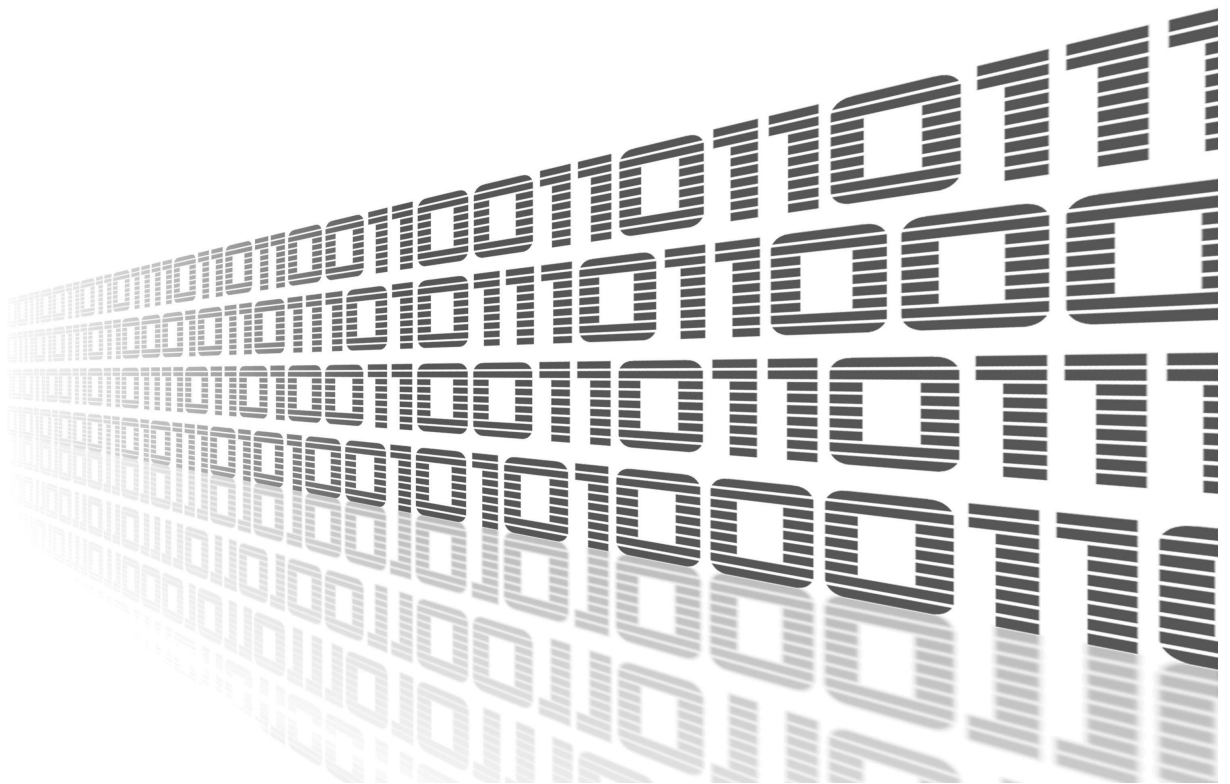




Dynamic Multipoint VPN

APPLICATION NOTE



ADVANTECH

Used symbols



Danger – Information regarding user safety or potential damage to the router.



Attention – Problems that may arise in specific situations.



Information or notice – Useful tips or information of special interest.



Example – Example of function, command or script.



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1. Basic Information



The described router apps *FRR* and *NHRP* are not contained in the standard router firmware. Uploading of this router app is described in the Configuration manual (see Chapter [Related Documents](#)).

A Dynamic Multipoint VPN (DMVPN) is a concept of the secure network that exchanges data between remote routers ("spokes") without needing to pass traffic through a headquarter virtual private network (VPN) router ("hub"). Each spoke is permanently connected to the headquarter (hub) using VPN tunnel. If two spokes need to communicate to each other, temporary VPN tunnel is created between them (headquarter has a role of NHRP server). Tunnels are canceled after finishing of communication. The DMVPN allows establishing VPN tunnels between routers with dynamically assigned port addresses (this is not possible when using "classical" site-to-site VPN). The DMVPN essentially creates a topology that could be called *(full) mesh VPN*. This means that each remote router (spoke) can connect directly to all other remote routers, no matter where they are located.



Spoke-to-spoke capability is not currently supported in our DMVPN solution.

1.1 Architecture

DMVPN concept includes mechanisms such as GRE tunneling and IPsec encryption with Next Hop Resolution Protocol (NHRP) routing that are designed to reduce administrative burden and provide reliable dynamic connectivity between sites.

Key components:

- **Multipoint GRE (mGRE)** – Allows a single GRE interface to support multiple IPsec tunnels (i.e. one mGRE interface supports all spokes), simplifying the size and complexity of the configuration.
- **Dynamic IPsec protocol encryption** – Secures (encrypts) data transmitted through VPN tunnels.
- **Next-Hop Resolution Protocol (NHRP)** – The headquarter router (hub) maintains an NHRP database of the public interface addresses of the each spoke. Each spoke registers its real address on boot. When direct tunnels with other spokes are requested, it queries the NHRP database for real addresses of the spokes' destinations. When the connection is not needed, it is terminated (VPN tunnel is canceled).

The following figure shows the way Dynamic Multipoint VPN concept works. Headquarter router with NHRP database is referred to as *HUB*, remote routers are referred to as *Spoke A* and *Spoke B*.

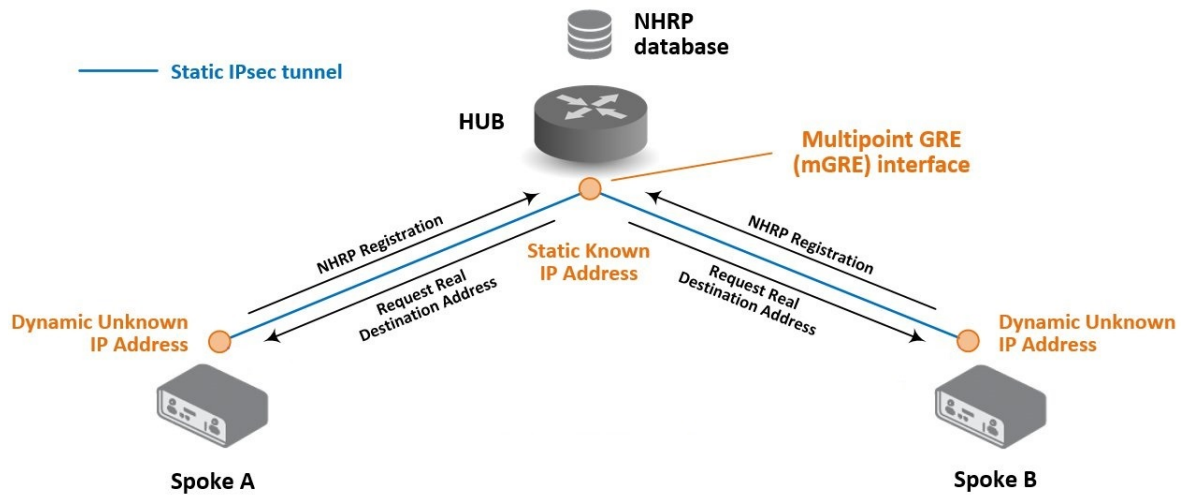


Figure 1: DMVPN architecture

1.2 Necessary Requirements

- Cisco headquarter hub router and connection to the Internet from hub and all spokes. Only Cisco router can be used as headquarter hub router.
- *NHRP* router app in every spoke router.
- *FRR* router app in every spoke router.
- GRE tunnel configuration in every spoke router (with proper IP routes).

See the example configuration below for more details.

2. Configuration Example

For a configuration example two Advantech routers were used as spokes - router A and router B and one Cisco ISR4331 router as headquarter hub.

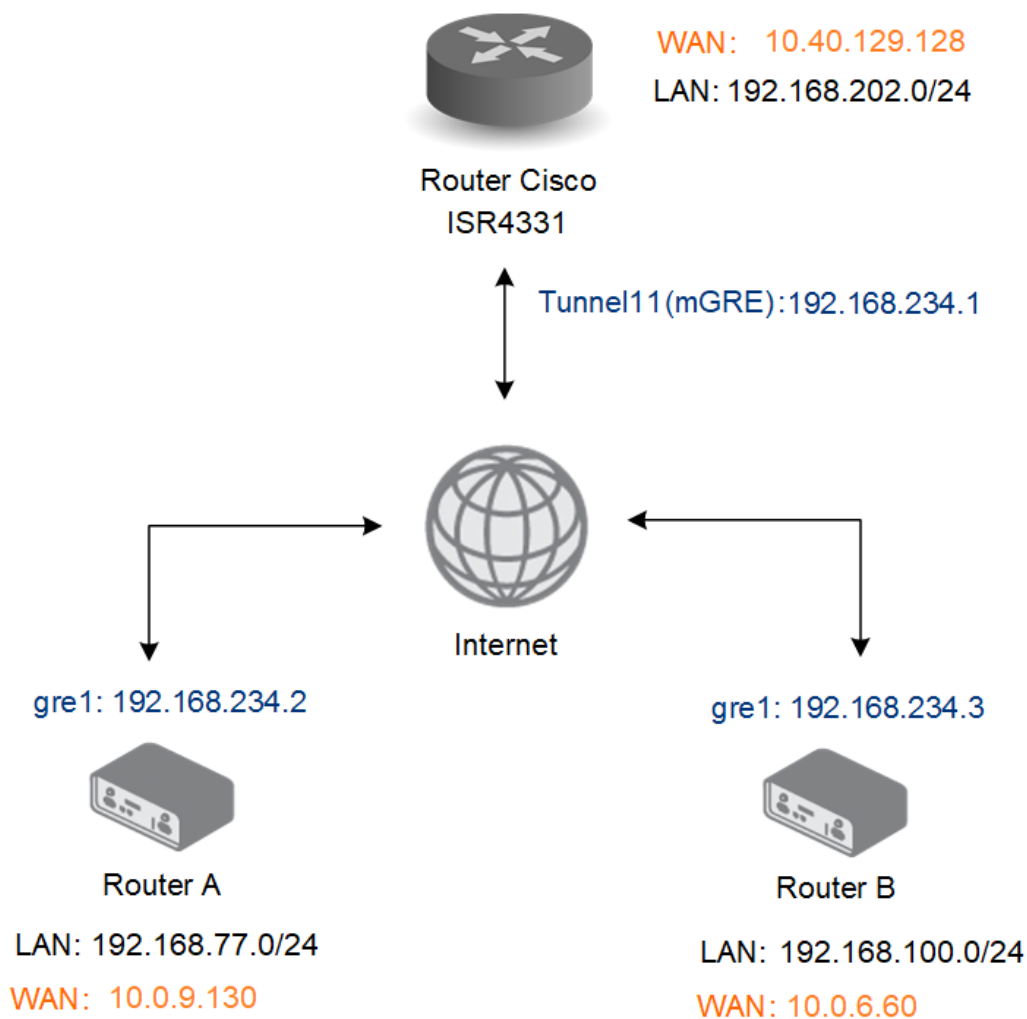


Figure 2: Configuration example scheme

2.1 Headquarter Hub Router Configuration

In this example configuration, the Cisco ISR4331 router was used as the headquarter hub router. The necessary configuration is the following. (Log-in to the Cisco router console and type `config terminal` command. Refer to proper Cisco manual for the instructions how to configure the Cisco router.) More about IPsec Tunnel and certificate generation can be found in IPsec Tunnel Application Note [\[7\]](#)

```

1  !
2  crypto pki trustpoint server.cisco
3  enrollment pkcs12
4  revocation-check none
5  rsakeypair server.cisco
6  !
7  crypto pki certificate map ike_v2_certmap 10
8  subject-name co client
9  !
10 crypto pki certificate chain server.cisco
11 certificate 29BEF8C0BE9377F585E4C9E7E569B4B1FEA8544A
12 308203C2 308202AA A0030201 02021429 BEF8C0BE 9377F585 E4C9E7E5 69B4B1FE
13 A8544A30 0D06092A 864886F7 0D01010B 05003081 8E310B30 09060355 04061302
14 ...
15 D1A4308D 19992469 0FB6A78F DCAD252B E83C040E 087BC4E0 F0379F41 02EEC176
16 56937ECD 03926DF0 3B782620 E1116E19 256426CB D188D214 5DF5A7AC D1E755E5
17 BDE3837E C26D
18 quit
19 certificate ca 29BEF8C0BE9377F585E4C9E7E569B4B1FEA8543C
20 308203FF 308202E7 A0030201 02021429 BEF8C0BE 9377F585 E4C9E7E5 69B4B1FE
21 A8543C30 0D06092A 864886F7 0D01010B 05003081 8E310B30 09060355 04061302
22 ...
23 C319BFFF 3645B107 EA089A1A 9C3BC558 9AA9FF3F EA735430 83E7E464 B5311867
24 CF1E190B 020AB854 052B06A5 6883BA55 7C604513 82ED6A63 5CF567FD 66F49EE8 899C7B
25 quit
26 !
27 crypto ikev2 proposal ike_v2_proposal
28 encryption aes-gcm-256
29 prf sha256
30 group 21
31 !
32 crypto ikev2 policy ike_v2_policy
33 proposal ike_v2_proposal
34 !
35 !
36 crypto ikev2 profile ike_v2_profile
37 match certificate ike_v2_certmap
38 identity local fqdn server.cisco
39 authentication remote rsa-sig
40 authentication local rsa-sig
41 pki trustpoint server.cisco
42 !
43 crypto ipsec transform-set aes-gcm esp-gcm 256
44 mode transport
45 !
46 crypto ipsec profile FlexVPN

```



```

47 set security-policy limit 100
48 set transform-set aes-gcm
49 set pfs group21
50 set ikev2-profile ike_v2_profile
51 responder-only
52 !
53 interface Tunnel11
54 ip address 192.168.234.1 255.255.255.0
55 no ip redirects
56 ip nhrp network-id 1234
57 no ip nhrp record
58 no ip nhrp cache non-authoritative
59 tunnel source GigabitEthernet0/0/0
60 tunnel mode gre multipoint
61 tunnel key 1234
62 tunnel protection ipsec profile FlexVPN
63 !
64 interface GigabitEthernet0/0/0
65 ip address 10.40.29.128 255.255.252.0
66 ip nat outside
67 ip access-group 101 in
68 negotiation auto
69 spanning-tree portfast disable
70 !
71 interface GigabitEthernet0/0/1
72 no ip address
73 negotiation auto
74 spanning-tree portfast trunk
75 !
76 interface GigabitEthernet0/0/1.202
77 encapsulation dot1Q 202
78 ip address 192.168.202.254 255.255.255.0
79 !
80 router bgp 65001
81 bgp router-id 192.168.234.1
82 bgp log-neighbor-changes
83 bgp listen range 192.168.234.0/24 peer-group DMVPN_SPOKES
84 network 192.168.202.0
85 neighbor DMVPN_SPOKES peer-group
86 neighbor DMVPN_SPOKES remote-as 65001
87 neighbor DMVPN_SPOKES route-reflector-client
88 neighbor DMVPN_SPOKES route-map SPOKE_ROUTERS out
89 !
90 route-map SPOKE_ROUTERS permit 10
91 !

```

2.2 GRE Tunnel Configuration

Create the GRE tunnels between the headquarter (hub router) and remote routers (spokes).

Open the Web interface of the first spoke (*Router A*) and press *GRE* item in the *Configuration* section and then select *1st Tunnel*. Fill in the configuration form as indicated in the Figure and Table below.

1st GRE Tunnel Configuration

☒ Create 1st GRE tunnel

Description *

Remote IP Address *

Local IP Address *

Remote Subnet *

Remote Subnet Mask *

Local Interface IP Address *

Remote Interface IP Address *

Multicasts

Pre-shared Key *

* can be blank

Figure 3: Router A – GRE configuration

Item	Value
Remote Subnet	192.168.234.0 (<i>Cisco headquarter hub</i>)
Local Interface IP Address	192.168.234.2
Pre-shared Key	1234

Table 1: Router A – GRE configuration

2.2.1 Configure the other Spoke (Router B)

Make the same configuration for Advantech routers B. Change only the local side of the tunnel IP address.

2nd GRE Tunnel Configuration

☒ Create 2nd GRE tunnel

Description *

DMVPN

Remote IP Address *

Local IP Address *

Remote Subnet *

192.168.234.0

Remote Subnet Mask *

255.255.255.0

Local Interface IP Address *

192.168.234.3

Remote Interface IP Address *

Multicasts

enabled

Pre-shared Key *

....

* can be blank

Apply

Figure 4: Router B – GRE configuration

2.3 IPsec Configuration

It is necessary to configure IPsec for remote Advantech routers A and B (spokes) to ensure the security (encryption) of tunnel connections.

Open the Web interface of the first spoke (*Router A*) and press *IPsec* item in the *Configuration* section and then select *1st Tunnel*. Fill in the configuration form as indicated in the Figure and Table below.

1st IPsec Tunnel Configuration	
<input checked="" type="checkbox"/> Create 1st IPsec tunnel	
Description *	DMVPN SPOKE1
Type	policy-based ▼
Host IP Mode	IPv4 ▼
Remote IP Address *	10.40.29.128
Tunnel IP Mode	IPv4 ▼
Remote ID *	server.cisco
Local ID *	client@router
Install Routes	yes ▼
First Remote Subnet *	
First Remote Subnet Mask *	
Second Remote Subnet *	
Second Remote Subnet Mask *	
Remote Protocol/Port *	47
First Local Subnet *	
First Local Subnet Mask *	
Second Local Subnet *	
Second Local Subnet Mask *	
Local Protocol/Port *	47
Remote Virtual Network *	
Remote Virtual Mask *	
Local Virtual Address *	
Cisco FlexVPN **	no ▼
Encapsulation Mode	transport ▼
Force NAT Traversal	yes ▼

Figure 5: IPsec Router A configuration Part 1

Remote Virtual Network *	<input type="text"/>
Remote Virtual Mask *	<input type="text"/>
Local Virtual Address *	<input type="text"/>
Cisco FlexVPN **	no ▼
Encapsulation Mode	transport ▼
Force NAT Traversal	yes ▼
IKE Protocol	IKEv2 ▼
IKE Mode	main ▼
IKE Algorithm	manual ▼
IKE Encryption	AES256GCM128 ▼
IKE Hash	SHA256 ▼
IKE DH Group	21 ▼
IKE Reauthentication	no ▼
XAUTH Enabled	no ▼
XAUTH Mode	client ▼
XAUTH Username	<input type="text"/>
XAUTH Password	<input type="text"/>
ESP Algorithm	manual ▼
ESP Encryption	AES256GCM128 ▼
ESP Hash	MD5 ▼
PFS	enabled ▼
PFS DH Group	21 ▼

Figure 6: IPsec Router A configuration Part 2

Key Lifetime	<input type="text" value="3600"/>	sec
IKE Lifetime	<input type="text" value="3600"/>	sec
Rekey Margin	<input type="text" value="540"/>	sec
Rekey Fuzz	<input type="text" value="100"/>	%
DPD Delay *	<input type="text" value="20"/>	sec
DPD Timeout *	<input type="text"/>	sec
Authenticate Mode	<input type="text" value="X.509 certificate"/>	
Pre-shared Key	<input type="text"/>	
CA Certificate *	<div> <div>-----BEGIN CERTIFICATE-----</div> <div>MIID/zCCAuegAwIBAgIUk74wL6Td/WF5EL</div> <div>BQAwwY4xCzAJBgNVBAYTAKNaMRAwDgYDV1B</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Remote Certificate / PubKey *	<div><input type="text"/></div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Certificate / PubKey	<div> <div>-----BEGIN CERTIFICATE-----</div> <div>MIIDxTCCAq2gAwIBAgIUk74wL6Td/WF5EL</div> <div>BQAwwY4xCzAJBgNVBAYTAKNaMRAwDgYDV1B</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Private Key	<div> <div>-----BEGIN RSA PRIVATE KEY-----</div> <div>Proc-Type: 4, ENCRYPTED</div> <div>DEK-Info: DES-EDE3-CBC, C053026FE4</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Passphrase *	<input type="password" value="....."/>	
Revocation Check	<input type="text" value="if possible"/>	
Debug **	<input type="text" value="control"/>	
<p>* can be blank</p> <p>** affects all tunnels</p>		
<input type="button" value="Apply"/>		

Figure 7: IPsec Router A configuration Part 3

Save the changes using the *Apply* button. Use the same procedure for all spokes – the *IPsec* For Router B the configuration should look like this:

2nd IPsec Tunnel Configuration	
<input checked="" type="checkbox"/> Create 2nd IPsec tunnel	
Description *	DMPVN SPOKE2
Type	policy-based ▼
Host IP Mode	IPv4 ▼
Remote IP Address *	10.40.29.128
Tunnel IP Mode	IPv4 ▼
Remote ID *	server.cisco
Local ID *	client2@router
Install Routes	yes ▼
First Remote Subnet *	
First Remote Subnet Mask *	
Second Remote Subnet *	
Second Remote Subnet Mask *	
Remote Protocol/Port *	47
First Local Subnet *	
First Local Subnet Mask *	
Second Local Subnet *	
Second Local Subnet Mask *	
Local Protocol/Port *	47
Remote Virtual Network *	
Remote Virtual Mask *	
Local Virtual Address *	
Encapsulation Mode	transport ▼
Force NAT Traversal	no ▼

Figure 8: IPsec Router B configuration Part 1

Remote Virtual Network *	<input type="text"/>
Remote Virtual Mask *	<input type="text"/>
Local Virtual Address *	<input type="text"/>
Encapsulation Mode	transport ▼
Force NAT Traversal	no ▼
IKE Protocol	IKEv2 ▼
IKE Mode	main ▼
IKE Algorithm	manual ▼
IKE Encryption	AES256GCM128 ▼
IKE Hash	SHA256 ▼
IKE DH Group	21 ▼
IKE Reauthentication	yes ▼
XAUTH Enabled	no ▼
XAUTH Mode	client ▼
XAUTH Username	<input type="text"/>
XAUTH Password	<input type="text"/>
ESP Algorithm	manual ▼
ESP Encryption	AES256GCM128 ▼
ESP Hash	MD5 ▼
PFS	enabled ▼
PFS DH Group	21 ▼

Figure 9: IPsec Router B configuration Part 2

Key Lifetime	<input type="text" value="36000"/>	sec
IKE Lifetime	<input type="text" value="36000"/>	sec
Rekey Margin	<input type="text" value="540"/>	sec
Rekey Fuzz	<input type="text" value="100"/>	%
DPD Delay *	<input type="text" value="20"/>	sec
DPD Timeout *	<input type="text"/>	sec
Authenticate Mode	<input type="text" value="X.509 certificate"/>	
Pre-shared Key	<input type="text"/>	
CA Certificate *	<div> <div>-----BEGIN CERTIFICATE-----</div> <div>MIID/zCCAuegAwIBAgIUk74wL6Td/WF!EL</div> <div>BQAwwY4xCzAJBgNVBAYTAKNaMRAwDgYD.lB</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Remote Certificate / PubKey *	<div><input type="text"/></div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Certificate / PubKey	<div> <div>-----BEGIN CERTIFICATE-----</div> <div>MIIDyDCCArCgAwIBAgIUk74wL6Td/WF!EL</div> <div>BQAwwY4xCzAJBgNVBAYTAKNaMRAwDgYD.lB</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Private Key	<div> <div>-----BEGIN RSA PRIVATE KEY-----</div> <div>Proc-Type: 4,ENCRYPTED</div> <div>DEK-Info: DES-EDE3-CBC,6A994C0B8</div> </div> <div> <input type="button" value="Vybrat soubor"/> <input type="button" value="Soubor nevybrán"/> </div>	
Local Passphrase *	<input type="text" value="....."/>	
Revocation Check	<input type="text" value="If possible"/>	
Debug	<input type="text" value="control"/>	
* can be blank		
<input type="button" value="Apply"/>		

Figure 10: IPsec Router B configuration Part 3

2.4 NHRP Configuration – NHRP Router App

NHRP configuration can be done via the *NHRP* router app. The *OpenNHRP* Linux implementation of NHRP – Next-Hop Resolution Protocol – is used in the router app. It is Cisco DMVPN compatible.



The router app *NHRP* is not part of the standard router firmware. See the Configuration Manual ([1, 2]) for the description of uploading the router app to the router.

Go to the *Router Apps* page and then *NHRP* to configure the *NHRP* router app. Tick the *Enable NHRP* box and insert the configuration commands in the fields.

NHRP Configuration

☒ Enable NHRP

/var/nhrp/opennhrp.conf

```
interface gre1
  map 192.168.234.1/24 10.40.29.128 register
  holding-time 60
  shortcut
  redirect
  non-caching
```

/var/nhrp/opennhrp-script

```
#!/bin/sh

case $1 in
interface-up)
  ip route flush proto 42 dev $NHRP_INTERFACE
  ip neigh flush dev $NHRP_INTERFACE
  ;;
peer-register)
  ;;
peer-up)
  if [ -n "$NHRP_DESTMTU" ]; then
    ARGS=`ip route get $NHRP_DESTNBMA from $NHRP_SRCNBMA | head -1`
    ip route add $ARGS proto 42 mtu $NHRP_DESTMTU
  fi
  echo "Create link from $NHRP_SRCADDR ($NHRP_SRCNBMA) to $NHRP_DESTADDR ($NHRP_DESTNBMA)"
  /etc/init.d/ipsec start
  ..
```

Debug Error

Figure 11: NHRP router app configuration

Field `/var/nhrp/opennhrp.conf` – insert the following configuration. It is to register the proper interface to the NHRP headquarter hub router and other needed parameters (edit to your own needs).

```
1 interface gre1
2 map 192.168.234.1/24 10.40.29.128 register
3 holding-time 60
4 shortcut
5 redirect
6 non-caching
```

Field `/var/nhrp/opennhrp-script` – this is the *OpenNHRP* script to define the behavior in various situations. You can left it unchanged. If you accidentally edit it, you can copy it from the next page.

Press the *Apply* button to save the changes. Use the same procedure for all spokes – the *NHRP Configuration* remains the same for all the spoke routers.

Field `/var/nhrp/opennhrp-script`

```
1 #!/bin/sh
2
3 case $1 in
4 interface-up)
5 ip route flush proto 42 dev $NHRP_INTERFACE
6 ip neigh flush dev $NHRP_INTERFACE
7 ;;
8 peer-register)
9 ;;
10 peer-up)
11 if [ -n "$NHRP_DESTMTU" ]; then
12 ARGS='ip route get $NHRP_DESTNBMA from $NHRP_SRCNBMA | head -1'
13 ip route add $ARGS proto 42 mtu $NHRP_DESTMTU
14 fi
15 echo "Create link from $NHRP_SRCADDR ($NHRP_SRCNBMA) to $NHRP_DESTADDR (
    $NHRP_DESTNBMA)"
16 /etc/init.d/ipsec start
17 ;;
18 peer-down)
19 echo "Delete link from $NHRP_SRCADDR ($NHRP_SRCNBMA) to $NHRP_DESTADDR (
    $NHRP_DESTNBMA)"
20 if [ "$NHRP_PEER_DOWN_REASON" != "lower-down" ]; then
21 /etc/init.d/ipsec stop
22 fi
23 ip route del $NHRP_DESTNBMA src $NHRP_SRCNBMA proto 42
24 ;;
25 route-up)
26 echo "Route $NHRP_DESTADDR/$NHRP_DESTPREFIX is up"
27 ip route replace $NHRP_DESTADDR/$NHRP_DESTPREFIX proto 42 via $NHRP_NEXTHOP dev
    $NHRP_INTERFACE
28 ip route flush cache
```

```

29 ;;
30 route-down)
31 echo "Route $NHRP_DESTADDR/$NHRP_DESTPREFIX is down"
32 ip route del $NHRP_DESTADDR/$NHRP_DESTPREFIX proto 42
33 ip route flush cache
34 ;;
35 esac
36
37 exit 0

```

2.5 BGP Configuration – FRR Router App

BGP configuration can be done via the *FRR* router app.



The router app *FRR* is not part of the standard router firmware. See the Configuration Manual ([1, 2]) for the description of uploading the router app to the router.

Go to the *Router apps* page and then find the *FRR* item in the Configuration section to configure the *BGP* protocol of this router. In the *BGP* tick the *Enable BGP* box and insert the configuration commands in the field.

Configuration for Router A should look like this:

BGP Configuration

☒ Enable BGP


```

!
! Default configuration with enabled vty
! Change password!!!
!
password conel
enable password conel
!
line vty
!
log syslog
!
router bgp 65001
  bgp router-id 192.168.234.2
  bgp log-neighbor-changes
  no bgp ebgp-requires-policy
!
  neighbor 192.168.234.1 remote-as 65001
  neighbor 192.168.234.1 disable-connected-check
!
  address-family ipv4 unicast
    network 192.168.100.0/24
  exit-address-family
  timers bgp 3 15
!
debug bgp neighbor-events
debug bgp zebra
debug bgp nht
debug bgp updates
!
!
        
```

Figure 12: BGP configuration Router A Part 1

```

!
!
router bgp 64402
  bgp router-id 100.100.100.100
  bgp log-neighbor-changes
  bgp disable-ebgp-connected-route-check
  no bgp ebgp-requires-policy
  neighbor 172.24.0.2 remote-as 64501
!
  address-family ipv4
    network 192.168.111.0/24
    network 172.24.0.1/32
  exit-address-family
!
  timers bgp 3 15

debug bgp neighbor-events
debug bgp zebra
debug bgp nht
debug bgp updates
!

```

Apply

Figure 13: BGP configuration Router A Part 2

and BGP configuration for router B can be like this:

BGP Configuration

☒ Enable BGP

```

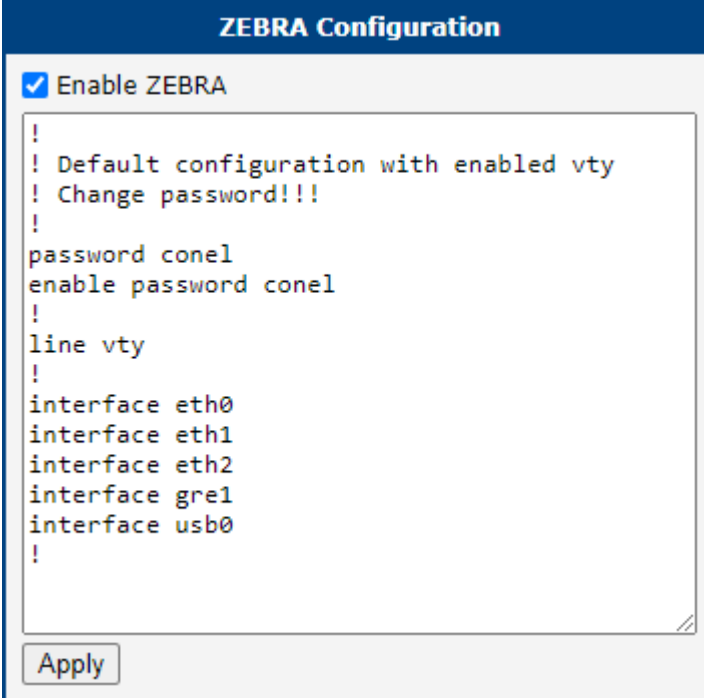
!
! Default configuration with enabled vty
! Change password!!!
!
password conel
enable password conel
!
line vty
!
log syslog
!
router bgp 65001
  bgp router-id 192.168.234.3
  bgp log-neighbor-changes
  no bgp ebgp-requires-policy
!
  neighbor 192.168.234.1 remote-as 65001
  neighbor 192.168.234.1 disable-connected-check
!
  address-family ipv4 unicast
    network 192.168.77.0/24
  exit-address-family
  timers bgp 3 15
!
debug bgp neighbor-events
debug bgp zebra
debug bgp nht
debug bgp updates
        
```

Figure 14: BGP configuration Router B

2.6 Zebra Configuration – FRR Router App

Like in BGP section before, the Zebra configuration can be done via the *FRR* router app.

Go to the *Router Apps* page and then find the *FRR* item in the Configuration section to configure the *ZEBRA* protocol of this router. In the *ZEBRA* tick the *Enable ZEBRA* box and insert the configuration commands in the field.



ZEBRA Configuration

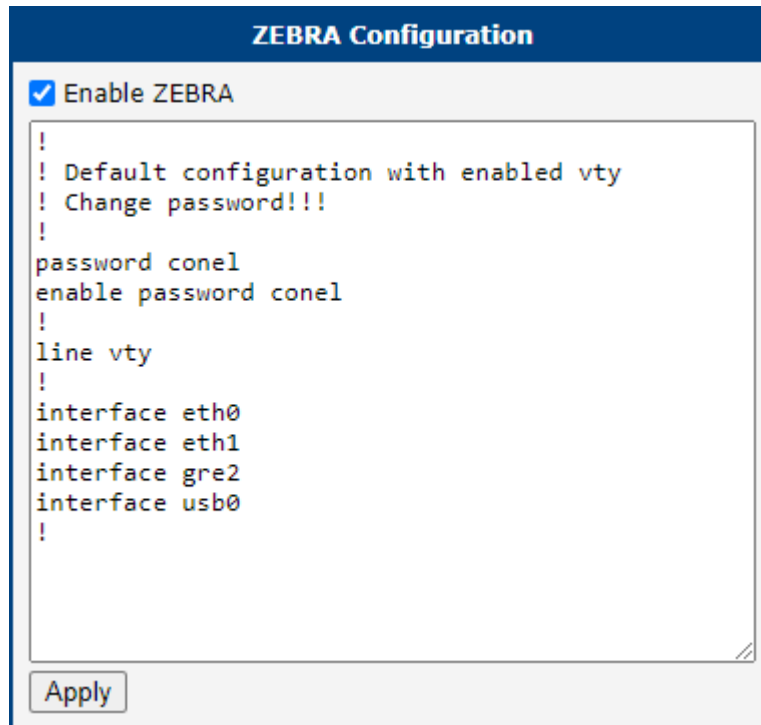
☒ Enable ZEBRA

```
!
! Default configuration with enabled vty
! Change password!!!
!
password conel
enable password conel
!
line vty
!
interface eth0
interface eth1
interface eth2
interface gre1
interface usb0
!
```

Apply

Figure 15: Zebra configuration Router A

and for router B the ZEBRA configuration should be:



The image shows a 'ZEBRA Configuration' window. At the top, there is a checkbox labeled 'Enable ZEBRA' which is checked. Below this is a text area containing the following configuration text:

```
!  
! Default configuration with enabled vty  
! Change password!!!  
!  
password conel  
enable password conel  
!  
line vty  
!  
interface eth0  
interface eth1  
interface gre2  
interface usb0  
!
```

At the bottom left of the window is an 'Apply' button.

Figure 16: Zebra configuration Router B

2.7 Check the Function of Dynamic Multipoint VPN

If the configuration is done correctly, the following information will be displayed on *System Log* page of router A and B. The router is sending NHRP Registration Request and is receiving the success message (same on router A and B):

Received Registration Reply from 192.168.234.1: success

System Log	
System Messages	
2015-07-27 03:07:59	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:07:59	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:07:59	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:08:20	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:08:20	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:08:20	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:08:41	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:08:42	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:08:42	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:09:03	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:09:04	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:09:04	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:09:25	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:09:25	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:09:25	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:09:46	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:09:47	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:09:47	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:10:08	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:10:08	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:10:08	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:10:29	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:10:30	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:10:30	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:10:51	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:10:51	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:10:51	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24
2015-07-27 03:11:12	opennhp[857]: Sending Registration Request to 192.168.234.1 (my mtu=0)
2015-07-27 03:11:13	opennhp[857]: Received Registration Reply from 192.168.234.1: success
2015-07-27 03:11:13	opennhp[857]: NAT detected: our real NBMA address is 37.188.224.24

Figure 17: Router A – System Log with the NHRP registration success message

You should see changes in the Route Tables of the routers. Here the *Route Table* of the Router C – page *Network* in the *Status* section of the router. See the routes to the networks according to the scheme in Figure 2 via gre1 tunnel network interface.

Route Table							
Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
0.0.0.0	192.168.254.254	0.0.0.0	UG	0	0	0	usb0
10.40.28.0	192.168.234.1	255.255.252.0	UG	0	0	0	gre1
192.168.1.0	192.168.234.1	255.255.255.0	UG	0	0	0	gre1
192.168.10.0	0.0.0.0	255.255.255.0	U	0	0	0	eth0
192.168.100.0	192.168.234.1	255.255.255.0	UG	0	0	0	gre1
192.168.234.1	0.0.0.0	255.255.255.255	UH	0	0	0	gre1
192.168.254.254	0.0.0.0	255.255.255.255	UH	0	0	0	usb0

Figure 18: Router C – Route Table

If you login to the Cisco headquarter hub router and run the `show dmvpn` command, you should see the spokes (peers) connected with the proper tunnel addresses and other information:

```

1 Router#show dmvpn
2 Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
3 N - NATed, L - Local, X - No Socket
4 T1 - Route Installed, T2 - Nexthop-override
5 C - CTS Capable, I2 - Temporary
6 # Ent --> Number of NHRP entries with same NBMA peer
7 NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
8 UpDn Time --> Up or Down Time for a Tunnel
9 =====
10
11 Interface: Tunnel11, IPv4 NHRP Details
12 Type:Hub, NHRP Peers:2,
13
14 # Ent Peer NBMA Addr Peer Tunnel Add State UpDn Tm Attrb
15 -----
16 1 10.0.9.130 192.168.234.2 UP 00:34:01 D
17 1 10.0.6.60 192.168.234.3 UP 00:30:03 D
18
19 Router#show ip bgp
20 BGP table version is 42, local router ID is 192.168.234.1
21 Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
22 r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
23 x best-external, a additional-path, c RIB-compressed,
24 t secondary path,
25 Origin codes: i - IGP, e - EGP, ? - incomplete
26 RPKI validation codes: V valid, I invalid, N Not found
27
28 Network Next Hop Metric LocPrf Weight Path
29 *>i 192.168.77.0 192.168.234.3 0 100 0 i
30 *>i 192.168.100.0 192.168.234.2 0 100 0 i
31 *> 192.168.202.0 0.0.0.0 0 32768 i
32 Router#ping 192.168.77.10
33 Type escape sequence to abort.
34 Sending 5, 100-byte ICMP Echos to 192.168.77.10, timeout is 2 seconds:
35 !!!!!
36 Success rate is 100 percent (5/5), round-trip min/avg/max = 38/39/41 ms
37 Router#ping 192.168.100.10
38 Type escape sequence to abort.
39 Sending 5, 100-byte ICMP Echos to 192.168.100.10, timeout is 2 seconds:
40 !!!!!
41 Success rate is 100 percent (5/5), round-trip min/avg/max = 38/47/55 ms
42 Router#

```

3. Related Documents

[1] Advantech Czech: **IPsec Tunnel Application Note** (APP-0006-EN)

You can obtain product-related documents on *Engineering Portal* at icr.advantech.cz address.

To get your router's *Quick Start Guide*, *User Manual*, *Configuration Manual*, or *Firmware* go to the [Router Models](#) page, find the required model, and switch to the *Manuals* or *Firmware* tab, respectively.

The *Router Apps* installation packages and manuals are available on the [Router Apps](#) page.

For the *Development Documents*, go to the [DevZone](#) page.