

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РФ

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ФАКУЛЬТЕТ ПРОГРАММНОЙ ИНЖЕНЕРИИ И КОМПЬЮТЕРНОЙ ТЕХНИКИ

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УНИВЕРСИТЕТ ИТМО

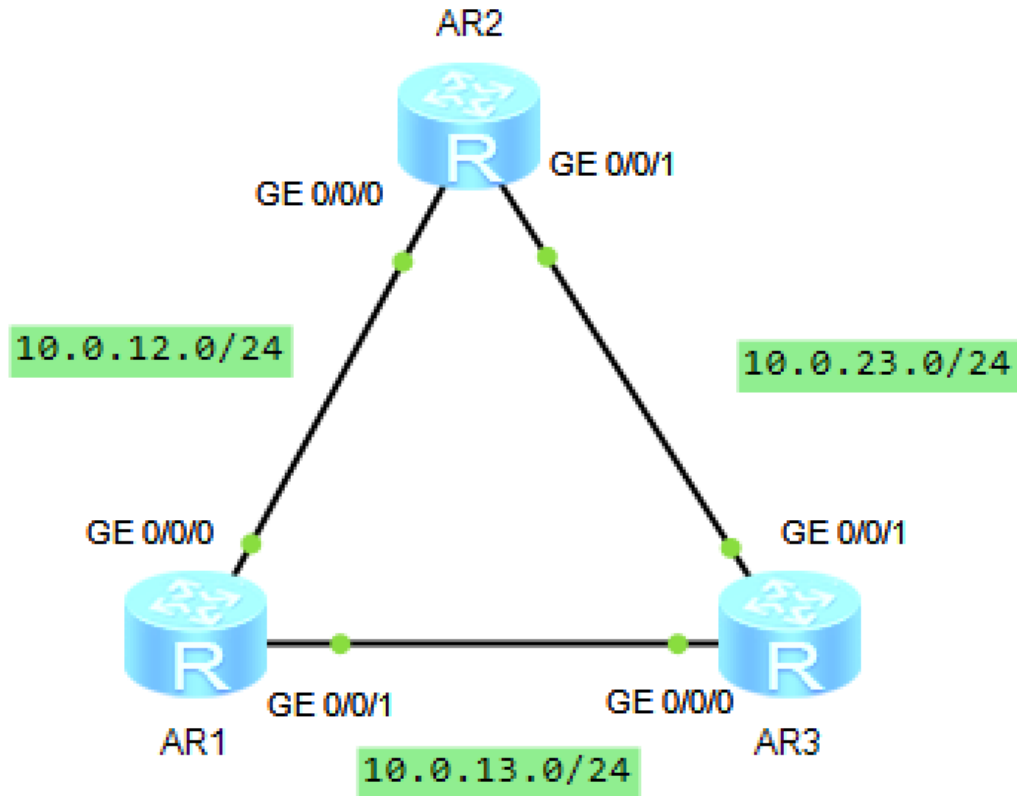
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Адресация и маршрутизация IPv4

Топология



Конфигурация

Настройка адресов для физических интерфейсов

R1:

```
<R1>system-view
Enter system view, return user view with Ctrl+Z.
[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.12.1 24
Sep 7 2024 17:23:00-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[0]:The
line protocol
IP on the interface GigabitEthernet0/0/0 has entered the UP state.
[R1-GigabitEthernet0/0/0]quit

[R1]interface GigabitEthernet0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.13.1 24
Sep 7 2024 17:26:56-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[1]:The
line protocol
IP on the interface GigabitEthernet0/0/1 has entered the UP state.
[R1-GigabitEthernet0/0/1]quit
```

```
[R1]display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 1
```

Interface	IP Address/Mask	Physical	Protocol
GigabitEthernet0/0/0	10.0.12.1/24	up	up
GigabitEthernet0/0/1	10.0.13.1/24	up	up
GigabitEthernet0/0/2	unassigned	down	down
NULL0	unassigned	up	

up(s)

R2:

```
<R2>system-view
Enter system view, return user view with Ctrl+Z.
[R2]interface GigabitEthernet0/0/0
[R2-GigabitEthernet0/0/0]ip address 10.0.12.2 24
Sep 7 2024 17:33:30-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[0]:The
line protocol
IP on the interface GigabitEthernet0/0/0 has entered the UP state.
[R2-GigabitEthernet0/0/0]quit

[R2]interface GigabitEthernet0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.23.2 24
Sep 7 2024 17:35:05-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[1]:The
line protocol
IP on the interface GigabitEthernet0/0/1 has entered the UP state.
[R2-GigabitEthernet0/0/1]quit
```

```
[R2]display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 1
```

Interface	IP Address/Mask	Physical	Protocol
GigabitEthernet0/0/0	10.0.12.2/24	up	up
GigabitEthernet0/0/1	10.0.23.2/24	up	up
GigabitEthernet0/0/2	unassigned	down	down

NULL0	unassigned	up
up(s)		

R3:

```

<R3>system-view
Enter system view, return user view with Ctrl+Z.
[R3]interface GigabitEthernet0/0/0
[R3-GigabitEthernet0/0/0]ip address 10.0.13.3 24
Sep  7 2024 17:39:15-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[0]:The
line protocol
  IP on the interface GigabitEthernet0/0/0 has entered the UP state.
[R3-GigabitEthernet0/0/0]quit

[R3]interface GigabitEthernet0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.23.1 24
Sep  7 2024 17:40:09-08:00 Huawei %%01IFNET/4/LINK_STATE(1)[1]:The
line protocol
  IP on the interface GigabitEthernet0/0/1 has entered the UP state.
[R3-GigabitEthernet0/0/1]quit

```

```

[R3]display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 1

Interface                IP Address/Mask      Physical
Protocol
GigabitEthernet0/0/0      10.0.13.3/24          up          up
GigabitEthernet0/0/1      10.0.23.1/24          up          up
GigabitEthernet0/0/2      unassigned            down        down
NULL0                    unassigned            up
up(s)

```

Маршрутизатор	Интерфейс	IP-адрес / маска
R1	GigabitEthernet0/0/0	int g0/0/0 ip ad 10.0.12.1 24
	GigabitEthernet0/0/1	int g0/0/2 ip ad 10.0.13.1 24
R2	GigabitEthernet0/0/0	int g0/0/0 ip ad 10.0.12.2 24
	GigabitEthernet0/0/1	int g0/0/1 ip ad 10.0.23.2 24
R3	GigabitEthernet0/0/0	int g0/0/1 ip ad 10.0.13.3 24
	GigabitEthernet0/0/1	int g0/0/2 ip ad 10.0.23.1 24

Проверка связи с помощью ping

R1-R2:

```
<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=110 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=10 ms
  Reply from 10.0.12.2: bytes=56 Sequence=4 ttl=255 time=10 ms
  Reply from 10.0.12.2: bytes=56 Sequence=5 ttl=255 time=30 ms

--- 10.0.12.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 10/38/110 ms
```

R1-R3:

```
<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=30 ms
  Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=20 ms
  Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=20 ms
  Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=20 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 = 20/24/30 ms
```

R2-R3:

```
<R2>ping 10.0.23.1
PING 10.0.23.1: 56 data bytes, press CTRL_C to break
  Reply from 10.0.23.1: bytes=56 Sequence=1 ttl=255 time=30 ms
  Reply from 10.0.23.1: bytes=56 Sequence=2 ttl=255 time=40 ms
  Reply from 10.0.23.1: bytes=56 Sequence=3 ttl=255 time=20 ms
  Reply from 10.0.23.1: bytes=56 Sequence=4 ttl=255 time=20 ms
  Reply from 10.0.23.1: bytes=56 Sequence=5 ttl=255 time=20 ms

--- 10.0.23.1 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 20/26/40 ms
```

Создание loopback-интерфейсов

R1:

```
[R1]interface LoopBack0
[R1-LoopBack0]ip address 10.0.1.1 32
```

R2:

```
[R2]interface LoopBack0
[R2-LoopBack0]ip address 10.0.1.2 32
```

R3:

```
[R3]interface LoopBack0
[R3-LoopBack0]ip address 10.0.1.3 32
```

Маршрутизатор	Интерфейс	IP-адрес / маска
R1	LoopBack0	int LoopBack0 ip ad 10.0.1.1 32
R2	LoopBack0	int LoopBack0 ip ad 10.0.1.2 32
R3	LoopBack0	int LoopBack0 ip ad 10.0.1.3 32

Таблица маршрутизации R1

```
<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
10.0.1.1/32 Direct  0    0             D   127.0.0.1      LoopBack0
10.0.12.0/24 Direct  0    0             D   10.0.12.1      GigabitEthernet
0/0/0
10.0.12.1/32 Direct  0    0             D   127.0.0.1      GigabitEthernet
0/0/0
10.0.12.255/32 Direct  0    0             D   127.0.0.1      GigabitEthernet
0/0/0
10.0.13.0/24 Direct  0    0             D   10.0.13.1      GigabitEthernet
0/0/1
10.0.13.1/32 Direct  0    0             D   127.0.0.1      GigabitEthernet
0/0/1
10.0.13.255/32 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
127.255.255.255/32 Direct  0    0             D   127.0.0.1      InLoopBack0
255.255.255.255/32 Direct  0    0             D   127.0.0.1      InLoopBack0
```

Проверка связи между loopback-интерфейсами

```
[R1]ping -a 10.0.1.1 10.0.1.2
PING 10.0.1.2: 56 data bytes, press CTRL_C to break
Request time out
Request time out
Request time out
Request time out
Request time out

--- 10.0.1.2 ping statistics ---
  packet(s) transmitted
    0 packet(s) received
 100.00% packet loss
```

Настройка статических маршрутов

```
[R1]ip route-static 10.0.1.2 32 10.0.12.2
[R1]ip route-static 10.0.1.3 32 10.0.13.3

[R2]ip route-static 10.0.1.1 32 10.0.12.1
[R2]ip route-static 10.0.1.3 32 10.0.23.1

[R3]ip route-static 10.0.1.1 32 10.0.13.1
[R3]ip route-static 10.0.1.2 32 10.0.23.2
```


Таблица маршрутизации R1

```
[R1]display ip routing-table
```

```
Route Flags: R - relay, D - download to fib
```

```
-----
```

```
Routing Tables: Public
```

```
Destinations : 13          Routes : 13
```

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.1.1/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.1.2/32	Static	60	0	RD	10.0.12.2	GigabitEthernet
0/0/0						
10.0.1.3/32	Static	60	0	RD	10.0.13.3	GigabitEthernet
0/0/1						
10.0.12.0/24	Direct	0	0	D	10.0.12.1	GigabitEthernet
0/0/0						
10.0.12.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.12.255/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.13.0/24	Direct	0	0	D	10.0.13.1	GigabitEthernet
0/0/1						
10.0.13.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/1						
10.0.13.255/32	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
127.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0
255.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0

Проверка связи между loopback-интерфейсами

```
[R1]ping -a 10.0.1.1 10.0.1.2
PING 10.0.1.2: 56 data bytes, press CTRL_C to break
  Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=255 time=30 ms
  Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=255 time=10 ms
  Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=255 time=30 ms
  Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=255 time=20 ms
  Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=255 time=20 ms

--- 10.0.1.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 10/22/30 ms
[R1]ping -a 10.0.1.1 10.0.1.3
PING 10.0.1.3: 56 data bytes, press CTRL_C to break
  Reply from 10.0.1.3: bytes=56 Sequence=1 ttl=255 time=30 ms
  Reply from 10.0.1.3: bytes=56 Sequence=2 ttl=255 time=20 ms
  Reply from 10.0.1.3: bytes=56 Sequence=3 ttl=255 time=30 ms
  Reply from 10.0.1.3: bytes=56 Sequence=4 ttl=255 time=20 ms
  Reply from 10.0.1.3: bytes=56 Sequence=5 ttl=255 time=30 ms

--- 10.0.1.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 20/26/30 ms
```

Настройка маршрута от R1 к R2 через R3 в качестве резервного маршрута от LoopBack0 R1 к LoopBack0 R2

Настройка статических маршрутов R1, R2

```
[R1]ip ro 10.0.1.2 32 10.0.13.3 preference 100
[R2]ip ro 10.0.1.1 32 10.0.23.1 preference 100
```

Таблица маршрутизации R1 (до выключения g0/0/0)

```
[R1]display ip routing-table
Route Flags: R - relay, D - download to fib
-----
Routing Tables: Public
Destinations : 13          Routes : 13
```

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.1.1/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.1.2/32	Static	60	0	RD	10.0.12.2	GigabitEthernet
0/0/0						
10.0.1.3/32	Static	60	0	RD	10.0.13.3	GigabitEthernet
0/0/1						
10.0.12.0/24	Direct	0	0	D	10.0.12.1	GigabitEthernet
0/0/0						
10.0.12.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.12.255/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.13.0/24	Direct	0	0	D	10.0.13.1	GigabitEthernet
0/0/1						
10.0.13.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/1						
10.0.13.255/32	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
127.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0
255.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0

Отключение интерфейса GigabitEthernet0/0/0 на маршрутизаторе R1

```
[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]shutdown
Sep  7 2024 19:06:12-08:00 R1 %%01IFPDT/4/IF_STATE(1)[0]:Interface GigabitEthern
et0/0/0 has turned into DOWN state.
```

Таблица маршрутизации R1 (после выключения g0/0/0)

```
[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
10.0.1.1/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.1.2/32	Static	100	0	RD	10.0.13.3	GigabitEthernet
0/0/1						
10.0.1.3/32	Static	60	0	RD	10.0.13.3	GigabitEthernet
0/0/1						
10.0.13.0/24	Direct	0	0	D	10.0.13.1	GigabitEthernet
0/0/1						
10.0.13.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet

```

0/0/1
  10.0.13.255/32 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
127.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0
255.255.255.255/32 Direct 0 0 D 127.0.0.1 InLoopBack0

```

Трассировка маршрута, по которому передаются пакеты с данными

```

[R1]tracert -a 10.0.1.1 10.0.1.2

traceroute to 10.0.1.2(10.0.1.2), max hops: 30 ,packet length: 40,press CTRL_C
to break

 1 10.0.13.3 40 ms 20 ms 20 ms

 2 10.0.23.2 40 ms 40 ms 10 ms

```

Настройка маршрутов по умолчанию для установления связи между интерфейсом LoopBack0 маршрутизатора R1 и LoopBack0 R2.

Включение интерфейсов и удаление настроенных маршрутов

```

[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]
[R1-GigabitEthernet0/0/0]undo shutdown
[R1-GigabitEthernet0/0/0]
Sep  7 2024 19:36:48-08:00 R1 %%01IFPDT/4/IF_STATE(1)[0]:Interface
GigabitEthernet
et0/0/0 has turned into UP state.
[R1-GigabitEthernet0/0/0]
Sep  7 2024 19:36:48-08:00 R1 %%01IFNET/4/LINK_STATE(1)[1]:The line
protocol IP
on the interface GigabitEthernet0/0/0 has entered the UP state

[R1]undo ip ro 10.0.1.2 32 10.0.12.2
[R1]undo ip ro 10.0.1.2 32 10.0.13.3

```

Таблица маршрутизации R1

```
[R1]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
10.0.1.1/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.1.3/32	Static	60	0	RD	10.0.13.3	GigabitEthernet
0/0/1						
10.0.12.0/24	Direct	0	0	D	10.0.12.1	GigabitEthernet
0/0/0						
10.0.12.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.12.255/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/0						
10.0.13.0/24	Direct	0	0	D	10.0.13.1	GigabitEthernet
0/0/1						
10.0.13.1/32	Direct	0	0	D	127.0.0.1	GigabitEthernet
0/0/1						
10.0.13.255/32	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
127.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0
255.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0

Настройка маршрута по умолчанию на R1

```
[R1]ip ro 0.0.0.0 0 10.0.12.2
```

Таблица маршрутизации R1

```
[R1]display ip routing-table
```

```
Route Flags: R - relay, D - download to fib
```

```
-----
```

```
-
```

```
Routing Tables: Public
```

```
Destinations : 13
```

```
Routes : 13
```

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
0.0.0.0/0	Static	60	0	RD	10.0.12.2	
GigabitEthernet						
0/0/0						
10.0.1.1/32	Direct	0	0	D	127.0.0.1	LoopBack0
10.0.1.3/32	Static	60	0	RD	10.0.13.3	
GigabitEthernet						
0/0/1						
10.0.12.0/24	Direct	0	0	D	10.0.12.1	
GigabitEthernet						
0/0/0						

10.0.12.1/32	Direct	0	0	D	127.0.0.1	
GigabitEthernet						
0/0/0						
10.0.12.255/32	Direct	0	0	D	127.0.0.1	
GigabitEthernet						
0/0/0						
10.0.13.0/24	Direct	0	0	D	10.0.13.1	
GigabitEthernet						
0/0/1						
10.0.13.1/32	Direct	0	0	D	127.0.0.1	
GigabitEthernet						
0/0/1						
10.0.13.255/32	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
127.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0
255.255.255.255/32	Direct	0	0	D	127.0.0.1	InLoopBack0

Проверка наличия связи между LoopBack0 маршрутизатора R1 и LoopBack0 маршрутизатора R2

```
[R1]ping -a 10.0.1.1 10.0.1.2
PING 10.0.1.2: 56 data bytes, press CTRL_C to break
  Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=255 time=60 ms
  Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=255 time=20 ms
  Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=255 time=20 ms
  Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=255 time=20 ms
  Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=255 time=20 ms

--- 10.0.1.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
           round-trip min/avg/max = 20/28/60 ms
```

Вывод

В ходе выполнения лабораторной работы я познакомился со средой eNSP и её настройкой, создал первую топологию и назначил адреса и статические маршруты.