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 - bridge VLAN
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VLAN

VLAN (. *Virtual Local Area Network*) — («») , , . VLAN Ethernet- 802.1q. , VLAN Ethernet- VLAN-ID Ethernet-.

1	VLAN.	esr(config)# vlan <VID>	<VID> – VLAN, [2..4094]. vlan (), vlan () .
2	vlan () .	esr(config-vlan)# name <vlan-name>	<vlan-name> – 255 .
3	, Ethernet- VLAN () .	esr(config-vlan)# force-up	
4	Ethernet- VLAN' (VLAN-ID – 1) ().	esr(config-if-gi)# switchport forbidden default-vlan	
5	L2-.	esr(config-if-gi)# mode switchport	
6	.	esr(config-if-gi)# mode hybrid	ESR-1000/1200/1500/1511 /1700
7	L2-.	esr(config-if-gi)# switchport access	ESR-10/12V(F)/14VF/20/21/100/200 /3100. .

		esr(config-if-gi)# switchport trunk	ESR-10/12V(F)/14VF/20/21/100/200/3100.
		esr(config-gi)# switchport general	ESR-1000/1200/1500/1511/1700.
8	VLAN .	esr(config-if-gi)# switchport trunk allowed vlan add <VID>	ESR-10/12V(F)/14VF/20/21/100/200/3100. <VID> – VLAN, [2..4094]. vlan () vlan ().
		esr(config-if-gi)# switchport general allowed vlan add <VID> tagged	ESR-1000/1200/1500/1511/1700. <VID> – VLAN, [2..4094]. vlan () vlan ().
9	VLAN ().	esr(config-if-gi)# switchport trunk native-vlan <VID>	ESR-10/12V(F)/14VF/20/21/100/200/3100. <VID> – VLAN, [2..4094].
		esr(config-if-gi)# switchport general allowed vlan add <VID> untagged	ESR-1000/1200/1500/1511/1700. <VID> – VLAN, [2..4094].
10	Ethernet- VLAN () .	esr(config-if-gi)# switchport trunk allowed vlan auto-all	ESR-10/12V(F)/14VF/20/21/100/200/3100.
		esr(config-if-gi)# switchport general allowed vlan auto-all	ESR-1000/1200/1500/1511/1700.

1. VLAN

VLAN 2 gi1/0/1.

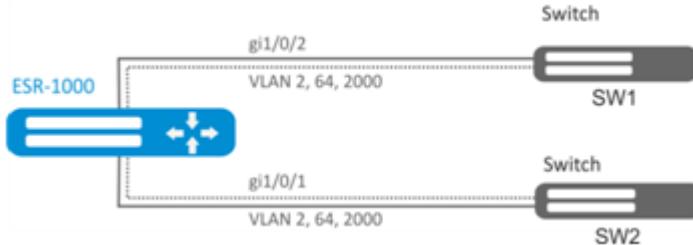


VLAN 2 gi1/0/1:

```
esr(config)# interface gi 1/0/1
esr(config-if-gi)# switchport general allowed vlan remove 2 untagged
esr(config-if-gi)# no switchport general pvid
```

2. VLAN

gi1/0/1 gi1/0/2 VLAN 2, VLAN 64, VLAN 2000.



VLAN 2, VLAN 64, VLAN 2000 ESR-1000:

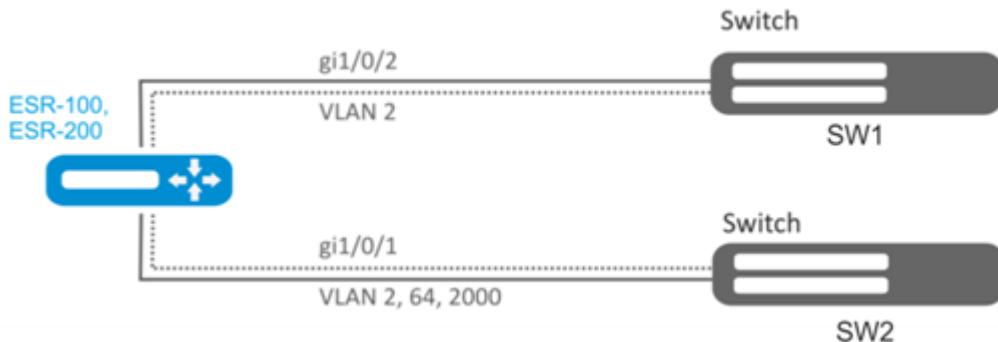
```
esr-1000(config)# vlan 2,64,2000
```

VLAN 2, VLAN 64, VLAN 2000 gi1/0/1-2:

```
esr-1000(config)# interface gi1/0/1
esr-1000(config-if-gi)# mode switchport
esr-1000(config-if-gi)# switchport forbidden default-vlan
esr-1000(config-if-gi)# switchport general allowed vlan add 2,64,2000 tagged
```

3. VLAN

gi1/0/1 VLAN 2, VLAN 64, VLAN 2000 trunk, gi1/0/2 access VLAN 2 ESR-100/ESR-200.



VLAN 2, VLAN 64, VLAN 2000 ESR-100/ESR-200:

```
esr(config)# vlan 2,64,2000
```

VLAN 2, VLAN 64, VLAN 2000 gi1/0/1:

```
esr(config)# interface gi1/0/1
esr(config-if-gi)# mode switchport
esr(config-if-gi)# switchport forbidden default-vlan
esr(config-if-gi)# switchport mode trunk
esr(config-if-gi)# switchport trunk allowed vlan add 2,64,2000
```

VLAN 2 gi1/0/2:

```
esr(config)# interface gi1/0/2
esr(config-if-gi)# mode switchport
esr(config-if-gi)# switchport access vlan 2
```

LLDP

Link Layer Discovery Protocol (LLDP) — , , , , .

1	LLDP .	esr(config)# lldp enable	
2	LLDPDU .	esr(config-if-gi)# lldp receive	

3	LLDPDU .	esr(config-if-gi)# lldp transmit	
8	LLDPDU () .	esr(config)# lldp timer <SEC>	<SEC> – , [1..32768]. : 30
4	, , LLDP () .	esr(config)# lldp hold-multiplier <SEC>	<SEC> – , [1..10]. : 4
5	IP-, LLDP TLV management-address () .	esr(config)# lldp management-address <ADDR>	<ADDR> – IP-, AAA.BBB.CCC.DDD, [0..255].
6	system-description, LLDP TLV system-description () .	esr(config)# lldp system-description <DESCRIPTION>	<DESCRIPTION> – , 255 .
7	system-name, LLDP TLV system-name () .	esr(config)# lldp system-name <NAME>	<NAME> – , 255 . hostname

LLDPDU ESR-1 ESR-2.



1. R1 LLDP :

```
esr(config)# lldp enable
```

LLDPDU gi 1/0/1.

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# lldp receive
esr(config-if-gi)# lldp transmit
```

2. R2

LLDP :

```
esr(config)# lldp enable
```

LLDPDU gi 1/0/1.

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# lldp receive
esr(config-if-gi)# lldp transmit
```

LLDP :

```
esr# show lldp neighbors
```

```
esr# show lldp neighbors gigabitethernet 1/0/1
```

LLDP :

```
esr# show lldp statistics
```

LLDP MED

LLDP MED — LLDP, : VLAN ID, DSCP, priority.

1	LLDP	esr(config)# lldp enable	
2	LLDPDU .	esr(config-if-gi)# lldp transmit	
3	MED LLDP	esr(config)# lldp med fast-start enable	
4	.	esr(config)# network-policy <NAME>	<NAME> – network-policy, 31 .
5	.	esr(config-net-policy)# application <APP_TYPE>	<APP-TYPE> – , network-policy. : <ul style="list-style-type: none"> • voice; • voice-signaling; • guest-voice; • guest-voice-signaling; • softphone-voice; • video-conferencing; • streaming-video; • video-signaling.
6	DSCP () .	esr(config-net-policy)# dscp <DSCP>	<DSCP> – DSCP, [0..63].
7	COS () .	esr(config-net-policy)# priority <PRIORITY>	<COS> – , : <ul style="list-style-type: none"> • best-effort – COS0; • background – COS1; • excellent-effort – COS2; • critical-applications – COS3; • video – COS4; • voice – COS5; • internetwork-control – COS6; • network-control – COS7.
8	VLAN ID.	esr(config-net-policy)# vlan <VID> [tagged]	<VID> – VLAN, [1...4094]; <ul style="list-style-type: none"> • tagged – , Ethernet-
9	.	esr(config-if-gi)# lldp network-policy <NAME>	<NAME> – network-policy, 31 .

Voice VLAN

Voice VLAN — VLAN ID, IP- trunk VLAN ID VoIP-. VLAN ID MED LLDP.

:

VLAN, vid 10 vid 20 , Voice VLAN gi 1/0/1 ESR. IP- Voice VLAN.



:

VLAN 10 20 gi 1/0/1 trunk:

```
esr(config)# vlan 10,20
esr(config-vlan)# exit
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# mode switchport
esr(config-if-gi)# switchport mode trunk
esr(config-if-gi)# switchport trunk allowed vlan add 10,20
esr(config-if-gi)# exit
```

LLDP MED LLDP :

```
esr(config)# lldp enable
esr(config)# lldp med fast-start enable
```

, voice VLAN ID 20:

```
esr(config)# network-policy VOICE_VLAN
esr(config-net-policy)# application voice
esr(config-net-policy)# vlan 20 tagged
esr(config-net-policy)# exit
```

LLDP :

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# lldp transmit
esr(config-if-gi)# lldp receive
esr(config-if-gi)# lldp network-policy VOICE_VLAN
esr(config-if-gi)# exit
```

-
Ethernet- VLAN - VLAN, . - VLAN, /, Ethernet- - .. - . - (VLAN-ID) ,.. OSI.

1	- (routeport hybrid).	<pre>esr(config)# interface gigabitethernet <PORT>.<S-VLAN> interface tengigabitethernet <PORT>.<S-VLAN> interface port-channel <CH>.<S-VLAN></pre>	<PORT> - . <CH> - . <S-VLAN> - S-VLAN. bridge-group, - .
2	- () .	<pre>esr(config-subif)# description <DESCRIPTION></pre>	<DESCRIPTION> - , 255 .
3	VRF, - () .	<pre>esr(config-subif)# ip vrf forwarding <VRF></pre>	<VRF> - VRF, 31 .
4	IPv4/IPv6- IP- .	<pre>esr(config-subif)# ip address <ADDR>/<LEN> esr(config-subif)# ipv6 address <IPV6-ADDR>/<LEN> esr(config-subif)# ip address dhcp</pre>	<ADDR/LEN> - IP- , AAA.BBB.CCC.DDD/EE, AAA - DDD [0..255] EE [1..32]. IPv4- . IP-. <IPV6-ADDR/LEN> - IP- , X:X:X:X::X/EE, X [0..FFFF] EE [1..128]. IPv6- . IPv6-. UIPV4/IPv6- . 8 IPv4/IPv6- . DHCP- . DHCP-.
5	Firewall (. Firewall).	<pre>esr(config-subif)# ip firewall disable</pre>	

		esr(config-subif)# security-zone <NAME>	<NAME> – , 31 .
6	, – ().	esr(config-subif)# load-average <TIME>	<TIME> – , [5..150].
7	IPv4/IPv6 ARP-, ().	esr(config-subif)# ip arp reachable-time <TIME> esr(config-subif)# ipv6 nd reachable-time <TIME>	<TIME> – MAC-, . 5000 10000000 . [0;5;1,5]*<TIME>.
8	MTU (MaximumTransmitionUnit). MTU 1500 "system jumbo-frames" ().	esr(config-subif)# mtu <MTU>	<MTU> – MTU . : 1500.
9	().	esr(config-subif)# history statistics	
10	MSS (Maximum segment size) TCP- ().	esr(config-subif)# ip tcp adjust-mss <MSS> esr(config-subif)# ipv6 tcp adjust-mss <MSS>	<MSS> – MSS, [500..1460]. : 1460

- :

- QoS (. [QoS](#));
- proxy (. [HTTP/HTTPS-](#));
- (. [Netflow sFlow](#));
- (.);
- VRRF (.);
- BRAS (. [BRAS \(Broadband Remote Access Server\)](#));
- IDS/IPS (. [IPS/IDS](#)).

- :
192.168.3.1/24 VLAN: 828 gigabitethernet 1/0/1.

- VLAN: 828

```
esr(config)# interface gigabitethernet 1/0/1.828
```

IP- :

```
esr(config)# interface gigabitethernet 1/0/1.828
esr(config-subif)# ip address 192.168.3.1/24
esr(config-subif)# exit
```



IP-, – firewall, .

Q-in-Q

Q-in-Q — 802.1q-. VLAN . (InnerTag) 802.1q- payload. C-VLAN (Customer VLAN). (OuterTag) — 802.1q-, 802.1q-, S-VLAN (Service VLAN). Ethernet 802.1ad.

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1	- (routeport hybrid).	<pre>esr(config)# interface gigabitethernet <PORT>.<S-VLAN> interface tengigabitethernet <PORT>.<S-VLAN> interface port-channel <CH>.<S-VLAN></pre>	<PORT> - . <CH> - . <S-VLAN> - S-VLAN. bridge-group, - .
2	Q-in-Q .	<pre>esr(config)# interface gigabitethernet <PORT>.<S-VLAN>.<C-VLAN> esr(config)# interface tengigabitethernet <PORT>.<S-VLAN>.<C-VLAN> esr(config)# interface port-channel <CH>.<S-VLAN>.<C-VLAN></pre>	<PORT> - . <CH> - . <S-VLAN> - S-VLAN. <C-VLAN> - C-VLAN. - bridge-group, - .
3	Q-in-Q () .	<pre>esr(config-qinq-if)# description <DESCRIPTION></pre>	<DESCRIPTION> - , 255 .
4	VRF, Q-in-Q () .	<pre>esr(config-qinq-if) # ip vrf forwarding <VRF></pre>	<VRF> - VRF, 31 .
5	IPv4/IPv6- IP- .	<pre>esr(config-qinq-if)# ip address <ADDR/LEN></pre>	<ADDR/LEN> - IP- , AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32]. IPv4- IP- .
		<pre>esr(config-qinq-if)# ipv6 address <IPV6-ADDR/LEN></pre>	<IPV6-ADDR/LEN> - IP- , X:X:X::X/EE, X [0..FFFF] EE [1..128]. IPv6- IPV6- . UIPv4/IPv6- . 8 IPv4/IPv6- .
		<pre>esr(config-qinq-if)# ip address dhcp</pre>	DHCP- DHCP- .
6	Firewall (. Firewall).	<pre>esr(config-qinq-if)# ip firewall disable esr(config-qinq-if)# security-zone <NAME></pre>	<NAME> - , 31 .
7	, - () .	<pre>esr(config-subif)# load-average <TIME></pre>	<TIME> - , [5..150].
8	IPv4/IPv6 ARP-, () .	<pre>esr(config-subif)# ip arp reachable-time <TIME> esr(config-subif)# ipv6 nd reachable-time <TIME></pre>	<TIME> - MAC-, 5000 10000000 . [0,5;1,5]*<TIME>.
9	MTU (MaximumTransmitionUnit). MTU 1500 "system jumbo-frames" () .	<pre>esr(config-subif)# mtu <MTU></pre>	<MTU> - MTU . : 1500.
10	() .	<pre>esr(config-subif)# history statistics</pre>	
11	MSS (Maximum segment size) TCP- () .	<pre>esr(config-subif)# ip tcp adjust-mss <MSS></pre>	<MSS> - MSS, [500..1460].
		<pre>esr(config-subif)# ipv6 tcp adjust-mss <MSS></pre>	: 1460

qinq- :

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

Q-in-Q

:

192.168.1.1/24 C-VLAN: 741, S-VLAN: 828 gigabitethernet 1/0/1.

:

- S-VLAN: 828

```
esr(config)# interface gigabitethernet 1/0/1.828
esr(config-subif)# exit
```

Q-in-Q- S-VLAN: 741 IP- .

```
esr(config)# interface gigabitethernet 1/0/1.828.741
esr(config-qinq-if)# ip address 192.168.1.1/24
esr(config-qinq-if)# exit
```



IP-, Q-in-Q - firewall, .

USB-

USB- . USB- USB-. 10- USB-.

USB-

1	USB- , .		
2	, USB-.	esr# show celluar status modem	"USB port" .
3	USB- .	esr(config)# cellular profile <ID>	<ID> – USB- [1..10].
4	().	esr(config-cellular-profile)# description <DESCRIPTION>	<DESCRIPTION> – , 255 .
5		esr(config-cellular-profile)# apn <NAME>	<NAME> – , 31 .
6	(/).	esr(config-cellular-profile)# user <NAME>	<NAME> – , 31 .
7	(/).	esr(config-user)# password ascii-text { <CLEAR-TEXT> encrypted <ENCRYPTED-TEXT> }	<CLEAR-TEXT> – , [1 .. 64] , [0-9a-fA-F]; <ENCRYPTED-TEXT> – , [2..128] .
8	(/).	esr(config-user)# enable	
9	.	esr(config-cellular-profile)# number <WORD>	<WORD> – , 15 .
10	().	esr(config-cellular-profile)# allowed-auth <TYPE>	<TYPE> – [none, PAP, CHAP, MSCHAP, MSCHAPv2, EAP]. : PAP
11	IP- .	esr(config-cellular-profile)# ip-version { ipv4 ipv6 }	<ul style="list-style-type: none"> • ipv4 – IPv4; • ipv6 – IPv6;
12	USB- .	esr(config)# cellular modem <ID>	<ID> – USB- [1..10].
13	().	esr(config-cellular-modem)# description <DESCRIPTION>	<DESCRIPTION> – , 255 .
14	VRF, ().	esr(config-cellular-modem)# ip vrf forwarding <VRF>	<VRF> – VRF, 31 .
15	USB-, (2).	esr(config-cellular-modem)# device <WORD>	<WORD> – USB- [1..12].
16	USB-.	esr(config-cellular-modem)# profile <ID>	<ID> – USB- [1..10].
17	SIM- ().	esr(config-cellular-modem)# pin <WORD>	<WORD> – SIM- [4..8]. .
18	USB- ().	esr(config-cellular-modem)# allowed-mode <MODE>	<MODE> – USB- [2g, 3g, 4g]. : .
19	().	esr(config-cellular-modem)# mru { <MRU> }	<MRU> – MRU, [128..16383]. : 1500.
20	MTU (MaximumTransmitionUnit). MTU 1500 "system jumbo-frames" ().	esr(config-cellular-modem)# mtu <MTU>	<MTU> – MTU . : 1500.

21	USB- (.).	<code>esr(config-cellular-modem)# preferred-mode {<MODE>}</code>	<MODE> – USB- [2g, 3g, 4g]
22	Firewall (. Firewall).	<code>esr(config-subif)# ip firewall disable</code>	
		<code>esr(config-subif)# security-zone <NAME></code>	<NAME>- , 31 .
23	USB-.	<code>esr(config-cellular-modem)# enable</code>	
:			
<ul style="list-style-type: none"> • QoS (. QoS); • proxy (. HTTP/HTTPS-); • (. Netflow sFlow); • (. Policy-based routing MultiWAN). 			



, NAT.

, USB-.

, , USB-:

```
esr# show cellular status modem
Number
device      USB port       Manufacturer      Model      Current state      Interface      Link
state
1          1-2           huawei            E3372    Disabled        --           Down
```

USB-:

```
esr(config)# cellular profile 1
```

APN, , APN:

```
esr(config-cellular-profile)# apn internet.mts.ru
```

, , :

```
esr(config-cellular-profile)# user mts
esr(config-ppp-user)# password ascii-text mts
esr(config-cellular-profile)# number *99#
esr(config-cellular-profile)# allowed-auth PAP
```

USB- , , :

```
esr(config)# cellular modem 1
esr(config-cellular-modem)# device 1-2
```

:

```
esr(config-cellular-modem)# profile 1
esr(config-cellular-modem)# enable
```

PPP E1

PPP (. Point-to-Point Protocol) — , . , .

PPP- E1, ToPGATE-SFP ESR.

1		<code>esr(config-if-gi)# mode switchport</code>	
2	e1	<code>esr(config-if-gi)# switchport mode e1</code>	
3		<code>esr(config-if-gi)# switchport e1 clock source <SOURCE></code>	<SOURCE> – : <ul style="list-style-type: none">• Internal () – ;• line – .
4	MTU (Maximum Transmition Unit)	<code>esr(config-if-gi)# mtu <MTU></code>	<MTU> – MTU, E1 Multilink [128..1500].
5	- ()	<code>esr(config-if-gi)# switchport e1 crc <FCS></code>	<FCS> – : <ul style="list-style-type: none">• 16 () – FCS16;• 32 – FCS32.
6	()	<code>esr(config-if-gi)# switchport e1 framing <CRC></code>	<CRC> – : <ul style="list-style-type: none">• crc-4 – CRC-4;• no-crc4 () – .
7	()	<code>esr(config-if-gi)# switchport e1 invert data</code>	
8	()	<code>esr(config-if-gi)# switchport e1 linecode <CODE></code>	<CODE> – ; <ul style="list-style-type: none">• ami – ;• hdb3 () – 3.
9		<code>esr(config-if-gi)# switchport e1 timeslots <RANGE></code>	<RANGE> – -
10	1 , ()	<code>esr(config-if-gi)# switchport e1 unframed</code>	
11	E1	<code>esr(config)# interface e1 1/<SLOT>/1</code>	<SLOT> – .
12	CHAP- PPP ()	<code>esr(config-e1)# ppp authentication chap</code>	
13	, CHAP- ()	<code>esr(config-e1)# ppp chap hostname <NAME></code>	<NAME> –
14	()	<code>esr(config-e1)# ppp chap password ascii-text <CLEAR-TEXT></code>	<CLEAR-TEXT> – , [1 .. 64] , [0-9a-fA-F]
15	()	<code>esr(config-e1)# ppp chap refuse</code>	
16	()	<code>esr(config-e1)# ppp chap username <NAME></code>	<NAME> –
17	IP- IP- ()	<code>esr(config-e1)# ppp ipcp accept-address</code>	
18	IP-, ()	<code>esr(config-e1)# ppp ipcp remote-address <ADDR></code>	<ADDR> – IP-
19	Configure-Request , ()	<code>esr(config-e1)# ppp max-configure <VALUE></code>	<VALUE> –
20	Configure-NAK , ()	<code>esr(config-e1)# ppp max-failure <VALUE></code>	<VALUE> –
21	Terminate-Request , ()	<code>esr(config-e1)# ppp max-terminate <VALUE></code>	<VALUE> –
22	MRU (Maximum Receive Unit) ()	<code>esr(config-e1)# ppp mru <MRU></code>	<MRU> – MRU
23	MLPPP ()	<code>esr(config-e1)# ppp multilink</code>	
24	MLPPP- ()	<code>esr(config-e1)# ppp multilink-group <GROUP-ID></code>	<GROUP-ID> –
25	, keepalive- ()	<code>esr(config-e1)# ppp timeout keepalive <TIME></code>	<TIME> –
26	, ()	<code>esr(config-e1)# ppp timeout retry <TIME></code>	<TIME> –

:

PPP- IP- 10.77.0.1/24 ToPGATE-SFP, 1-8 ; – .



, ToPGATE-SFP, gigabitethernet 1/0/3 1:

```
esr# configure
esr(config)# interface gigabitethernet 1/0/3
esr(config-if-gi)# description "*** ToPGATE ***"
esr(config-if-gi)# switchport mode el
esr(config-if-gi)# switchport el timeslots 1-8
esr(config-if-gi)# switchport el clock source line
esr(config-if-gi)# switchport el slot 3
esr(config-if-gi)# exit
```

interface el 1/3/1:

```
esr(config)# interface el 1/3/1
esr(config-el1)# security-zone trusted
esr(config-el1)# ip address 10.77.0.1/24
esr(config-el1)# exit
```

```
esr# commit
Configuration has been successfully committed
esr# confirm
Configuration has been successfully confirmed
```

MLPPP

Multilink PPP (MLPPP) , , . . .



1	.	esr(config)# interface multilink <IF>	<IF> - .
2	().	esr(config-multilink)# description <DESCRIPTION>	<DESCRIPTION> - , 255 .
3	, ().	esr(config-multilink)# load-average <TIME>	<TIME> - , [5..150]. : 5.
4	MTU (Maximum Transmition Unit) (). MTU 1500 "system jumbo-frames".	esr(config-multilink)# mtu <MTU>	<MTU> - MTU, [1280..1500]. : 1500.
5	CHAP-.	esr(config-multilink)# ppp authentication chap	
6	().	esr(config-multilink)# ppp chap refuse	

7	, CHAP-.	esr(config-multilink)# ppp chap hostname <NAME>	<NAME> – , 31
8	, CHAP-.	esr(config-multilink)# ppp chap password ascii-text { <CLEAR-TEXT> encrypted <ENCRYPTED-TEXT> }	<CLEAR-TEXT> – , [8 .. 64], [0-9a-fA-F]. <ENCRYPTED-TEXT> – , [16..128].
9	IP- IP- ().	esr(config-multilink)# ppp ipcp accept-address	
10	IP-, .	esr(config-multilink)# ppp iccp remote-address <ADDR>	<ADDR> – IP- .
11	.	esr(config-multilink)# chap username <NAME>	<NAME> – , 31 .
12	.	esr(config-ppp-user)# password ascii-text { <CLEAR-TEXT> encrypted <ENCRYPTED-TEXT> }	<CLEAR-TEXT> – , [8 .. 64], [0-9a-fA-F]. <ENCRYPTED-TEXT> – , [16..128].
13	Configure-Request , ().	esr(config-multilink)# ppp max-configure <VALUE>	<VALUE> – , [1..255]. : 10.
14	Configure-NAK , ().	esr(config-multilink)# ppp max-failure <VALUE>	<VALUE> – , [1..255].
15	Terminate-Request , ().	esr(config-multilink)# ppp max-terminate <VALUE>	<VALUE> – , [1..255]. : 2.
16	MRU (Maximum Receive Unit) .	esr(config-multilink)# ppp mru <MRU>	<MRU> – MRU, [128..1485]. : 1500.
17	, keepalive- ().	esr(config-multilink)# ppp timeout keepalive <TIME>	<TIME> – , [1..32767]. : 10.
18	, ().	esr(config-multilink)# ppp timeout retry <TIME>	<TIME> – , [1..255]. : 3.
19	MLPP-.	esr(config-multilink)# mrru <MRRU>	<MRRU> – MLPP-, [1500..10000].
20	e1 .	esr(config-if-gi)# switchport e1 <SLOT>	<SLOT> – , [0..3].
21	SFPe1-.	esr(config-if-gi)# switchport mode e1	
22	MLPPP E1-.	esr(config-e1)# ppp multilink	
23	E1- .	esr(config-e1)# ppp multilink-group <GROUP-ID>	<GROUP-ID> – , [1..4].

MLPPP- IP- 10.77.0.1/24 MXE.



gigabitethernet 1/0/10 1:

```

esr# configure
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# switchport mode el
esr(config-if-gi)# switchport el slot 0
esr(config-if-gi)# exit
esr(config)# interface gigabitethernet 1/0/2
esr(config-if-gi)# switchport mode el
esr(config-if-gi)# switchport el slot 1
esr(config-if-gi)# exit

```

MLPPP 3:

```

esr(config)# interface multilink 3
esr(config-multilink)# ip address 10.77.0.2/24
esr(config-multilink)# security-zone trusted
esr(config-multilink)# exit
esr(config)# exit

```

interface e1 1/0/1, interface e1 1/0/2 MLPPP 3:

```

esr(config)# interface e1 1/0/1
esr(config-e1)# ppp multilink
esr(config-e1)# ppp multilink-group 3
esr(config-e1)# exit
esr(config)# interface e1 1/0/2
esr(config-1)# ppp multilink
esr(config-1)# ppp multilink-group 3
esr(config-1)# exit

```

Bridge

Bridge () — Ethernet , IP. Ethernet-, IP-. (2 OSI), .

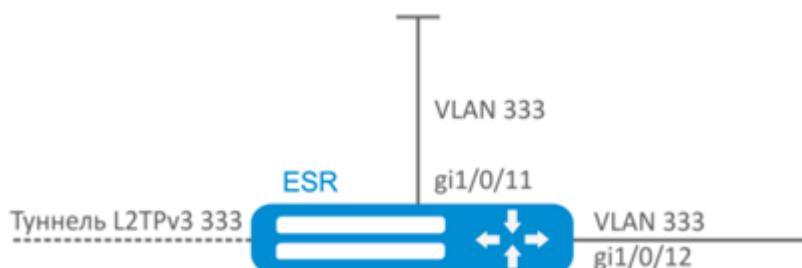
1	(bridge) .	esr(config)# bridge <BRIDGE-ID>	<BRIDGE-ID> – , : • ESR-10/12V(F)/14VF – [1..50]; • ESR-20/21/100/200 – [1..250]; • ESR-1000/1200/1500 /1511/1700/3100 – [1..500].
2	.	esr(config-bridge)# enable	
3	VRF, ().	esr(config-bridge)# ip vrf forwarding <VRF>	<VRF> – VRF, 31 .
4	().	esr(config-bridge)# description <DESCRIPTION>	<DESCRIPTION> – , 255 .
5	-, qinq-, L2GRE L2TPv3 . / L2- ().	esr(config-if-gi)# bridge-group <BRIDGE-ID> esr(config-if-l2tpv3)# bridge-group <BRIDGE-ID>	<BRIDGE-ID> – , : • ESR-10/12V(F)/14VF – [1..50]; • ESR-20/21/100/200 – [1..250]; • ESR-1000/1200/1500 /1511/1700/3100 – [1..500].
6	VLAN. L2-, VLAN, L2- ()	esr(config-bridge)# vlan <VID>	<VID> – VLAN, [1..4094].

7	MTU (Maximum Transmission Unit), bridge (; , bridge VLAN). MTU 1500 "system jumbo-frames"	esr(config-bridge)# mtu <MTU>	<MTU> – MTU, : • ESR-10/12VF/14VF – [552..9600]; • ESR-20/21 – [552..9500]; • ESR-100/200/1000/1200/1500/1511/1700 – [552..10000]; • ESR-1500/1511/1700 /3100 – [552..9190]. : 1500
8	IPv4/IPv6- IP- .	esr(config-bridge)# ip address <ADDR/LEN>	<ADDR/LEN> – IP- , AAA.BBB.CCC.DDD/EE, AAA – DDD [0..255] EE [1..32]. IPv4- . IP- .
		esr(config-bridge)# ipv6 address <IPV6-ADDR/LEN>	<IPV6-ADDR/LEN> – IP- , X:X:X::X/EE, X [0..FFFF] EE [1..128]. IPv6- . IPv6- . UIPV4/IPv6- . 8 IPv4/IPv6- .
		esr(config-bridge)# ip address dhcp	DHCP- . DHCP- .
9	Firewall (. Firewall).	esr(config-bridge)# ip firewall disable	
		esr(config-bridge)# security-zone <NAME>	<NAME>-, 31 .
9	().	esr(config-bridge)# history statistics	
8	, bridge ()	esr(config-bridge)# load-average <TIME>	<TIME> – , [5..150]. : 5
9	MAC- , ().	esr(config-bridge)# mac-address <ADDR>	<ADDR> -- , XX:XX:XX:XX:XX:XX, [00..FF].
10	bridge- . . (; ESR-1000/1200/1500/1511/1700 /3100)	esr(config-bridge)# protected-ports [exclude vlan]	exclude vlan – , VLAN (bridge) .
11	unknown-unicast (MAC-) bridge. (; ESR-1000/1200/1500/1511/1700 /3100)	esr(config-bridge)# unknown-unicast-forwarding disable	
12	IPv4/IPv6- ARP-, bridge () .	esr(config-bridge)# ip arp reachable-time <TIME> esr(config-bridge)# ipv6 nd reachable-time <TIME>	<TIME> – MAC-, . 5000 10000000 . [0,5;1,5] *<TIME>.
bridge- : <ul style="list-style-type: none">• QoS (. QoS);• proxy (. HTTP/HTTPS);• (. Netflow sFlow);• (.);• VRRF (.);• BRAS (. BRAS (Broadband Remote Access Server));• IDS/IPS (. IPS/IDS).			

bridge VLAN L2TPv3-

:

L2- , , L2TPv3-, . VLAN 333.



VLAN 333:

```
esr(config)# vlan 333  
esr(config-vlan)# exit
```

«trusted»:

```
esr(config)# security-zone trusted  
esr(config-zone)# exit
```

gi1/0/11, gi1/0/12 VLAN 333:

```
esr(config)# interface gigabitethernet 1/0/11-12  
esr(config-if)# mode switchport  
esr(config-if)# switchport general allowed vlan add 333 tagged
```

bridge 333, VLAN 333 «trusted»:

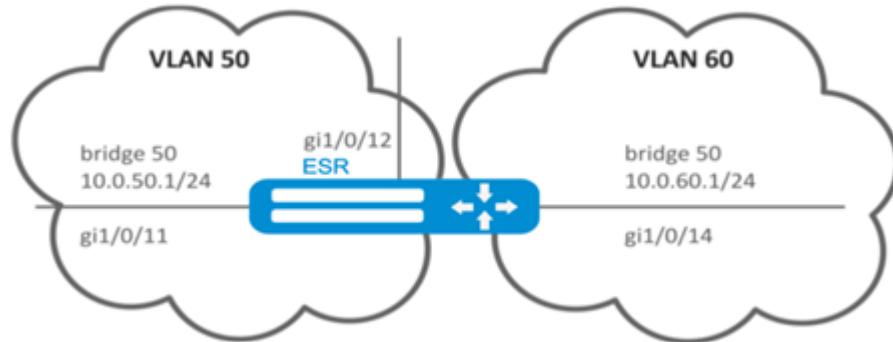
```
esr(config)# bridge 333  
esr(config-bridge)# vlan 333  
esr(config-bridge)# security-zone trusted  
esr(config-bridge)# enable
```

L2TPv3-, (L2TPv3- L2TPv3-). VID .

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

bridge VLAN

VLAN 50 (10.0.50.0/24) VLAN 60 (10.0.60.0/24). VLAN 50 – «LAN1», VLAN 60 – «LAN2», .



VLAN 50, 60:

```
esr(config)# vlan 50,60  
esr(config-vlan)# exit
```

«LAN1» «LAN2»:

```
esr(config)# security-zone LAN1
esr(config-zone)# exit
esr(config)# security-zone LAN2
esr(config-zone)# exit
```

gi1/0/11, gi1/0/12 VLAN 50:

```
esr(config)# interface gigabitethernet 1/0/11-12
esr(config-if-gi)# switchport general allowed vlan add 50 tagged
```

gi1/0/14 VLAN 60:

```
esr(config)# interface gigabitethernet 1/0/14
esr(config-if-gi)# switchport general allowed vlan add 60 tagged
```

bridge 50, VLAN 50, IP- 10.0.50.1/24 «LAN1»:

```
esr(config)# bridge 50
esr(config-bridge)# vlan 50
esr(config-bridge)# ip address 10.0.50.1/24
esr(config-bridge)# security-zone LAN1
esr(config-bridge)# enable
```

bridge 60, VLAN 60, IP- 10.0.60.1/24 «LAN2»:

```
esr(config)# bridge 60
esr(config-bridge)# vlan 60
esr(config-bridge)# ip address 10.0.60.1/24
esr(config-bridge)# security-zone LAN2
esr(config-bridge)# enable
```

Firewall, :

```
esr(config)# security zone-pair LAN1 LAN2
esr(config-zone-pair)# rule 1
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# exit
esr(config)# security zone-pair LAN2 LAN1
esr(config-zone-pair)# rule 1
esr(config-zone-pair-rule)# action permit
esr(config-zone-pair-rule)# enable
esr(config-zone-pair-rule)# exit
esr(config-zone-pair)# exit
esr(config)# exit
```

:

```
esr# show interfaces bridge
```

/ VLAN-

:

```
gigabitethernet 1/0/1 Ethernet- VLAN-.   gigabitethernet 1/0/2,  VLAN-ID 828.   gigabitethernet 1/0/2 Ethernet- VLAN-ID 828,      gigabitethernet 1
/0/1.
```

:

bridge VLAN IP-.

```
esr(config)# bridge 1
esr(config-bridge)# enable
esr(config-bridge)# exit
```

gigabitethernet 1/0/1 bridge 1.

```
esr(config)# interface gigabitethernet 1/0/1
esr(config-if-gi)# bridge-group 1
esr(config-if-gi)# exit
```

- gigabitethernet 1/0/2.828 bridge 1.

```
esr(config)# interface gigabitethernet 1/0/2.828
esr(config-subif)# bridge-group 1
esr(config-subif)# exit
```



VLAN- Ethernet-, 4. gigabitethernet 1/0/2 Q-in-Q MTU 4 .

Dual-Homing



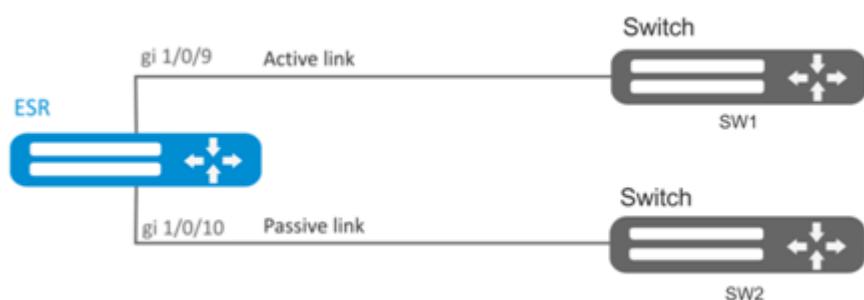
ESR-1000.

Dual-Homing – ,

1	, .	esr(config-if-gi)# backup interface<IF> vlan <VID>	<IF> – , . <VID> – VLAN, [2...4094]. «-» «,».
2	MAC-, () .	esr(config)# backup-interface mac-duplicate <COUNT>	<COUNT> – , [1..4].
3	, () .	esr(config)# backup-interface mac-per-second<COUNT>	<COUNT> – MAC- , [50..400].
4	, () .	esr(config)# backup-interface preemption	

:

L2- ESR VLAN 50-55 SW1 SW2.



VLAN 50-55:

```
esr(config)# vlan 50-55
```

STP gigabitethernet 1/0/9 gigabitethernet 1/0/10, :

```
esr(config)# interface gigabitethernet 1/0/9-10
esr(config-if-gi)# spanning-tree disable
```

gigabitethernet 1/0/9 gigabitethernet 1/0/10 VLAN 50-55 general.

```
esr(config-if-gi)# switchport general allowed vlan add 50-55
esr(config-if-gi)# exit
```

gigabitethernet 1/0/10 gigabitethernet 1/0/9:

```
esr(config)# interface gigabitethernet 1/0/9
esr(config-if-gi)# backup interface gigabitethernet 1/0/10 vlan 50-55
```

```
esr# show interfaces backup
```

(SPAN/RSPAN)

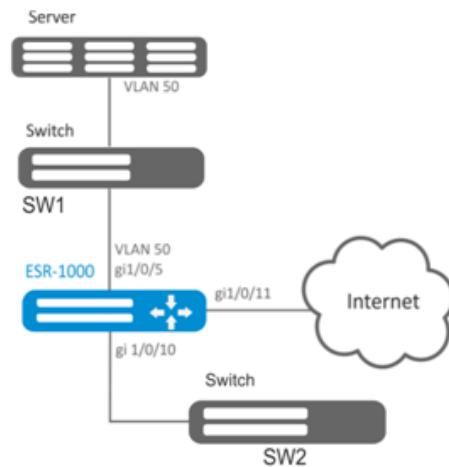


(RSPAN) ESR-1000/1200/1500/1511/1700

— , () ().

1	VLAN, ().	esr(config)# port monitor remote vlan <VID> <DIRECTION>	<VID> – VLAN, [2...4094]; <DIRECTION> – : <ul style="list-style-type: none">• tx – VLAN ;• rx – VLAN .
2	().	esr(config)# port monitor remote	
3	().	esr(config)# port monitor mode <MODE>	<MODE> – : <ul style="list-style-type: none">• network – ();• monitor-only – .
4	.	esr(config-if-gi)# port monitor interface <IF> [<DIRECTION>]	<IF> – c ; <DIRECTION> – : <ul style="list-style-type: none">• tx – ;• rx – .

VLAN 50 gi1/0/11



- VLAN 50;
- gi 1/0/5 VLAN 50 general.

VLAN, :

```
sr1000(config)# port monitor remote vlan 50
```

gi 1/0/5 :

```
sr1000(config)# interface gigabitethernet 1/0/5
sr1000(config-if-gi)# port monitor interface gigabitethernet 1/0/11
```

gi 1/0/5 :

```
sr1000(config-if-gi)# port monitor remote
```

LACP

LACP — , . . .

1	LACP.	<pre>esr(config)# lACP system-priority <PRIORITY></pre>	<PRIORITY> – , [1..65535]. : 1.
2	.	<pre>esr(config)# port-channel load-balance { src-dst-mac-ip src-dst-mac src-dst-ip src-dst-mac-ip-port }</pre>	<ul style="list-style-type: none">• src - dst - mac - ip – MAC- IP- ;• src - dst - mac – MAC- ;• src - dst - ip – IP- ;• src - dst - mac - ip - port – MAC-, IP- .

3	LACP.	<code>esr(config)# lACP timeout {short long }</code>	<ul style="list-style-type: none"> • long – ; • short – . <p>: long.</p>
4	.	<code>esr(config)# interface port-channel <ID></code>	<code><ID></code> – , [1..12].
5	.		
6	.	<code>esr(config)# interface <IF-TYPE><IF-NUM></code>	<p><code><IF-TYPE></code> (gigabitethernet tengigabitethernet).</p> <p><code><IF-NUM></code> – F/S/P – F- (1), S – (0), P – .</p>
7	.	<code>esr(config-if-gi)# channel-group <ID> mode <MODE></code>	<p><code><ID></code> – , [1..12].</p> <p><code><MODE></code> – : <ul style="list-style-type: none"> • auto – LACP; • on – . </p>
8	LACP- Ethernet.	<code>esr(config-if-gi)# lACP port-priority <PRIORITY></code>	<p><code><PRIORITY></code> – , [1..65535].</p> <p>: 1</p>
9	, – ().	<code>esr(config-subif)# load-average <TIME></code>	<code><TIME></code> – , [5..150].
10	IPv4/IPv6 ARP-, ().	<code>esr(config-subif)# ip arp reachable-time <TIME></code> <code>esr(config-subif)# ipv6 nd reachable-time <TIME></code>	<p><code><TIME></code> – MAC-, .</p> <p>5000 10000000 . [0,5;1,5] *<code><TIME></code>.</p>
11	MTU (MaximumTransmitionUnit). MTU 1500 "system jumbo-frames" ().	<code>esr(config-subif)# mtu <MTU></code>	<p><code><MTU></code> – MTU .</p> <p>: 1500.</p>
12	().	<code>esr(config-subif)# history statistics</code>	
13	MSS (Maximum segment size) TCP- ().	<code>esr(config-subif)# ip tcp adjust-mss <MSS></code> <code>esr(config-subif)# ipv6 tcp adjust-mss <MSS></code>	<p><code><MSS></code> – MSS, [500..1460].</p> <p>: 1460</p>
:		<ul style="list-style-type: none"> • IPv4/IPv6- (, IP-, IPv6- DHCP-); • Firewall (, Firewall); • QoS (, QoS); • proxy (, HTTP/HTTPS-); • (, Netflow sFlow); • (,); • VRRF(,) • BRAS (, BRAS (Broadband Remote Access Server)); • IDS/IPS (, IPS/IDS). 	

ESR .



gi1/0/1, gi1/0/2 «no security-zone».

port-channel 2:

```
esr(config)# interface port-channel 2
```

gi1/0/1, gi1/0/2 :

```
esr(config)# interface gigabitethernet 1/0/1-2
esr(config-if-gi)# channel-group 2 mode auto
```

port-channel .

AUX



ESR-21.

AUX , ESR.

1	.	esr(config)# line aux <NUM>	<NUM> – , [1..3].
2	(). , . . .	esr(config-line-aux) databits <BITS> esr(config-line-aux) flowcontrol <FMODE> esr(config-line-aux) parity <PMODE> esr(config-line-aux) speed <SPEED> esr(config-line-aux) stopbits <STOP-BITS>	<BITS> - [7..8]; "8", <FMODE> – . : <ul style="list-style-type: none"> • software – ; • hardware – ; • disabled – ; "disabled", <PMODE> – . : <ul style="list-style-type: none"> • odd – ; • even – ; • none – ; "none", <SPEED> – /. : <ul style="list-style-type: none"> • 300; • 1200; • 2400; • 4800; • 9600; • 19200; • 38400; • 57600; • 115200; "115200", <STOP-BITS> - [1..2]; "1".
3	().	esr(config-line-aux)# description <DESCRIPTION>	<DESCRIPTION> – , 255 .
4	, (). : "transport telnet port".	esr(config-line-aux)# modem inout	
5	ESR TCP-, TCP- ESR telnet (). : "modem inout".	esr(config-line-aux)# transport telnet port <PORT>	<PORT> – TCP- . [1..65535].

1:

IP- ESR Serial-, Leased line (),



Modem Zyxel U-336E Plus.

ESR-21

```
esr-21-1(config)# line aux 2  
esr-21-1(config-line-aux)# flowcontrol hardware  
esr-21-1(config-line-aux)# exit  
esr-21-1(config)#
```

RS-232 :

```
esr-21-1(config)# interface serial 1/0/2  
esr-21-1(config-serial)# ip address 1.1.1.1/24  
esr-21-1(config-serial)# exit  
esr-21-1(config)#
```

firewall :

```
esr-21-1(config)# security zone xx  
esr-21-1(config-zone)# exit  
esr-21-1(config)# security zone-pair xx self  
esr-21-1(config-zone-pair)# rule 1  
esr-21-1(config-zone-pair-rule)# action permit  
esr-21-1(config-zone-pair-rule)# enable  
esr-21-1(config-zone-pair-rule)# exit  
esr-21-1(config-zone-pair)# exit  
esr-21-1(config)#
```

```
esr-21-1(config)# interface serial 1/0/2  
esr-21-1(config-serial)# security-zone xx  
esr-21-1(config-serial)# exit  
esr-21-1(config)#
```

ESR-21

```
:  
esr-21-2(config)# line aux 2  
esr-21-2(config-line-aux)# flowcontrol hardware  
esr-21-2(config-line-aux)# exit  
esr-21-2(config)#
```

RS-232 :

```
esr-21-2(config)# interface serial 1/0/2  
esr-21-2(config-serial)# ip address 1.1.1.2/24  
esr-21-2(config-serial)# exit  
esr-21-2(config)#
```

firewall :

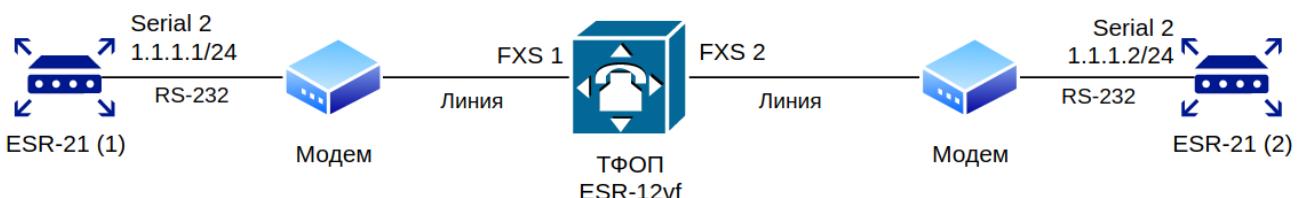
```
esr-21-2(config)# security zone xx  
esr-21-2(config-zone)# exit  
esr-21-2(config)# security zone-pair xx self  
esr-21-2(config-zone-pair)# rule 1  
esr-21-2(config-zone-pair-rule)# action permit  
esr-21-2(config-zone-pair-rule)# enable  
esr-21-2(config-zone-pair-rule)# exit  
esr-21-2(config-zone-pair)# exit  
esr-21-2(config)#
```

:

```
esr-21-2(config)# interface serial 1/0/2  
esr-21-2(config-serial)# security-zone xx  
esr-21-2(config-serial)# exit  
esr-21-2(config)#
```

2:

IP- ESR Serial-, Dial-Up ()



ESR-12VF :

```

dialplan pattern factory_test
  description "dialplan for factory test"
  pattern "S5, L5 (00[1-3]@{local} | [xABCD*#].S)"
    enable
exit
sip profile 1
  dialplan pattern "factory_test"
  enable
proxy primary
  enable
  ip address proxy-server 192.0.2.5
  registration
  ip address registration-server 192.0.2.5
exit
exit
interface voice-port 1
  sip user phone 001
  profile sip 1
exit
interface voice-port 2
  sip user phone 002
  profile sip 1
  caller-id mode fsk-bell
exit

```



- Modem ZyXEL OMNI 56K (MINI)
- Modem Acorp-M56SCD

:

ESR-21

```

esr-21-1(config)# line aux 2
esr-21-1(config-line-aux)# flowcontrol hardware
esr-21-1(config-line-aux)# modem inout
esr-21-1(config-line-aux)# exit
esr-21-1(config)#

```

RS-232 :

```

esr-21-1(config)# interface serial 1/0/2
esr-21-1(config-serial)# ip address 1.1.1.1/24
esr-21-1(config-serial)# exit
esr-21-1(config)#

```

firewall :

```

esr-21-1(config)# security zone xx
esr-21-1(config-zone)# exit
esr-21-1(config)# security zone-pair xx self
esr-21-1(config-zone-pair)#   rule 1
esr-21-1(config-zone-pair-rule)# action permit
esr-21-1(config-zone-pair-rule)# enable
esr-21-1(config-zone-pair-rule)# exit
esr-21-1(config-zone-pair)# exit
esr-21-1(config)#

```

:

```
esr-21-1(config)# interface serial 1/0/2
esr-21-1(config-serial)# security-zone xx
esr-21-1(config-serial)# exit
esr-21-1(config)#
```

```
:
```



```
esr-21-1(config)# interface serial 1/0/2
esr-21-1(config-serial)# dialer string 002
esr-21-1(config-serial)# dialer
esr-21-1(config-serial)# exit
esr-21-1(config)#
```

ESR-21

```
:
```



```
esr-21-2(config)# line aux 2
esr-21-2(config-line-aux)# flowcontrol hardware
esr-21-2(config-line-aux)# modem inout
esr-21-2(config-line-aux)# exit
esr-21-2(config)#
```

RS-232 :

```
esr-21-2(config)# interface serial 1/0/2
esr-21-2(config-serial)# ip address 1.1.1.2/24
esr-21-2(config-serial)# exit
esr-21-2(config)#
```

firewall :

```
esr-21-2(config)# security zone xx
esr-21-2(config-zone)# exit
esr-21-2(config)# security zone-pair xx self
esr-21-2(config-zone-pair)# rule 1
esr-21-2(config-zone-pair-rule)# action permit
esr-21-2(config-zone-pair-rule)# enable
esr-21-2(config-zone-pair-rule)# exit
esr-21-2(config-zone-pair)# exit
esr-21-2(config)#
```

:

```
esr-21-2(config)# interface serial 1/0/2
esr-21-2(config-serial)# security-zone xx
esr-21-2(config-serial)# exit
esr-21-2(config)#
```

3:

2

- 1 V.22bis
-

ESR-21,

- AT&N1" - V.22bis
- ATM0LO -

```
esr-21-1(config)# chat-script dial_test "ABORT 'BUSY' ABORT 'NO CARRIER' ABORT ERROR '' AT OK AT&F OK AT&N14 OK  
ATM0LO OK ATD\\T CONNECT ''"  
esr-21-1(config)#
```

:

```
esr-21-1(config)# interface serial 1/0/2  
esr-21-1(config-serial)# dialer string 001 modem-script dial_test  
esr-21-1(config-serial)# exit  
esr-21-1(config)#
```

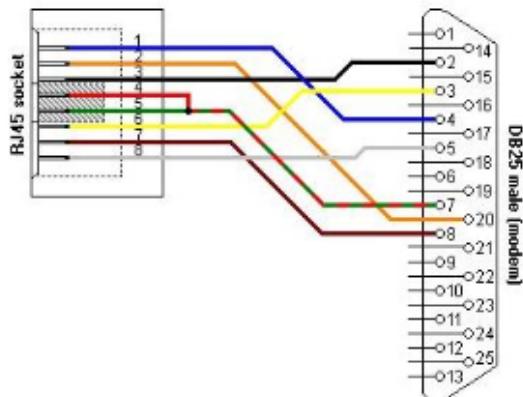
ESR-21:

```
esr-21-2(config)# chat-script answer_test "ABORT 'BUSY' ABORT 'NO CARRIER' '' AT OK AT&F OK ATM0LO RING ATAr  
CONNECT ''"  
esr-21-2(config)#
```

:

```
esr-21-2(config)# interface serial 1/0/2  
esr-21-2(config-serial)# dialer string 000 modem-script answer_test  
esr-21-2(config-serial)# exit  
esr-21-2(config)#
```

RJ-45 <-> DB-25 pinout



RJ-45 <-> RJ-45 pinout (rolled over cable)

