]:Neighbor state leaves full or changed to Down. (ProcessId=1, NeighborRouterId=10.0.3.3, NeighborAreaId=0, NeighborInterface=GigabitEthernet0/0/0,NeighborDownImmediate reason=Neighbor Down Due to Inactivity, NeighborDownPrimeReason=Interface Parameter Mismatch, NeighborChangeTime=2021-10-05 21:31:22-08:00)
```

Рисунок 24 – Настройка hello и dead

20.) После этого на рисунке 8 видно, что R1 потерял соседа R3, так как у них разные hello/dead интервалы. Чтобы это исправить я изменил интервалы у роутера R3. (Рисунки 8-9).

```
<R1>display ospf peer brief

      OSPF Process 1 with Router ID 10.0.1.1
      Peer Statistic Information
-----
Area Id          Interface          Neighbor id      State
0.0.0.0          GigabitEthernet0/0/1  10.0.2.2        Full
-----
```

Рисунок 25 – Интервалы роутера R3

```
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ospf timer hello 15
[R3-GigabitEthernet0/0/0]
Oct  5 2021 21:39:45-08:00 R3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.191.3.1 configurations have been changed. The current change number is 11, the change loop count is 0, and the maximum number of records is 4095.
Oct  5 2021 21:39:46-08:00 R3 %%01OSPF/4/NBR_CHANGE_E(1)[0]:Neighbor changes event: neighbor status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=HelloReceived, NeighborPreviousState=Down, NeighborCurrentState=Init)
[R3-GigabitEthernet0/0/0]ospf timer dead 60
[R3-GigabitEthernet0/0/0]
Oct  5 2021 21:40:01-08:00 R3 %%01OSPF/4/NBR_CHANGE_E(1)[1]:Neighbor changes event: neighbor status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=2WayReceived, NeighborPreviousState=Init, NeighborCurrentState=ExStart)
Oct  5 2021 21:40:01-08:00 R3 %%01OSPF/4/NBR_CHANGE_E(1)[2]:Neighbor changes event: neighbor status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=NegotiationDone, NeighborPreviousState=ExStart, NeighborCurrentState=Exchange)
Oct  5 2021 21:40:01-08:00 R3 %%01OSPF/4/NBR_CHANGE_E(1)[3]:Neighbor changes event: neighbor status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=ExchangeDone, NeighborPreviousState=Exchange, NeighborCurrentState=Loading)
Oct  5 2021 21:40:01-08:00 R3 %%01OSPF/4/NBR_CHANGE_E(1)[4]:Neighbor changes event: neighbor status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent>LoadingDone, NeighborPreviousState>Loading, NeighborCurrentState=Full)
```

Рисунок 26 – Интервалы роутера R3 ч.2

21.) Применил команду advertise к третьему роутеру и посмотрел, что изменилось на первом (аналогично для второго). На рисунке 12 видно изменения, произошедшие на третьем роутере. (Рисунки 10-12).

```
[R3]ip route-static 0.0.0.0 0.0.0.0 LoopBack 2
[R3]ospf 1
[R3-ospf-1]default
Oct  5 2021 21:44:25-08:00 R3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.191.3.1 configurations have been changed. The current change number is 12, the change loop count is 0, and the maximum number of records is 4095.
[R3-ospf-1]
```

Рисунок 27 – Применяем изменения на R3


```

<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 11          Routes : 11

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
0/0/0              0.0.0.0/0  O_ASE  150   1             D   10.0.13.3         GigabitEthernet
10.0.1.0/24        Direct    0     0             D   10.0.1.1          LoopBack0
10.0.1.1/32        Direct    0     0             D   127.0.0.1         LoopBack0
10.0.2.2/32        OSPF     10     1             D   10.0.12.2         GigabitEthernet
0/0/1              10.0.3.3/32 OSPF    10     1             D   10.0.13.3         GigabitEthernet
0/0/0              10.0.12.0/24 Direct    0     0             D   10.0.12.1         GigabitEthernet
0/0/1              10.0.12.1/32 Direct    0     0             D   127.0.0.1         GigabitEthernet
0/0/1              10.0.13.0/24 Direct    0     0             D   10.0.13.1         GigabitEthernet
0/0/0              10.0.13.1/32 Direct    0     0             D   127.0.0.1         GigabitEthernet
0/0/0              127.0.0.0/8 Direct    0     0             D   127.0.0.1         InLoopBack0
0/0/0              127.0.0.1/32 Direct    0     0             D   127.0.0.1         InLoopBack0

```

Рисунок 28 – Применяем изменения на R3

```

<R3>display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
      Destinations : 12          Routes : 12

Destination/Mask    Proto    Pre  Cost           Flags NextHop         Interface
0/0/0              0.0.0.0/0  Static   60     0             D   172.16.0.1        LoopBack2
10.0.1.1/32        OSPF     10     1             D   10.0.13.1         GigabitEthernet
0/0/0              10.0.2.2/32 OSPF     10     2             D   10.0.13.1         GigabitEthernet
0/0/0              10.0.3.0/24 Direct    0     0             D   10.0.3.3          LoopBack0
10.0.3.3/32        Direct    0     0             D   127.0.0.1         LoopBack0
10.0.12.0/24        OSPF     10     2             D   10.0.13.1         GigabitEthernet
0/0/0              10.0.13.0/24 Direct    0     0             D   10.0.13.3         GigabitEthernet
0/0/0              10.0.13.3/32 Direct    0     0             D   127.0.0.1         GigabitEthernet
0/0/0              127.0.0.0/8 Direct    0     0             D   127.0.0.1         InLoopBack0
127.0.0.1/32        Direct    0     0             D   127.0.0.1         InLoopBack0
172.16.0.0/24       Direct    0     0             D   172.16.0.1        LoopBack2
172.16.0.1/32       Direct    0     0             D   127.0.0.1         LoopBack2

```

Рисунок 29 – Изменения на R3

22.) Проверил связь между роутером R2 и LoopBack2 с помощью команды ping. (Рисунок 13).

```
<R2>ping 172.16.0.1
PING 172.16.0.1: 56 data bytes, press CTRL_C to break
Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=254 time=80 ms
Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=254 time=80 ms
Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=254 time=60 ms
Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=254 time=60 ms
Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=254 time=60 ms

--- 172.16.0.1 ping statistics ---
5 packet(s) transmitted
5 packet(s) received
0.00% packet loss
round-trip min/avg/max = 60/68/80 ms
```

Рисунок 30 – Работа команды ping

23.) Изменил приоритет для роутеров R1 и R3 с помощью команды drpriority. (Рисунки 14-15).

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ospf dr-priority 200
```

Рисунок 31 – drpriority R1

```
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ospf dr-priority 100
```

Рисунок 32 – drpriority R2

24.) Потушил и включил обратно G0/0/0 для первого и третьего роутера, вывел информацию о DR и BDR R1 и R3. (Рисунок 16)

```
<R1>display ospf peer 10.0.3.3

OSPF Process 1 with Router ID 10.0.1.1
Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors
Router ID: 10.0.3.3      Address: 10.0.13.3
State: Full  Mode:Nbr is Master  Priority: 100
DR: 10.0.13.1  BDR: 10.0.13.3  MTU: 0
Dead timer due in 55 sec
Retrans timer interval: 5
Neighbor is up for 00:00:19
Authentication Sequence: [ 0 ]
```

Рисунок 33 – Информация о DR и BDR R1 и R3

Итоговое состояние:

```
interface GigabitEthernet0/0/0
 ip address 10.0.13.1 255.255.255.0
 ospf dr-priority 200
 ospf timer hello 15
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.1 255.255.255.0
#
interface GigabitEthernet0/0/2
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
ospf 1 router-id 10.0.1.1
 area 0.0.0.0
  network 10.0.1.0 0.0.0.255
  network 10.0.13.0 0.0.0.255
  network 10.0.12.0 0.0.0.255
#
user-interface con 0
```

Рисунок 34 – R1

```
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
#
interface GigabitEthernet0/0/2
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
#
ospf 1 router-id 10.0.2.2
 area 0.0.0.0
  network 10.0.2.0 0.0.0.255
  network 10.0.12.0 0.0.0.255
#
user-interface con 0
user-interface vty 0 4
user-interface vty 16 20
#
```

Рисунок 35 – R2

```
interface GigabitEthernet0/0/0
 ip address 10.0.13.3 255.255.255.0
 ospf dr-priority 100
 ospf timer hello 15
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface GigabitEthernet0/0/3
#
wlan
#
interface NULL0
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
#
interface LoopBack2
 ip address 172.16.0.1 255.255.255.0
#
ospf 1 router-id 10.0.3.3
 default-route-advertise
 area 0.0.0.0
  network 10.0.3.0 0.0.0.255
  network 10.0.13.0 0.0.0.255
#
ip route-static 0.0.0.0 0.0.0.0 LoopBack2
#
user-interface con 0
```

Рисунок 36 – R3

Вывод: Я научился настраивать статические маршруты и IP адреса для роутеров используя консоль, а также, настраивать запасные маршруты в случае обрыва кабеля. Я научился пользоваться технологией OSPF, изменять hello и dead интервалы и менять приоритет для управления DR.