# GRE-

GRE (. *Generic Routing Encapsulation* — ) — . — OSI IP-. GRE VPN 3- OSI. ESR GRE-, . .

| | | | |
|---|---|---|---|
| 1 | L3-, GRE-. | | |
| 2 | GRE- . | **esr(config)# tunnel gre <INDEX>** | <INDEX> – :<br>• ESR-10/12V(F)/14VF – [1..10];<br>• ESR-20/21/100/200 – [1..250];<br>• ESR-1000/1200/1500 /1511/1700/3100 – [1..500]. |
| 3 | VRF, GRE- ( ). | **esr(config-gre )# ip vrf forwarding <VRF>** | <VRF> – VRF, 31 . |
| 4 | ( ). | **esr(config-gre)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 5 | IP- . | **esr(config-gre)# local address <ADDR>** | <ADDR> – IP- , AAA.BBB.CCC.DDD, [0..255]. |
| | | **esr(config-gre)# local interface <IF>** | <IF> – , IP- . |
| 6 | IP- . | **esr(config-gre)# remote address <ADDR>** | <ADDR> – IP- , AAA.BBB.CCC.DDD, [0..255]. |
| 7 | GRE-. | **esr(config-gre)# mode <MODE>** | <MODE> – GRE-:<br>• **ip** – IP- GRE;<br>• **ethernet** – Ethernet- GRE.<br>: ip |
| 8 | IP- ( ip). | **esr(config-gre)# ip address <ADDR/LEN>** | <ADDR/LEN> – IP- AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32].<br>8 IP- .<br>IPv4- . IP-. |
| 9 | GRE- ( ethernet). | **esr(config-gre)# bridge-group <BRIDGE-ID>** | <BRIDGE-ID> – , :<br>• ESR-10/12V(F)/14VF – [1..50];<br>• ESR-20/21/100/200 – [1..250];<br>• ESR-1000/1200/1500 /1511/1700/3100 – [1..500] |
| 10 | GRE- firewall (. Firewall). | **esr(config-gre)# security-zone<NAME>** | <NAME> – , 12 . |
| | | **esr(config-gre)# ip firewall disable** | |

| | | | |
|---|---|---|---|
| 11 | MTU (MaximumTransmitionUnit) ( ). MTU 1500 "system jumbo-frames" | **esr(config-gre)# mtu <MTU>** | <MTU> – MTU, :<br>• ESR-10/12V(F)/14VF – [1280..9600];<br>• ESR-20/21 – [1280..9500];<br>• ESR-100/200/1000/1200/1500/1511/1700/3100 – [1280.. 10000].<br>: 1500. |
| 12 | TTL ( ). | **esr(config-gre)# ttl <TTL>** | <TTL> – TTL, [1..255].<br>: . |
| 13 | DSCP IP- ( ). | **esr(config-gre)# dscp <DSCP>** | <DSCP> – DSCP, [0..63].<br>: . |
| 14 | (Key) GRE ( RFC 2890) . . ( ). | **esr(config-gre)# key <KEY>** | <KEY> – KEY, [1..2000000].<br>: . |
| 15 | GRE- . . ( ) | **esr(config-gre)# local checksum** | |
| 16 | GRE-. . ( ) | **esr(config-gre)# remote checksum** | |
| 17 | ( ) | **esr(config-gre)# keepalive enable** | |
| 18 | keepalive ( ) | **esr(config-gre)# keepalive timeout <TIME>** | <TIME> – , [1..32767].<br>: 10 |
| 19 | ( ) | **esr(config-gre)# keepalive retries <VALUE>** | <VALUE> – , [1..255].<br>: 5 |
| 20 | IP- keepalive ( ethernet) | **esr(config-gre)# keepalive dst-address <ADDR>** | <ADDR> – IP- GRE-. |
| 21 | , ( ) | **esr(config-gre)# load-average <TIME>** | <TIME> – , [5..150].<br>: 5 |
| 22 | snmp-trap / . | **esr(config-gre)# snmp init-trap** | |
| 23 | IP- DHCP GRE- keepalive ( ) | **esr(config-gre)# keepalive dhcp dependent-interface <IF>** | <IF> – / , IP- DHCP |
| 24 | GRE- IP- /, keepalive dhcp dependent-interface ( ) | **esr(config-gre)# keepalive dhcp link-timeout <SEC>** | <SEC> – GRE- IP- DHCP |
| 25 | MSS (Maximum segment size) TCP- ( ). | **esr(config-gre)# ip tcp adjust-mss <MSS>** | <MSS> – MSS, [500..1460].<br>: 1460 |
| 26 | ( ). | **esr(config-gre)# history statistics** | |
| 27 | . | **esr(config-gre)# enable** | |

GRE- :

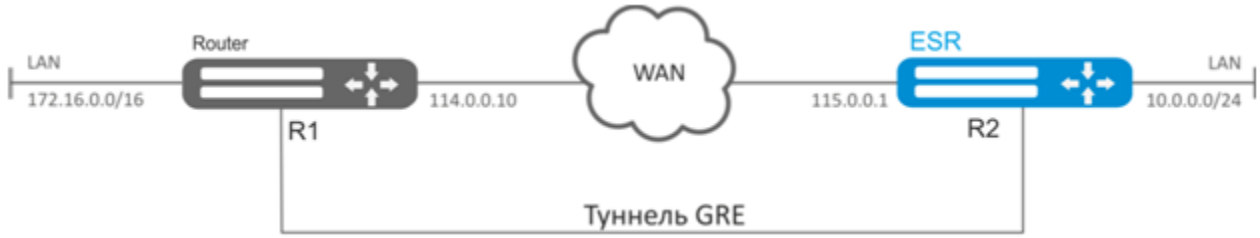
- QoS (. QoS);
- proxy (. HTTP/HTTPS-);
- (. Netflow sFlow);
- (. );
- BRAS (. BRAS (Broadband Remote Access Server));

## IP-GRE-

:

L3-VPN IP-, GRE.

- IP- 115.0.0.1;
- IP- 114.0.0.10;
- IP- 25.0.0.1/24.




:

WAN GRE , , WAN.

GRE 10:

```
esr(config)# tunnel gre 10
```

(IP- , WAN):

```
esr(config-gre)# local address 115.0.0.1
esr(config-gre)# remote address 114.0.0.10
```

IP- 25.0.0.1/24:

```
esr(config-gre)# ip address 25.0.0.1/24
```

, , firewall. :

```
esr(config-gre)# security-zone untrusted
```

**:**

```
esr(config-gre)# enable
esr(config-gre)# exit
```

. GRE:

```
esr(config)# ip route 172.16.0.0/16 tunnel gre 10
```

, GRE- .

GRE- :

- GRE :

  ```
  esr(config-gre)# local checksum
  ```

- GRE :

  ```
  esr(config-gre)# remote checksum
  ```

- :

  ```
  esr(config-gre)# key 15808
  ```

- DSCP, MTU, TTL:

```
esr(config-gre)# dscp 44
esr(config-gre)# mtu 1426
esr(config-gre)# ttl 18
```

- keepalive:

```
esr(config-gre)# keepalive enable
esr(config-gre)# keepalive timeout <TIME>
esr(config-gre)# keepalive retries <VALUE>
```

:

```
esr# show tunnels status gre 10
```

:

```
esr# show tunnels counters gre 10
```

:

```
esr# show tunnels configuration gre 10
```

IPv4-over-IPv4 .

**firewall GRE (47).**

## DMVPN

DMVPN (*Dynamic Multipoint Virtual Private Network*) — , . . DMVPN Hub-and-Spoke, VPN Spoke-to-Spoke Spoke-to-Hub . , , Hub.

, (NHC) IPsec- () (NBMA) NHRP- (NHS). NHC, , . , c .

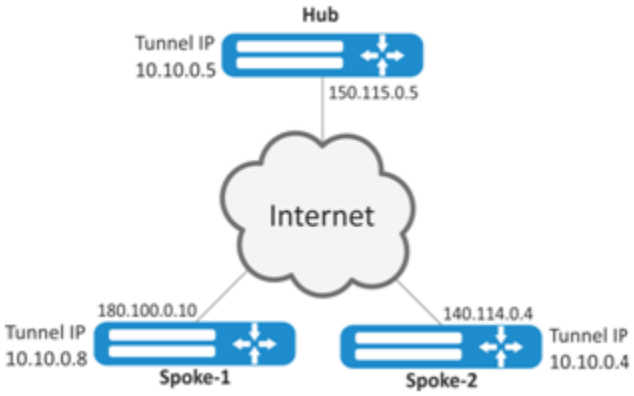
| | | | |
|---|---|---|---|
| 1 | “” IP-, . | | |
| 2 | IPsec- GRE-. | | . Policy-based IPsec VPN. |
| 2 | GRE- . | **esr(config)# tunnel gre <INDEX>** | <INDEX> – . |
| 3 | GRE- multipoint. | **esr(config-gre )# multipoint** | |
| 4 | NHRP ( ). | **esr(config-gre)# ip nhrp authentication <WORD>** | <WORD> – , [1..8] , [0-9a-fA-F]. |
| 5 | , NHS ( ). | **esr(config-gre)# ip nhrp holding-time <TIME>** | <TIME> – , , [1..65535].<br>: 7200 |
| 6 | «()» NHRP . | **esr(config-gre)# ip nhrp nhs <ADDR> [ no-registration ]** | <ADDR/LEN> – , AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32];<br>• **no-registration** — NHRP . |
| 7 | «» «» NBMA-. | **esr(config-gre)# ip nhrp map <ADDR> <ADDR>** | <ADDR> – IP- AAA.BBB.CCC.DDD, [0..255]. |
| 8 | . | **esr(config-gre)# ip nhrp multicast { dynamic \| nhs \| <ADDR> }** | • **dynamic** — , ;<br>• **nhs** — ;<br><ADDR> — , AAA.BBB.CCC.DDD, [0..255]. |

| | | | |
|---|---|---|---|
| 9 | NHRP Traffic Indication . NHS ( ). | **esr(config-gre)# ip nhrp redirect** | |
| 10 | . NHC( ). | **esr(config-gre)# ip nhrp shortcut** | |
| 11 | IPsec-VPN mGRE- ( ). | **esr(config-gre)# ip nhrp ipsec <WORD> { static \| dynamic }** | <WORD> – VPN, 31 ;<br>• **static** — , NHS;<br>• **dynamic** — , NHC. |
| 12 | NHRP. | **esr(config-gre)# ip nhrp enable** | |
| 13 | IP- . | | |
| - GRE- (. GRE-) | | | |

## 1

:

DMVPN , mGRE-, NHRP (Next Hop Resolution Protocol), (BGP), Ipsec. HUB . HUB – DMVPN c (NHS), – DMPVN (NHC).




Hub IP- — 150.115.0.5;

Spoke-1 IP- — 180.100.0.10;

Spoke-2 IP- — 140.114.0.4.

IPsec VPN:

IKE:

- -: 2;
- : AES128;
- : SHA1.

IPsec:

- : AES128;
- : SHA1.

:

1. Hub
   GRE:

```
esr# configure
esr(config)# tunnel gre 5
```

IP- , ISP:

```
esr(config-gre)# local address 150.115.0.5
```

MTU:

```
esr(config-gre)# mtu 1416
```

ttl:

```
esr(config-gre)# ttl 16
```

IP- GRE-:

```
esr(config-gre)# ip address 10.10.0.5/24
```

GRE- mutipoint :

```
esr(config-gre)# multipoint
```

NHRP. :

```
esr(config-gre)# ip nhrp multicast dynamic
```

Hub. BGP:

```
esr(config)# router bgp 65005
esr(config-bgp)# address-family ipv4
esr(config-bgp-af)# neighbor 10.10.0.8
esr(config-bgp-neighbor)# remote-as 65008
esr(config-bgp-neighbor)# enable
esr(config-bgp-neighbor)# exit
esr(config-bgp-af)# neighbor 10.10.0.4
esr(config-bgp-neighbor)# remote-as 65004
esr(config-bgp-neighbor)# enable
esr(config-bgp-neighbor)# exit
esr(config-bgp-af)# enable
```

IPsec Hub:

```
esr(config)# security ike proposal IKEPROP
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# exit
```

```
esr(config)# security ike policy IKEPOLICY
esr(config-ike-policy)# pre-shared-key ascii-text encrypted 8CB5107EA7005AFF
esr(config-ike-policy)# proposal IKEPROP
esr(config-ike-policy)# exit
```

```
esr(config)# security ike gateway IKEGW
esr(config-ike-gw)# ike-policy IKEPOLICY
esr(config-ike-gw)# local address 150.115.0.5
esr(config-ike-gw)# local network 150.115.0.5/32 protocol gre
esr(config-ike-gw)# remote address any
esr(config-ike-gw)# remote network any
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

```
esr(config)# security ipsec proposal IPSECPROP
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

```
esr(config)# security ipsec policy IPSECPOLICY
esr(config-ipsec-policy)# proposal IPSECPROP
esr(config-ipsec-policy)# exit
```

```
esr(config)# security ipsec vpn IPSECVPN
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway IKEGW
esr(config-ipsec-vpn)# ike ipsec-policy IPSECPOLICY
esr(config-ipsec-vpn)# enable
```

IPsec GRE-, :

```
esr(config-gre)# ip nhrp ipsec IPSECVPN dynamic
```

NHRP :

```
esr(config-gre)# ip nhrp enable
esr(config-gre)# enable
```

2. Spoke

DMVPN :

```
esr# configure
esr(config-gre)# tunnel gre 8
esr(config-gre)# mtu 1416
esr(config-gre)# ttl 16
esr(config-gre)# multipoint
esr(config-gre)# local address 180.100.0.10
esr(config-gre)# ip address 10.10.0.8/24
```

:

```
esr(config-gre)# ip nhrp holding-time 300
```

NHS:

```
esr(config-gre)# ip nhrp nhs 10.10.0.5/24
```

– :

```
esr(config-gre)# ip nhrp map 10.10.0.5 150.115.0.5
```

NHRP :

```
esr(config)# ip nhrp multicast nhs
```

BGP spoke:

```
esr(config)# router bgp 65008
esr(config-bgp)# address-family ipv4
esr(config-bgp-af)# neighbor 10.10.0.5
esr(config-bgp-neighbor)# remote-as 65005
esr(config-bgp-neighbor)# enable
esr(config-bgp-neighbor)# exit
esr(config-bgp-af)# enable
```

IPsec. IKE NHS, . A IKE NHC – any:

```
esr(config)# security ike proposal IKEPROP
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# exit
```

```
esr(config)# security ike policy IKEPOLICY
esr(config-ike-policy)# pre-shared-key ascii-text encrypted 8CB5107EA7005AFF
esr(config-ike-policy)# proposal IKEPROP
esr(config-ike-policy)# exit
```

```
esr(config)# security ike gateway IKEGW_HUB
esr(config-ike-gw)# ike-policy IKEPOLICY
esr(config-ike-gw)# local address 180.100.0.10
esr(config-ike-gw)# local network 180.100.0.10/32 protocol gre
esr(config-ike-gw)# remote address 150.115.0.5
esr(config-ike-gw)# remote network 150.115.0.5/32 protocol gre
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

```
esr(config)# security ike gateway IKEGW_SPOKE
esr(config-ike-gw)# ike-policy IKEPOLICY
esr(config-ike-gw)# local address 180.100.0.10
esr(config-ike-gw)# local network 180.100.0.10/32 protocol gre
esr(config-ike-gw)# remote address any
esr(config-ike-gw)# remote network any
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

```
esr(config)# security ipsec proposal IPSECPROP
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

```
esr(config)# security ipsec policy IPSECPOLICY
esr(config-ipsec-policy)# proposal IPSECPROP
esr(config-ipsec-policy)# exit
```

```
esr(config)# security ipsec vpn IPSECVPN_HUB
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway IKEGW_HUB
esr(config-ipsec-vpn)# ike ipsec-policy IPSECPOLICY
esr(config-ipsec-vpn)# enable
```

```
esr(config)# security ipsec vpn IPSECVPN_SPOKE
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway IKEGW_SPOKE
esr(config-ipsec-vpn)# ike ipsec-policy IPSECPOLICY
esr(config-ipsec-vpn)# enable
```

IPsec GRE-, :

```
esr(config-gre)# ip nhrp ipsec IPSECVPN_HUB static
esr(config-gre)# ip nhrp ipsec IPSECVPN_SPOKE dynamic
```

NHRP :

```
esr(config-gre)# ip nhrp enable
esr(config-gre)# enable
```

NHRP- :

```
esr# show ip nhrp
```

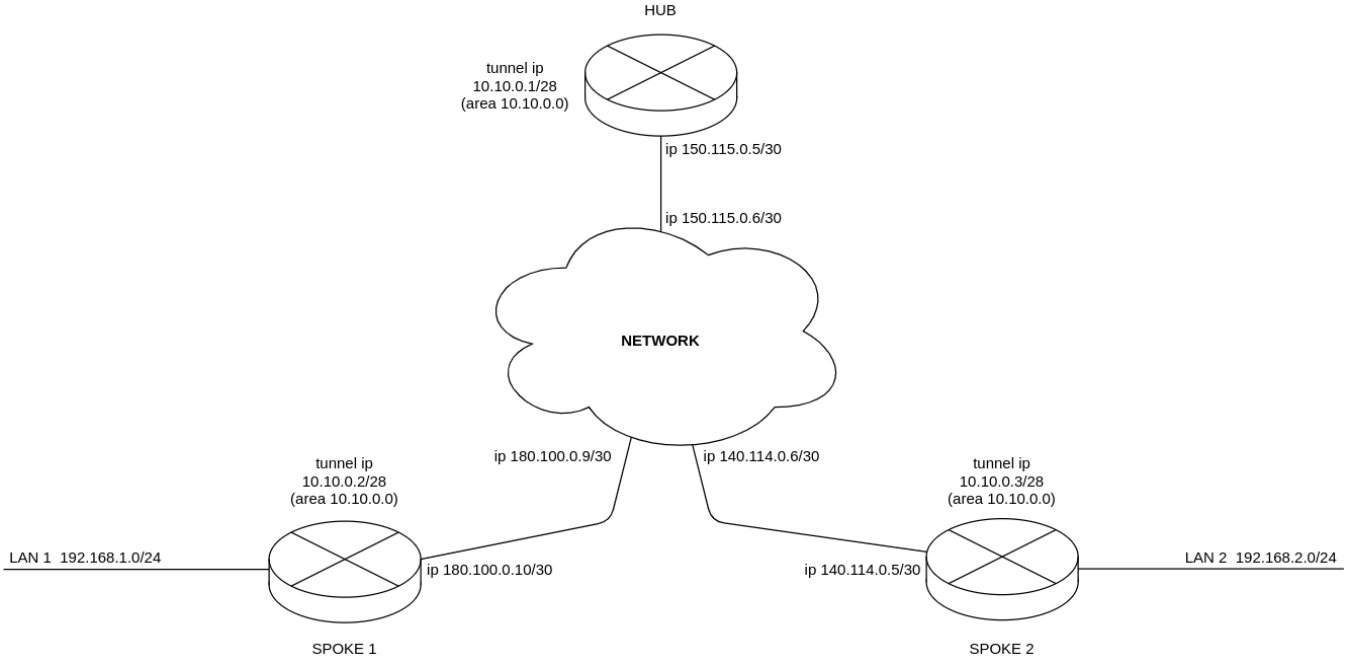
NHRP- :

```
esr# clear ip nhrp
```

## 2

:

DMVPN LAN1 LAN2, mGRE-, NHRP (Next Hop Resolution Protocol), (OSPF), IPsec. HUB- . HUB – DMVPN-c (NHS), – DMPVN- (NHC).




DMVPN , hub DR-. , spoke 1 spoke 2 hub.

Hub IP- — 150.115.0.5;
Spoke-1 IP- — 180.100.0.10;
Spoke-2 IP- — 140.114.0.4.

IPsec VPN:

IKE:

- -: 2;
- : AES128;
- : MD5.

IPsec:

- -: 2;
- : AES128;
- : MD5.

:

1. Hub
   OSPF.

```
esr(config)# router ospf log-adjacency-changes
esr(config)# router ospf 1
esr(config-ospf)# router-id 77.77.77.77
esr(config-ospf)# area 10.10.0.0
esr(config-ospf-area)# enable
esr(config-ospf-area)# exit
esr(config-ospf)# enable
esr(config-ospf)# exit
```

.

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# security-zone untrusted
esr(config-if-gi)# ip address 150.115.0.5/30
esr(config-if-gi)# exit
```

GRE-, , OSPF GRE-, NHRP NHRP enable. hub DR, .

```
esr(config)# tunnel gre 1
esr(config-gre)# ttl 16
esr(config-gre)# mtu 1416
esr(config-gre)# multipoint
esr(config-gre)# security-zone untrusted
esr(config-gre)# local address 150.115.0.5
esr(config-gre)# ip address 10.10.0.1/28
esr(config-gre)# ip ospf instance 1
esr(config-gre)# ip ospf area 10.10.0.0
esr(config-gre)# ip ospf priority 255
esr(config-gre)# ip ospf
esr(config-gre)# ip nhrp multicast dynamic
esr(config-gre)# ip nhrp enable
esr(config-gre)# enable
esr(config-gre)# exit
```

spoke 180.100.0.8/30 140.114.0.4/30.

```
esr(config)# ip route 180.100.0.8/30 150.115.0.6
esr(config)# ip route 140.114.0.4/30 150.115.0.6
```

IPsec Hub.

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# exit
```

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key ascii-text password
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

```
esr(config)# security ike gateway ike_spoke
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# local address 150.115.0.5
esr(config-ike-gw)# local network 150.115.0.5/32 protocol gre
esr(config-ike-gw)# remote address any
esr(config-ike-gw)# remote network any
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# pfs dh-group 2
esr(config-ipsec-proposal)# exit
```

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

```
esr(config)# security ipsec vpn ipsec_spoke
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_spoke
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
```

IPsec GRE-, .

```
esr(config)# tunnel gre 1
esr(config-gre)# ip nhrp ipsec ipsec_spoke dynamic
esr(config-gre)# exit
```

2. spoke1
   OSPF LAN1.

```
esr(config)# router ospf log-adjacency-changes
esr(config)# router ospf 1
esr(config-ospf)# router-id 1.1.1.1
esr(config-ospf)# area 10.10.0.0
esr(config-ospf-area)# network 192.168.1.0/24
esr(config-ospf-area)# enable
esr(config-ospf-area)# exit
esr(config-ospf)# enable
esr(config-ospf)# exit
```

.

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# security-zone untrusted
esr(config-if-gi)# ip address 180.100.0.10/30
esr(config-if-gi)# exit
```

GRE-, , OSPF GRE-, NHRP NHRP enable. hub DR, spoke.

```
esr(config)# tunnel gre 1
esr(config-gre)# ttl 16
esr(config-gre)# mtu 1416
esr(config-gre)# multipoint
esr(config-gre)# ip firewall disable
esr(config-gre)# local address 180.100.0.10
esr(config-gre)# ip address 10.10.0.2/28
esr(config-gre)# ip ospf instance 1
esr(config-gre)# ip ospf area 10.10.0.0
esr(config-gre)# ip ospf priority 0
esr(config-gre)# ip ospf
esr(config-gre)# ip nhrp holding-time 300
esr(config-gre)# ip nhrp map 10.10.0.1 150.115.0.5
esr(config-gre)# ip nhrp nhs 10.10.0.1/28
esr(config-gre)# ip nhrp multicast nhs
esr(config-gre)# ip nhrp enable
esr(config-gre)# enable
esr(config-gre)# exit
```

spoke 180.100.0.8/30 140.114.0.4/30.

```
esr(config)# ip route 150.115.0.4/30 180.100.0.9
esr(config)# ip route 140.114.0.4/30 180.100.0.9
```

IPsec Hub.

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# exit
```

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key ascii-text password
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

```
esr(config)# security ike gateway ike_spoke
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# local address 180.100.0.10
esr(config-ike-gw)# local network 180.100.0.10/32 protocol gre
esr(config-ike-gw)# remote address any
esr(config-ike-gw)# remote network any
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
esr(config)# security ike gateway ike_hub
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# local address 180.100.0.10
esr(config-ike-gw)# local network 180.100.0.10/32 protocol gre
esr(config-ike-gw)# remote address 150.115.0.5
esr(config-ike-gw)# remote network 150.115.0.5/32 protocol gre
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# pfs dh-group 2
esr(config-ipsec-proposal)# exit
```

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

```
esr(config)# security ipsec vpn ipsec_spoke
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_spoke
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
esr(config)# security ipsec vpn ipsec_hub
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_hub
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
```

IPsec GRE-, .

```
esr(config)# tunnel gre 1
esr(config-gre)# ip nhrp ipsec ipsec_hub static
esr(config-gre)# ip nhrp ipsec ipsec_spoke dynamic
esr(config-gre)# exit
```

3. NHRP- .

```
esr# show ip nhrp
```

4. security zone-pair untrusted self GRE over IPSec-.

```
esr(config)# security zone-pair untrusted self
esr(config-zone-pair)# rule 10
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol gre
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# rule 11
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol esp
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# rule 12
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol ah
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# exit
```

## L2TPv3-

L2TPv3 (Layer 2 Tunneling Protocol Version 3) — 2- OSI IP-. IP UDP. L2TPv3 MPLS P2P L2VPN (VLL) VPN L2. ESR L2TPv3-, .
.

| | | | |
|---|---|---|---|
| 1 | L3-, L2TPv3-. | | |

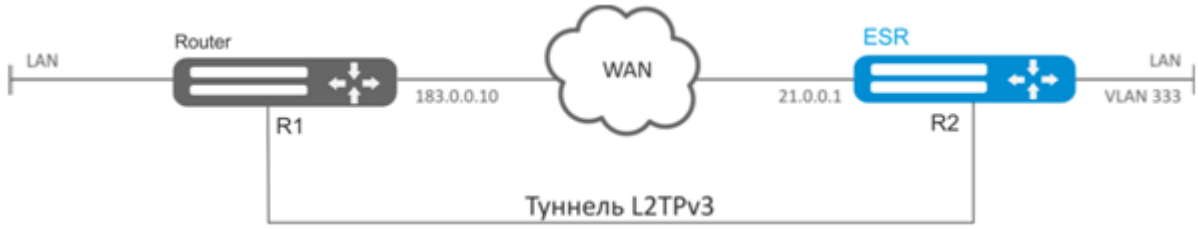
| | | | |
|---|---|---|---|
| 2 | L2TPv3- . | **esr(config)# tunnel l2tpv3 <INDEX>** | <INDEX> – :<br>• ESR-10/12V(F)/14VF – [1..10];<br>• ESR-20/21/100/200 – [1..250];<br>• ESR-1000/1200/1500 /1511/1700/3100 – [1..500]. |
| 3 | ( ). | **esr(config-l2tpv3)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 4 | IP- . | **esr(config-l2tpv3)# local address <ADDR>** | <ADDR> – IP- , AAA.BBB.CCC.DDD, [0..255]. |
| 5 | IP- . | **esr(config-l2tpv3)# remote address <ADDR>** | <ADDR> – IP- , AAA.BBB.CCC.DDD, [0..255]. |
| 6 | L2TPv3. | **esr(config-l2tpv3)# protocol <TYPE>** | <TYPE> – , :<br>• **ip** - IP-;<br>• **udp** - UDP-. |
| 7 | . | **esr(config-l2tpv3)# local session-id <SESSION-ID>** | <SESSION-ID> – , [1..200000]. |
| 8 | . | **esr(config-l2tpv3)# remote session-id <SESSION-ID>** | <SESSION-ID> – , [1..200000]. |
| 9 | UDP- ( UDP ). | **esr(config-l2tpv3)# local port <UDP>** | <UDP> – UDP- [1..65535]. |
| 10 | UDP- ( UDP ). | **esr(config-l2tpv3)# remote port <UDP>** | <UDP> – UDP- [1..65535]. |
| 11 | L2TPV3- . | **esr(config-l2tpv3)# bridge-group <BRIDGE-ID>** | <BRIDGE-ID> – , :<br>• ESR-10/12V(F)/14VF – [1..50];<br>• ESR-20/21/100/200 – [1..250];<br>• ESR-1000/1200/1500 – /1511/1700/3100 – [1..500] |
| 12 | . | **esr(config-l2tpv3)# enable** | |
| 13 | MTU (MaximumTransmitionUnit) ( ).<br>MTU 1500 "system jumbo-frames" | **esr(config-l2tpv3)# mtu <MTU>** | <MTU> – MTU, :<br>• ESR-10/12V(F)/14VF – [1280..9600];<br>• ESR-20/21 – [1280..9500];<br>• ESR-100/200/1000/1200/1500/1511/1700/3100 – [1280.. 10000].<br><br>: 1500. |
| 14 | cookie ( ). | **esr(config-l2tpv3)# local cookie <COOKIE>** | <COOKIE> – COOKIE, . |
| 15 | cookie ( ). | **esr(config-l2tpv3)# remote cookie <COOKIE>** | <COOKIE> – COOKIE, . |
| 16 | , ( ). | **esr(config-l2tpv3)# load-average <TIME>** | <TIME> – , [5..150].<br><br>: 5. |
| 17 | ( ). | **esr(config-subif)# history statistics** | |
| L2TPv3- :<br>• QoS (. QoS);<br>• BRAS (. BRAS (Broadband Remote Access Server)). | | | |

## L2TPv3-

:

L2 VPN IP-, L2TPv3.

- UDP, 519;
- IP- 21.0.0.1;
- IP- 183.0.0.10;
- 2, 3;
- 100, 200;
- bridge 333.




:

L2TPv3 333:

```
esr# configure
esr(config)# tunnel l2tpv3 333
```

(IP- , WAN):

```
esr(config-l2tpv3)# local address 21.0.0.1
esr(config-l2tpv3)# remote address 183.0.0.10
```

UDP-:

```
esr(config-l2tpv3)# protocol udp
esr(config-l2tpv3)# local port 519
esr(config-l2tpv3)# remote port 519
```

:

```
esr(config-l2tpv3)# local session-id 100
esr(config-l2tpv3)# remote session-id 200
```

L2TPv3- , ( bridge VLAN L2TPv3-):

```
esr(config-l2tpv3)# bridge-group 333
```

:

```
esr(config-l2tpv3)# enable
esr(config-l2tpv3)# exit
```

- , , VLAN id 333:

```
esr(config)# interface gi 1/0/2.333
```

- , ( PPP E1):

```
esr(config-subif)# bridge-group 333
esr(config-subif)# exit
```

, L2TPv3 .

. IP- 183.0.0.10. IP- 21.0.0.1. 519. 200, 100. , .

:

```
esr# show tunnels status l2tpv3 333
```

:

```
esr# show tunnels counters l2tpv3 333
```

:

```
esr# show tunnels configuration l2tpv3 333
```

**firewall UDP 519 519.**

## IPsec VPN

IPsec — , IP- . (), IP-, .

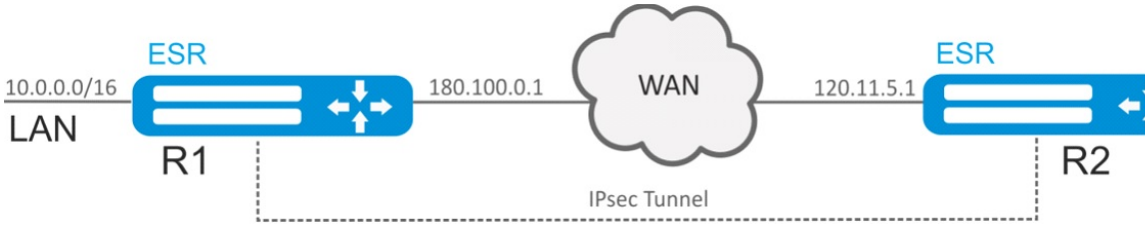
### Route-based IPsec VPN

| | | | |
|---|---|---|---|
| 1 | VTI- . | **esr(config)# tunnel vti <TUN>** | <TUN> – . |
| 2 | IP- VTI-. | **esr(config-vti)#local address <ADDR>** | <ADDR> – IP- . |
| 3 | IP- VTI-. | **esr(config-vti)#remote address <ADDR>** | <ADDR> – IP- . |
| 4 | IP- VTI- | **esr(config-vti)# ip address <ADDR /LEN>** | <ADDR/LEN> – IP- AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32]. |
| 5 | VTI- firewall VTI-. | **esr(config-vti)# security-zone<NAME>**<br>**esr(config-vti)# ip firewall disable** | <NAME> – , 12 . |
| 6 | . | **esr(config-vti)#enable** | |
| 7 | IKE- . | **esr(config)# security ike proposal <NAME>** | <NAME> – IKE, 31 . |
| 8 | IKE- ( ). | **esr(config-ike-proposal)# description<DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 9 | IKE ( ). | **esr(config-ike-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512.<br>: sha1 |
| 10 | IKE ( ). | **esr(config-ike-proposal)# encryption algorithm <ALGORITHM>** | <ALGORITHM> – , : des, 3des, blowfish128, blowfish192, blowfish256, aes128, aes192, aes256, aes128ctr, aes192ctr, aes256ctr, camellia128, camellia192, camellia256.<br>: 3des |
| 11 | - ( ) | **esr(config-ike-proposal)# dh-group <DH-GROUP>** | <DH-GROUP> – -, [1, 2, 5, 14, 15, 16, 17, 18].<br>: 1 |
| 12 | IKE ( ) | **esr(config-ike-proposal)# authentication method <METHOD>** | <METHOD> – . :<br>• **pre - shared - key** – , ;<br>• **rsa - public - key** – , RSA-.<br>: pre-shared-key |
| 13 | ike- . | **esr(config)# security ike policy <NAME>** | <NAME> – IKE, 31 . |
| 14 | IKE ( ). | **esr(config-ike-proposal)# lifetime seconds <SEC>** | <SEC> – , [4 ..86400] .<br>: 3600 |
| 15 | IKE- IKE-. | **esr(config-ike-policy)# proposal <NAME>** | <NAME> – IKE, 31 . |
| 16 | (, pre-shared-key) | **esr(config-ike-policy)# pre-shared-key ascii-text<TEXT>** | <TEXT> – [1..64] ASCII . |

| | | | |
|---|---|---|---|
| 17 | IKE- . | **esr(config)# security ike gateway <NAME>** | <NAME> – IKE, 31 . |
| 18 | IKE- IKE-. | **esr(config-ike-gw)# ike-policy <NAME>** | <NAME> – IKE, 31 . |
| 19 | IKE ( ). | **esr(config-ike-gw)# version <VERSION>** | <version> – IKE-: v1-only v2-only.<br><br>: v1-only |
| 20 | – route-based. | **esr(config-ike-gw)# mode route-based** | |
| 21 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection action <MODE>** | <MODE> – DPD:<br>• **restart** – ;<br>• **clear** – ;<br>• **hold** – ;<br>• **none** – , .<br><br>: none |
| 22 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection interval <SEC>** | <SEC> – DPD, [1..180] .<br><br>: 2 |
| 23 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection timeout <SEC>** | <SEC> – DPD, [1..180] .<br><br>: 30 |
| 24 | VTI- IKE-. | **esr(config-ike-gw)# bind-interface vti <VTI>** | <VTI> – VTI. |
| 25 | IPsec-. | **esr(config)# security ipsec proposal <NAME>** | <NAME> – IPsec, 31 . |
| 26 | IPsec ( ) | **esr(config-ipsec-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512.<br><br>: sha1 |
| 27 | IPsec ( ) | **esr(config-ipsec-proposal)# encryption algorithm <ALGORITHM>** | <ALGORITHM> – , : des, 3des, blowfish128, blowfish192, blowfish256, aes128, aes192, aes256, aes128ctr, aes192ctr, aes256ctr, camellia128, camellia192, camellia256.<br><br>: 3des |
| 28 | IPsec ( ). | **esr(config-ipsec-proposal)# protocol <PROTOCOL>** | <PROTOCOL> – ,<br><br>: esp |
| 29 | IPsec- . | **esr(config)# security ipsec policy <NAME>** | <NAME> – IPsec, 31 . |
| 30 | IPsec- IPsec- | **esr(config-ipsec-policy)# proposal <NAME>** | <NAME> – IPsec, 31 . |
| 31 | IPsec- ( ). | **esr(config-ipsec- policy)# lifetime { seconds <SEC> \|<br>packets <PACKETS> \| kilobytes <KB> }** | <SEC> – IPsec-, . [1140..86400] .<br><br><PACKETS> – , IPsec-. [4..86400].<br><br><KB> – , IPsec-. [4..86400] .<br><br>: 28800 |
| 32 | IPsec VPN . | **esr(config)# security ipsec vpn <NAME>** | <NAME> – VPN, 31 . |
| 33 | , VPN. | **esr(config-ipsec-vpn)# mode <MODE>** | <MODE> – VPN. |
| 34 | IPsec- IPsec-VPN. | **esr(config-ipsec-vpn)# ike ipsec-policy <NAME>** | <NAME> – IPsec-, 31 . |
| 35 | DSCP IP- IKE- ( ). | **esr(config-ipsec-vpn)# ike dscp <DSCP>** | DSCP> – DSCP, [0..63].<br><br>: 63 |
| 36 | VPN. | **esr(config-ipsec-vpn)# ike establish-tunnel <MODE>** | <MODE> – VPN:<br>• **by - request** – ;<br>• **route** – , ;<br>• **immediate** – . |
| 37 | IKE- IPsec-VPN. | **esr(config-ipsec-vpn)# ike gateway <NAME>** | <NAME> – IKE-, 31 . |
| 38 | , , SA ( ). | **esr(config-ipsec-vpn)# ike idle-time <TIME>** | <TIME> – , [4..86400]. |

| | | | |
|---|---|---|---|
| 39 | IKE- , ( ). | **esr(config-ipsec-vpn)# ike rekey disable** | |
| 40 | IKE- ( ). | **esr(config-ipsec-vpn)# ike rekey margin { seconds <SEC> \| packets <PACKETS> \| kilobytes <KB> }** | <SEC> – , ( lifetimeseconds, . 22.2.13). [4..86400].<br><PACKETS> – , ( lifetimepackets). [4..86400]<br><KB> – , ( lifetimekilobytes). [4..86400]<br>:<br>• – 540 .<br>• – . |
| 41 | margin seconds, margin packets, margin kilobytes ( ). | **esr(config-ipsec-vpn)# ike rekey randomization <VALUE>** | <VALUE> – , [1..100].<br>: 100% |
| 42 | IPsec-VPN ( ). | **esr(config-ipsec-vpn)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 43 | IPsec VPN. | **esr(config-ipsec-vpn)# enable** | |

## Route-based IPsec VPN




:

IPsec- R1 R2.

- R1 IP- – 120.11.5.1;
- R2 IP- – 180.100.0.1;

IKE:

- -: 2;
- : AES 128 bit;
- : MD5.

IP sec:

- : AES 128 bit;
- : MD5.

:

1. R1
   :

```
esr# configure
esr(config)# interface gi 1/0/1
esr(config-if-gi)# ip address 180.100.0.1/24
esr(config-if-gi)# security-zone untrusted
esr(config-if-gi)# exit
```

VTI. VTI IPsec-. IP- , WAN:

```
esr(config)# tunnel vti 1
esr(config-vti)# local address 180.100.0.1
esr(config-vti)# remote address 120.11.5.1
esr(config-vti)# enable
esr(config-vti)# exit
```

ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-object-group-service)# port-range 500
esr(config-object-group-service)# exit
```

LAN-. , IPsec-, VTI-:

```
esr(config)# ip route 192.0.2.0/24 tunnel vti 1
```

IKE. - 2, AES 128 bit, MD5. IKE-:

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# exit
```

IKE. IKE, :

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

IKE. VTI-, , :

```
esr(config)# security ike gateway ike_gw1
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# mode route-based
esr(config-ike-gw)# bind-interface vti 1
esr(config-ike-gw)# version v2-only
esr(config-ike-gw)# exit
```

IPsec-. AES 128 bit, MD5. IPsec-:

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

IPsec-. IPsec-, .

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, . *enable.*

```
esr(config)# security ipsec vpn ipsec1
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_gw1
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
esr(config)# exit
```

2. R2

:

```
esr# configure
esr(config)# interface gi 1/0/1
esr(config-if)# ip address 120.11.5.1/24
esr(config-if)# security-zone untrusted
esr(config-if)# exit
```

VTI.  VTI  IPsec-.  IP- ,  WAN:

```
esr(config)# tunnel vti 1
esr(config-vti)# remote address 180.100.0.1
esr(config-vti)# local address 120.11.5.1
esr(config-vti)# enable
esr(config-vti)# exit
```

ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-object-group-service)# port-range 500
esr(config-object-group-service)# exit
```

LAN-.  ,  IPsec-,  VTI-:

```
esr(config)# ip route 10.0.0.0/16 tunnel vti 1
```

IKE.  - 2,  AES 128 bit,  MD5.  IKE-:

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# exit
esr(config)#
```

IKE.  IKE,  :

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

IKE.  VTI-, ,  :

```
esr(config)# security ike gateway ike_gw1
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# mode route-based
esr(config-ike-gw)# bind-interface vti 1
esr(config-ike-gw)# version v2-only
esr(config-ike-gw)# exit
```

IPsec-.  AES 128 bit,  MD5.  IPsec-:

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

IPsec-.  IPsec-,  .

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, . *enable.*

```
esr(config)# security ipsec vpn ipsec1
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_gw1
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
esr(config)# exit
```

:

```
esr# show security ipsec vpn status ipsec1
```

:

```
esr# show security ipsec vpn configuration ipsec1
```

**firewall ESP ISAKMP (UDP- 500).**

## Policy-based IPsec VPN

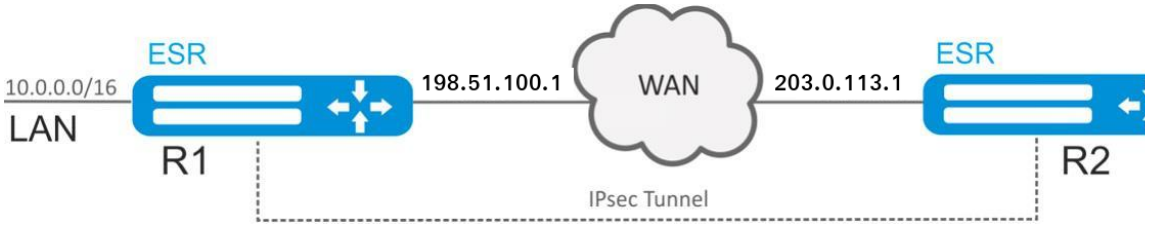
| | | | |
|---|---|---|---|
| 1 | IKE- . | **esr(config)# security ike proposal <NAME>** | <NAME> – IKE, 31 . |
| 2 | ( ). | **esr(config-ike-proposal)# description<DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 3 | IKE. | **esr(config-ike-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512. |
| 4 | IKE. | **esr(config-ike-proposal)# encryption algorithm <ALGORITHM>** | <ALGORITHM> – , : des, 3des, blowfish128, blowfish192, blowfish256, aes128, aes192, aes256, aes128ctr, aes192ctr, aes256ctr, camellia128, camellia192, camellia256. |
| 5 | -. | **esr(config-ike-proposal)# dh-group <DH-GROUP>** | <DH-GROUP> – -, [1, 2, 5, 14, 15, 16, 17, 18]. |
| 6 | . | **esr(config-ike-proposal)# authentication method <METHOD>** | <METHOD> – . :<br>• **pre - shared - key** – , ;<br>• **rsa - public - key** – , RSA-. |
| 7 | IKE . | **esr(config)# security ike policy <NAME>** | <NAME> – IKE, 31 . |
| 8 | IKE ( ). | **esr(config-ike-proposal)# lifetime seconds <SEC>** | <SEC> – , [4 ..86400] . |
| 9 | . | **esr(config-ike-policy)# proposal <NAME>** | <NAME> – IKE, 31 . |
| 10 | . | **esr(config-ike-policy)#pre-shared-key ascii-text<TEXT>** | <TEXT> – [1..64] ASCII . |
| 11 | IKE . | **esr(config)# security ike gateway <NAME>** | <NAME> – IKE, 31 . |
| 12 | IKE. | **esr(config-ike-gw)# ike-policy <NAME>** | <NAME> – IKE, 31 . |

| | | | |
|---|---|---|---|
| 13 | IKE ( ). | **esr(config-ike-gw)# version <VERSION>** | <version> – IKE-: **v1-only v2-only**. |
| 14 | . | **esr(config-ike-gw)#mode<MODE>** | <MODE> – , :<br>• **policy - based** – ;<br>• **route - based** – , . |
| 15 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection action <MODE>** | <MODE> – DPD:<br>• **restart** – ;<br>• **clear** – ;<br>• **hold** – ;<br>• **none** – , . |
| 16 | DPD ( ). | **esr(config-ike-gw)#dead-peer-detection interval <SEC>** | <SEC> – DPD, [1..180] . |
| 17 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection timeout <SEC>** | <SEC> – DPD, [1..180] . |
| 18 | IKE ( ). | **esr(config-ike-gw)# version <VERSION>** | <version> – IKE-: **v1-only v2-only**. |
| 19 | IP . | **esr(config-ike-gw)# local network <ADDR/LEN> [ protocol { <TYPE> \| <ID> } [ port <PORT> ] ]** | <ADDR/LEN> – IP- . AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32];<br><TYPE> – , : esp, icmp, ah, eigrp, ospf, igmp, ipip, tcp, pim, udp, vrrp, rdp, l2tp, gre;<br><ID> – IP-, [0x00-0xFF];<br><PORT> – TCP/UDP , [1..65535]. |
| 20 | IP- IPsec-. | **esr(config-ike-gw)#local address <ADDR>** | <ADDR> – IP- . |
| 21 | IP- IPsec-. | **esr(config-ike-gw)#remote address <ADDR>** | <ADDR> – IP- . |
| 22 | IP- , IP- . | **esr(config-ike-gw)# remote network <ADDR/LEN> [ protocol { <TYPE> \| <ID> } [ port <PORT> ] ]** | <ADDR/LEN> – IP- . AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32];<br><TYPE> – , : esp, icmp, ah, eigrp, ospf, igmp, ipip, tcp, pim, udp, vrrp, rdp, l2tp, gre;<br><ID> – IP-, [0x00-0xFF];<br><PORT> – TCP/UDP , [1..65535]. |
| 23 | IPsec. | **esr(config)# security ipsec proposal <NAME>** | <NAME> – IPsec, 31 . |
| 24 | IPsec. | **esr(config-ipsec-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512. |
| 26 | IPsec. | **esr(config-ipsec-proposal)# encryption algorithm <ALGORITHM>** | <ALGORITHM> – , : des, 3des, blowfish128, blowfish192, blowfish256, aes128, aes192, aes256, aes128ctr, aes192ctr, aes256ctr, camellia128, camellia192, camellia256. |
| 26 | ( ). | **esr(config-ipsec-proposal) #protocol <PROTOCOL>** | <PROTOCOL> – , |
| 27 | IPsec | **esr(config)# security ipsec policy <NAME>** | <NAME> – IPsec, 31 . |
| 28 | | **esr(config-ipsec-policy)# proposal <NAME>** | <NAME> – IPsec, 31 . |
| 29 | IPsec ( ). | **esr(config-ipsec-policy)# lifetime { seconds <SEC> \| packets <PACKETS> \| kilobytes <KB> }** | <SEC> – IPsec-, . [1140..86400] .<br><PACKETS> – , IPsec-. [4..86400].<br><KB> – , IPsec-. [4..86400] . |
| 30 | IPsec VPN . | **esr(config)# security ipsecvpn <NAME>** | <NAME> – VPN, 31 . |
| 31 | , VPN. | **esr(config-ipsec-vpn)# mode <MODE>** | <MODE> – VPN. |
| 32 | IPsec VPN. | **esr(config-ipsec-vpn)#ike ipsec-policy <NAME>** | <NAME> – IPsec-, 31 . |
| 33 | DSCP IP- IKE- ( ). | **esr(config-ipsec-vpn)#ike dscp <DSCP>** | DSCP> – DSCP, [0..63]. |

| | | | |
|---|---|---|---|
| 34 | VPN. | **esr(config-ipsec-vpn)#ike establish-tunnel <MODE>** | <MODE> – VPN:<br>• **by - request** – ;<br>• **route** – , ;<br>• **immediate** – . |
| 35 | IKE- VPN. | **esr(config-ipsec-vpn)# ike gateway <NAME>** | <NAME> – IKE-, 31 . |
| 36 | , , SA ( ). | **esr(config-ipsec-vpn)# ike idle-time <TIME>** | <TIME> – , [4..86400]. |
| 37 | IKE- , ( ). | **esr(config-ipsec-vpn)#ike rekey disable** | |
| 38 | IKE- ( ). | **esr(config-ipsec-vpn)# Ike rekey margin { seconds <SEC> \| packets <PACKETS> \| kilobytes <KB> }** | <SEC> – , ( lifetimeseconds) . [4..86400].<br><PACKETS> – , ( lifetimepackets). [4..86400].<br><KB> – , ( lifetimekilobytes). [4..86400] |
| 39 | marginseconds, marginpackets, marginkilobytes ( ). | **esr(config-ipsec-vpn)# ike rekey randomization <VALUE>** | <VALUE> – , [1..100]. |
| 40 | VPN ( ). | **esr(config-ipsec-vpn)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 41 | IPsec VPN. | **esr(config-ipsec-vpn)# enable** | |

## Policy-based IPsec VPN

:




IPsec- R1 R2.

R1 IP- – 198.51.100.1;

R2 IP- – 203.0.113.1;

IKE:

- -: 2;
- : AES 128 bit;
- : MD5.

IPsec:

- : AES 128 bit;
- : MD5.

:

1. R1

   :

```
esr# configure
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# ip address 198.51.100.1/24
esr(config-if-gi)# security-zone untrusted
esr(config-if-gi)# exit
```

   ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-object-group-service)# port-range 500
esr(config-object-group-service)# exit
```

IKE. - 2, AES 128 bit, MD5. IKE-:

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# exit
```

IKE. IKE, :

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

IKE. VTI-, , :

```
esr(config)# security ike gateway ike_gw1
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# local address 198.51.100.1
esr(config-ike-gw)# local network 10.0.0.0/16
esr(config-ike-gw)# remote address 203.0.113.1
esr(config-ike-gw)# remote network 192.0.2.0/24
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

IPsec-. AES 128 bit, MD5. IPsec-:

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

IPsec-. IPsec-, .

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, . *enable.*

```
esr(config)# security ipsec vpn ipsec1
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_gw1
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
esr(config)# exit
```

2. R2
   :

```
esr# configure
esr(config)# interface gi 1/0/1
esr(config-if)# ip address 203.0.113.1/24
esr(config-if)# security-zone untrusted
esr(config-if)# exit
```

ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-addr-set)# port-range 500
esr(config-addr-set)# exit
```

IKE. - 2, AES 128 bit, MD5. IKE-:

```
esr(config)# security ike proposal ike_prop1
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm md5
esr(config-ike-proposal)# encryption algorithm aes128
esr(config-ike-proposal)# exit
esr(config)#
```

IKE. IKE, :

```
esr(config)# security ike policy ike_pol1
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# proposal ike_prop1
esr(config-ike-policy)# exit
```

IKE. VTI-, , :

```
esr(config)# security ike gateway ike_gw1
esr(config-ike-gw)# ike-policy ike_pol1
esr(config-ike-gw)# remote address 198.51.100.1
esr(config-ike-gw)# remote network 10.0.0.0/16
esr(config-ike-gw)# local address 203.0.113.1
esr(config-ike-gw)# local network 192.0.2.0/24
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# exit
```

IPsec-. AES 128 bit, MD5. IPsec-:

```
esr(config)# security ipsec proposal ipsec_prop1
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

IPsec-. IPsec-, .

```
esr(config)# security ipsec policy ipsec_pol1
esr(config-ipsec-policy)# proposal ipsec_prop1
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, . *enable.*

```
esr(config)# security ipsec vpn ipsec1
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway ike_gw1
esr(config-ipsec-vpn)# ike ipsec-policy ipsec_pol1
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
esr(config)# exit
```

:

```
esr# show security ipsec vpn status ipsec1
```

:

```
esr# show security ipsec vpn configuration ipsec1
```

**firewall ESP ISAKMP (UDP- 500).**

## Remote Access IPsec VPN

Remote Access IPsec VPN – VPN-, IPsec VPN , .

RA IPsec VPN IPsec – Extended Authentication (XAUTH), - IPsec VPN.

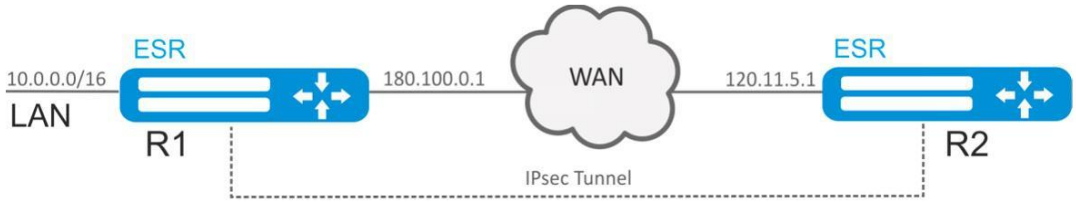
| | | | |
|---|---|---|---|
| 1 | IKE- . | **esr(config)# security ike proposal <NAME>** | <NAME> – IKE, 31 . |
| 2 | ( ). | **esr(config-ike-proposal)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 3 | IKE ( ). | **esr(config-ike-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512.<br>: sha1 |
| 4 | IP- VTI- ( ). | **esr(config-vti)# ip address <ADDR /LEN>** | <ADDR/LEN> – IP- AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..31]. |
| 5 | - ( ). | **esr(config-ike-proposal)# dh-group <DH-GROUP>** | <DH-GROUP> – -, [1, 2, 5, 14, 15, 16, 17, 18].<br>: 1 |
| 6 | IKE . | **esr(config)# security ike policy <NAME>** | <NAME> – IKE, 31 . |
| 7 | . | **esr(config-ike- policy)# authentication method <METHOD>** | <METHOD> – . :<br>• **xauth - psk - key** – , - . |
| 8 | ( ). | **esr(config-ike- policy)# authentication mode client** | |
| 9 | IKE ( ). | **esr(config-ike- policy)# lifetime seconds <SEC>** | <SEC> – , [4 ..86400] .<br>: 3600 |
| 10 | . | **esr(config-ike-policy)# proposal <NAME>** | <NAME> – IKE, 31 . |
| 11 | . | **esr(config-ike-policy)#pre-shared-key ascii-text <TEXT>** | <TEXT> – [1..64] ASCII . |
| 12 | . | **esr(config)# access profile <NAME>** | <NAME> – , 31 . |
| 13 | . | **esr(config-access-profile)# user <LOGIN>** | <LOGIN> – , 31 . |
| 14 | . | **esr(config-profile)# password ascii-text <TEXT>** | <TEXT> – [8..32] ASCII . |

| | | | |
|---|---|---|---|
| 15 | ( ). | **esr(config)# address-assignment pool <NAME>** | <NAME> – , 31 . |
| 16 | , IP ( ). | **esr(config-pool)# ip prefix <ADDR /LEN>** | <ADDR/LEN> – . |
| 17 | IKE . | **esr(config)# security ike gateway <NAME>** | <NAME> – IKE, 31 . |
| 18 | IKE. | **esr(config-ike-gw)# ike-policy <NAME>** | <NAME> – IKE, 31 . |
| 19 | . | **esr(config-ike-gw)# mode <MODE>** | <MODE> – , :<br>• **policy - based** – . |
| 20 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection action <MODE>** | <MODE> – DPD:<br>• **restart** – ;<br>• **clear** – ;<br>• **hold** – ;<br>• **none** – , .<br>: none |
| 21 | DPD ( ). | **esr(config-ike-gw)#dead-peer-detection interval <SEC>** | <SEC> – DPD, [1..180] .<br>: 2 |
| 22 | DPD ( ). | **esr(config-ike-gw)# dead-peer-detection timeout <SEC>** | <SEC> – DPD, [1..180] .<br>: 30 |
| 23 | IKE ( ). | **esr(config-ike-gw)# version <VERSION>** | <VERSION> – IKE-: **v1-only v2-only**.<br>: v1-only |
| 24 | IP ( ). | **esr(config-ike-gw)# local network <ADDR/LEN> [ protocol { <TYPE> \| <ID> } [ port <PORT> ] ]** | <ADDR/LEN> – IP- . AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32];<br><TYPE> – , : esp, icmp, ah, eigrp, ospf, igmp, ipip, tcp, pim, udp, vrrp, rdp, l2tp, gre;<br><ID> – IP-, [0x00-0xFF];<br><PORT> – TCP/UDP , [1..65535]. |
| 25 | IP- IPsec-. | **esr(config-ike-gw)#local address <ADDR>** | <ADDR> – IP- . |
| 26 | IP- IPsec-. | **esr(config-ike-gw)#remote address [any \| <ADDR/LEN> [ protocol { <TYPE> \| <ID> } [ port <PORT> ] ]** | Any – – , ;<br><ADDR/LEN> – IP- , . |
| 27 | IP- ( ). | **esr(config-ike-gw)# remote network dynamic pool <NAME>** | <NAME> – , 31 . |
| 28 | ( ). | **esr(config-ike-gw)# remote network dynamic client** | |
| 29 | XAUTH ( ). | **esr(config-ike-gw)# xauth access-profile <NAME>** | <NAME> – , 31 . |
| 30 | XAUTH ( ). | **esr(config-ike-gw)# xauth access-profile <NAME> client <LOGIN>** | <NAME> – , 31;<br><LOGIN> – , 31 . |
| 31 | IP IPsec VPN ( ). | **esr(config-ike-gw)# assign-interface loopback <INDEX>** | <INDEX> – , [1..65535]. |
| 32 | IPsec. | **esr(config)# security ipsec proposal <NAME>** | <NAME> – IPsec, 31 . |
| 33 | IPsec ( ). | **esr(config-ipsec-proposal)# authentication algorithm <ALGORITHM>** | <ALGORITHM> – , : md5, sha1, sha2-256, sha2384, sha2-512.<br>: sha1 |
| 34 | IPsec ( ). | **esr(config-ipsec-proposal)# encryption algorithm <ALGORITHM>** | <ALGORITHM> – , : des, 3des, blowfish128, blowfish192, blowfish256, aes128, aes192, aes256, aes128ctr, aes192ctr, aes256ctr, camellia128, camellia192, camellia256.<br>: 3des |
| 35 | ( ). | **esr(config-ipsec-proposal) #protocol <PROTOCOL>** | <PROTOCOL> – , :<br>• ah – , ;<br>• esp – .<br>: esp |

| | | | |
|---|---|---|---|
| 36 | config-ipsec-proposal | **esr(config)# security ipsec policy <NAME>** | <NAME> – IPsec, 31 . |
| 37 | | **esr(config-ipsec-policy)# proposal <NAME>** | <NAME> – IPsec, 31 . |
| 38 | IPsec ( ). | **esr(config-ipsec-policy)# lifetime { seconds <SEC> \| packets <PACKETS> \| kilobytes <KB> }** | <SEC> – IPsec-, .<br>[1140..86400] .<br>: 540<br><PACKETS> – , IPsec-.<br>[4..86400].<br>: .<br><KB> – , IPsec-. [4..86400] .<br>: . |
| 39 | IPsec VPN . | **esr(config)# security ipsec vpn <NAME>** | <NAME> – VPN, 31 . |
| 40 | , VPN. | **esr(config-ipsec-vpn)# mode <MODE>** | <MODE> – VPN, : ike, manual. |
| 41 | IPsec VPN. | **esr(config-ipsec-vpn)#ike ipsec-policy <NAME>** | <NAME> – IPsec-, 31 . |
| 42 | DSCP IP- IKE- ( ). | **esr(config-ipsec-vpn)#ike dscp <DSCP>** | DSCP> – DSCP, [0..63].<br>: 63 |
| 43 | VPN. | **esr(config-ipsec-vpn)#ike establish-tunnel <MODE>** | <MODE> – VPN:<br>• **by - request** – , ;<br>• **route** – , , ;<br>• **immediate** – , . |
| 44 | IKE- VPN. | **esr(config-ipsec-vpn)# ike gateway <NAME>** | <NAME> – IKE-, 31 . |
| 45 | , , SA ( ). | **esr(config-ipsec-vpn)# ike idle-time <TIME>** | <TIME> – , [4..86400].<br>: 0 |
| 46 | IKE- , ( ). | **esr(config-ipsec-vpn)#ike rekey disable** | : . |
| 47 | IKE- ( ). | **esr(config-ipsec-vpn)# ike rekey margin { seconds <SEC> \| packets <PACKETS> \| kilobytes <KB> }** | <SEC> – , ( lifetimeseconds) . [4..86400].<br>: 540<br><PACKETS> – , ( lifetimepackets). [4..86400].<br>: .<br><KB> – , ( lifetimekilobytes). [4..86400]<br>: . |
| 48 | marginseconds, marginpackets, marginkilobytes ( ). | **esr(config-ipsec-vpn)# ike rekey randomization <VALUE>** | <VALUE> – , [1..100].<br>: 100 |
| 49 | VPN ( ). | **esr(config-ipsec-vpn)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 50 | IPsec VPN. | **esr(config-ipsec-vpn)# enable** | |
| 51 | - XAUTH / ( ) ( ). | **esr(config-ipsec-vpn)# security ike session uniqueids <MODE>** | <MODE> – -, :<br>• no - XAUTH , XAUTH "INITIAL_CONTACT", IP-. , XAUTH . XAUTH IP-.<br>• never - XAUTH . XAUTH IP-. "INITIAL_CONTACT" .<br>• replace - XAUTH . XAUTH IP-.<br>• keep - XAUTH . XAUTH . |

## Remote Access IPsec VPN

:




Remote Access IPsec VPN R1 R2 IPsec - XAUTH. IPsec VPN R1, R2 IPsec VPN.

R2 IP- – 120.11.5.1;

R1 IP- – 180.100.0.1;

IPsec VPN:

- 192.0.2.0/24
- LAN 10.0.0.0/16

IKE:

- -: 2;
- : 3DES;
- : SHA1.

IPsec:

- : 3DES;
- : SHA1.

XAUTH:

- : client1;
- : password123.

:

1. R1
   :

```
esr# configure
esr(config)# security zone untrusted
esr(config-zone)# exit
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# security-zone untrusted
esr(config-if-gi)# ip address 180.100.0.1/24
esr(config-if-gi)# exit
```

ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-object-group-service)# port-range 500,4500
esr(config-object-group-service)# exit
```

IKE. - 2, 3 DES, SHA1. IKE-:

```
esr(config)# security ike proposal IKEPROP
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm sha1
esr(config-ike-proposal)# encryption algorithm 3des
esr(config-ike-proposal)# exit
```

IKE. IKE, , XAUTH :

```
esr(config)# security ike policy IKEPOLICY
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# authentication method xauth-psk-key
esr(config-ike-policy)# proposal IKEPROP
esr(config-ike-policy)# exit
```

IPsec VPN:

```
esr(config)# access profile XAUTH
esr(config-access-profile)# user client1
esr(config-profile)# password ascii-text password123
esr(config-profile)# exit
esr(config-access-profile)# exit
```

, IP IPsec VPN:

```
esr-1000(config)# address-assignment pool CLIENT_POOL
esr-1000(config-pool)# ip prefix 192.0.2.0/24
esr-1000(config-pool)# exit
```

IKE. IKE, , , XAUTH:

```
esr(config)# security ike gateway IKEGW
esr(config-ike-gw)# ike-policy IKEPOLICY
esr(config-ike-gw)# local address 180.100.0.1
esr(config-ike-gw)# local network 10.0.0.0/16
esr(config-ike-gw)# remote address any
esr(config-ike-gw)# remote network dynamic pool CLIENT_POOL
esr(config-ike-gw)# dead-peer-detection action clear
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# xauth access-profile XAUTH
esr(config-ike-gw)# exit
```

IPsec-. 3DES, SHA1. IPsec-:

```
esr(config)# security ipsec proposal IPSECPROP
esr(config-ipsec-proposal)# authentication algorithm sha1
esr(config-ipsec-proposal)# encryption algorithm 3des
esr(config-ipsec-proposal)# exit
```

IPsec-. IPsec-, .

```
esr(config)# security ipsec policy IPSECPOLICY
esr(config-ipsec-policy)# proposal IPSECPROP
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, IPsec – *by-request*. *enable.*

```
esr(config)# security ipsec IPSECVPN
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel by-request
esr(config-ipsec-vpn)# ike gateway IKEGW
esr(config-ipsec-vpn)# ike ipsec-policy IPSECPOLICY
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
```

esp udp 500, 4500 firewall IPsec VPN:

```
esr(config)# security zone-pair untrusted self
esr(config-zone-pair)# rule 1
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol udp
esr(config-zone-pair-rule)# match destination-port ISAKMP
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)#   rule 2
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol esp
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# end
```

2. R2
   :

```
esr# configure
esr(config)# interface gi 1/0/1
esr(config-if)# ip address 120.11.5.1/24
esr(config-if)# security-zone untrusted
esr(config-if)# exit
```

ISAKMP:

```
esr(config)# object-group service ISAKMP
esr(config-addr-set)# port-range 500,4500
esr(config-addr-set)# exit
```

IKE. - 2, 3 DES, SHA1. IKE-:

```
esr(config)# security ike proposal IKEPROP
esr(config-ike-proposal)# dh-group 2
esr(config-ike-proposal)# authentication algorithm sha1
esr(config-ike-proposal)# encryption algorithm 3des
esr(config-ike-proposal)# exit
```

IKE. IKE, , , XAUTH – :

```
esr(config)# security ike policy IKEPOLICY
esr(config-ike-policy)# pre-shared-key hexadecimal 123FFF
esr(config-ike-policy)# authentication method xauth-psk-key
esr(config-ike-policy)# authentication mode client
esr(config-ike-policy)# proposal IKEPROP
esr(config-ike-policy)# exit
```

:

```
esr(config)# access profile XAUTH
esr(config-access-profile)# user client1
esr(config-profile)# password ascii-text password123
esr(config-profile)# exit
esr(config-access-profile)# exit
```

loopback IP , IPsec VPN :

```
esr(config)# interface loopback 8
esr(config-loopback)# exit
```

IKE. , , , XAUTH :

```
esr(config)# security ike gateway IKEGW
esr(config-ike-gw)# ike-policy IKEPOLICY
esr(config-ike-gw)# assign-interface loopback 8
esr(config-ike-gw)# local address 120.11.5.1
esr(config-ike-gw)# remote address 180.100.0.1
esr(config-ike-gw)# remote network dynamic client
esr(config-ike-gw)# mode policy-based
esr(config-ike-gw)# xauth access-profile xauth client client1
esr(config-ike-gw)# exit
```

IPsec-. 3DES, SHA1. IPsec-:

```
esr(config)# security ipsec proposal IPSECPROP
esr(config-ipsec-proposal)# authentication algorithm md5
esr(config-ipsec-proposal)# encryption algorithm aes128
esr(config-ipsec-proposal)# exit
```

IPsec-. IPsec-, .

```
esr(config)# security ipsec policy IPSECPOLICY
esr(config-ipsec-policy)# proposal IPSECPROP
esr(config-ipsec-policy)# exit
```

IPsec VPN. VPN IKE-, IP sec-, . *enable.*

```
esr(config)# security ipsec vpn IPSECVPN
esr(config-ipsec-vpn)# mode ike
esr(config-ipsec-vpn)# ike establish-tunnel route
esr(config-ipsec-vpn)# ike gateway IKEGW
esr(config-ipsec-vpn)# ike ipsec-policy IPSECPOLICY
esr(config-ipsec-vpn)# enable
esr(config-ipsec-vpn)# exit
```

esp udp 500,4500 firewall IPsec VPN:

```
esr(config)# security zone-pair untrusted self
esr(config-zone-pair)# rule 1
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol udp
esr(config-zone-pair-rule)# match destination-port ISAKMP
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)#   rule 2
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# match protocol esp
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# end
```

:

```
esr# show security ipsec vpn status IPSECVPN
```

:

```
esr# show security ipsec vpn configuration IPSECVPN
```

**firewall ESP ISAKMP (UDP- 500, 4500).**

# LT-

LT (. Logical Tunnel – ) – , (VRF Lite), . LT- VRF firewall.

| | | | |
|---|---|---|---|
| 1 | LT- VRF. | **esr(config)# tunnel lt <ID>** | <ID> – [1..128]. |
| 2 | ( ). | **esr(config-lt)# description <DESCRIPTION>** | <DESCRIPTION> – , 255 . |
| 3 | LT- VFR. | **esr(config-lt)# ip vrf forwarding <VRF>** | <VRF> – VRF, 31 . |
| 4 | LT- firewall LT-. | **esr(config-lt)# security-zone<NAME>** | <NAME> – , 12 . |
| | | **esr(config-lt)# ip firewall disable** | |
| 5 | LT- LT ( VRF). | **esr(config-lt)# peer lt <ID>** | <ID> – [1..128]. |
| 6 | LT- IP- . LT-, IP- IP-. | **esr(config-lt)# ip address <ADDR /LEN>** | <ADDR/LEN> – IP- , AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32]. |
| 7 | . | **esr(config-lt)# enable** | |
| 8 | VRF LT-. | | |
| 9 | , ( ) | **esr(config-lt)# load-average <TIME>** | <TIME> – , [5..150].<br>: 5 |
| 10 | MTU (Maximum Transmition Unit) , bridge ( ; , bridge VLAN).<br>MTU 1500 "system jumbo-frames" | **esr(config-lt)# mtu <MTU>** | <MTU> – MTU, :<br>• ESR-10/12V(F)/14VF – [1280..9600];<br>• ESR-20/21 – [1280..9500];<br>• ESR-100/200/1000/1200/1500/1511/1700/3100 – [1280.. 10000].<br>: 1500. |

:

, VRF vrf_1 vrf_2.

:

```
hostname esr
ip vrf vrf_1
exit
ip vrf vrf_2
exit
interface gigabitethernet 1/0/1
  ip vrf forwarding vrf_1
  ip firewall disable
  ip address 10.0.0.1/24
exit
interface gigabitethernet 1/0/2
  ip vrf forwarding vrf_2
  ip firewall disable
  ip address 10.0.1.1/24
exit
```

:

LT- VRF IP- :

```
esr(config)# tunnel lt 1
esr(config-lt)# ip vrf forwarding vrf_1
esr(config-lt)# ip firewall disable
esr(config-lt)# ip address 192.168.0.1/30
esr(config-lt)# exit
esr(config)# tunnel lt 2
esr(config-lt)# ip vrf forwarding vrf_2
esr(config-lt)# ip firewall disable
esr(config-lt)# ip address 192.168.0.2/30
esr(config-lt)# exit
```

LT- LT- VRF, , :

```
esr(config)# tunnel lt 1
esr(config-lt)# peer lt 2
esr(config-lt)# enable
esr(config-lt)# exit
esr(config)# tunnel lt 2
esr(config-lt)# peer lt 1
esr(config-lt)# enable
esr(config-lt)# exit
```

**VRF , VRF:**

```
esr(config)# ip route vrf vrf_1 0.0.0.0/0 192.168.0.2
esr(config)# ip route vrf vrf_2 0.0.0.0/0 192.168.0.1
```