OpenVPN with Mikrotik RouterBOARD

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About Us

Our Company

- Company Name: AD.TEK Joint Stock Company
- Brand name: Advanced Networks Technology
- Head quarter: No.9 Building 10, Lane 95 Chua Boc st., Dong Da dist., Hanoi
- Founded: November 2010
- Resources: 30+ employees with 10+ Technical engineers
- Business: Datacenter and Enterprise Network solutions and products distribution
- Contact: sales@adtek.vn www.adtek.vn

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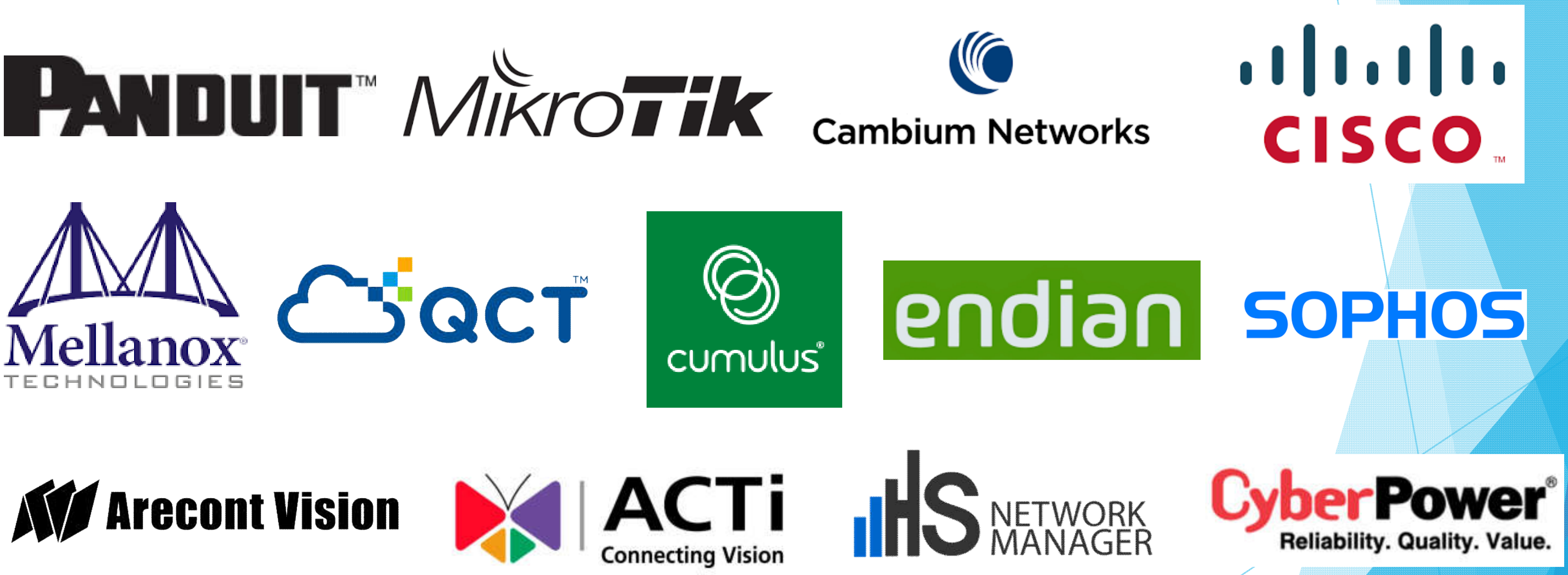
Our Solutions

- DataCenter: Cable Routing & Pathway system, Structured Cabling System, Network infrastructure, Network Routing & Switching, Cloud Storage, DCIM, UPS, Rack & Cabinet
- Enterprise: Structured Cabling system, Routing & Switching, Server & Storage, Security, Wireless Solution, Video Surveillance, UPS, Rack & Cabinet
- Wireless: Carrier grade Wireless PTP, PMP, Wifi Access Point, Hotspot & Billing solutions

Our Vertical Market

Healthcare	Education	Technology	Finance	Gov./Defense

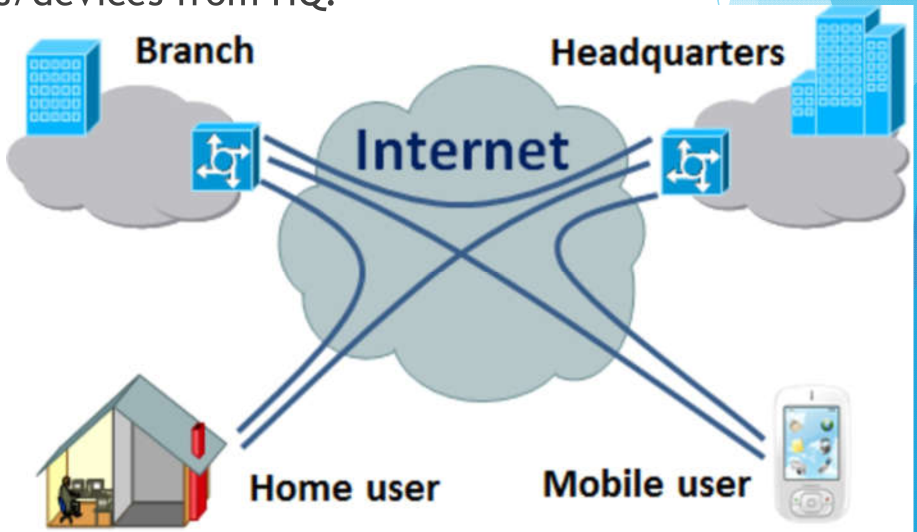
Our Partners



OpenVPN with Mikrotik RouterOS

Challenges

- Corporate with Head Quarter and multiple branch/offices need to sharing data between sites
- Corporate with mobile users working out of office and connect to Private/Local Applications system
- Central managed for IT networking equipments/devices from HQ.
- Over budget for leasedline/MPLS VPN from ISP.



Prerequisites

- Equipments
  - HQ networks (LAN, Servers) and Mikrotik Gateway router
  - Branch networks with Mikrotik Gateway router
- Technical skill
  - Networking basic: TCP/IP, NAT, IPSec, VPN, SSL knowledge based
  - RouterOS features, Webfig/Winbox, RouterOS CLI

What is OpenVPN?

- Open Source software application implements VPN (virtual private network) for creating secure point-to-point or site-to-site connection.
- Written by Jame Yonan and published under GNU General Public License (GPL)
- Support routed or bridged mode and remote access topology
- Used custom security protocol utilized SSL/TSL for key exchange
- Allow peers to authenticate each other using pre-shared secret key, certificates or username/password.
- Uses the OpenSSL encryption library, as well as the SSLv3/TLSv1 protocol, and contains many security and control features.
- Has been ported and embedded to several systems like DD-WRT (GNU/Linux-based firmware for wireless routers and access points), Mikrotik RouterOS, SoftEther VPN,…

Architecture

- **Encryption**
  - OpenVPN uses the OpenSSL library to provide encryption of both the data and control channels. It lets OpenSSL do all the encryption and authentication work, allowing OpenVPN to use all the ciphers available in the OpenSSL package
  - Can support the HMAC (Hash-based message authentication code) packet authentication feature to add an additional layer of security to the connection
  - Also support hardware acceleration to get better encryption performance
- **Authentication**
  - Support pre-shared keys, certificate-based, and username/password-based authentication
- **Security**
  - 256 bits encryption through OpenSSL library
  - Custom protocol based on SSL and TSL support IKE, IPSec, L2TP or PPTP.
- **Networking**
  - Support over both UDP or TCP
  - Support IPv6 (version 2.3.x)
  - Support working through proxy servers (including HTTP proxy server)
  - Support working through NAT
  - Support TUN (layer 2) or TAP (layer 3) interface
  - IANA official port: 1194

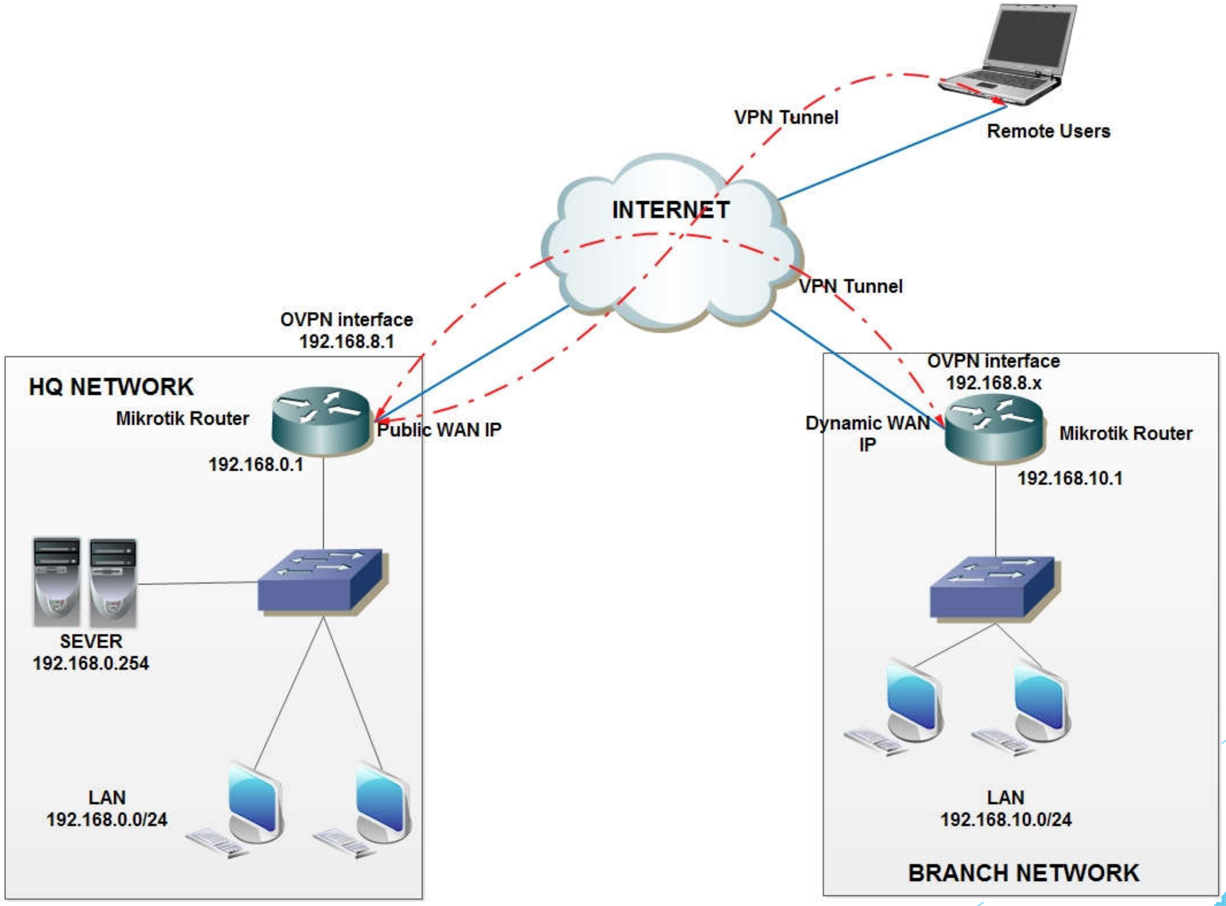
Mikrotik RouterOS and OpenVPN

- Support
  - TCP
  - Bridging (TAP interface)
  - Routing (TUN interface)
  - Certificates
  - P2P mode

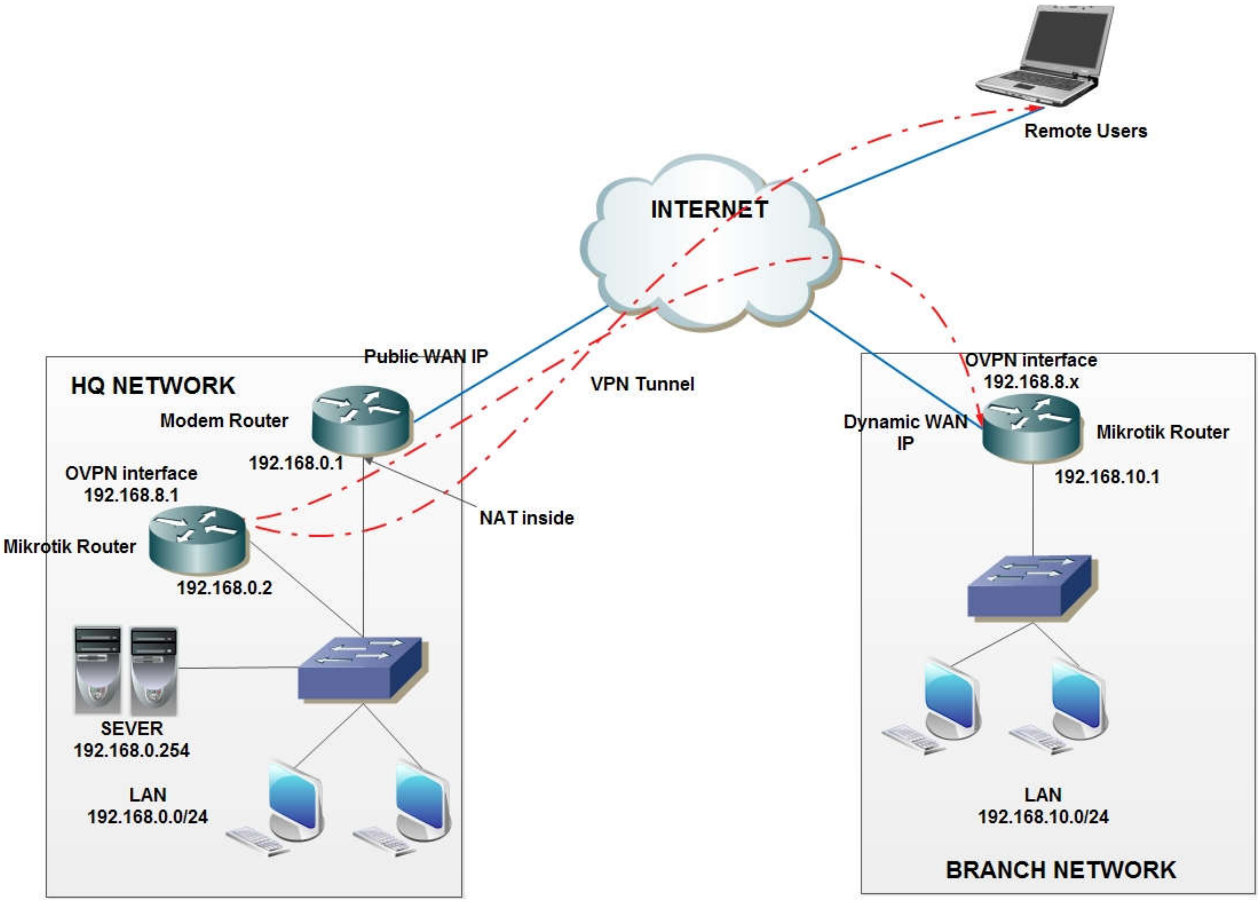
- Naming Linux/Windows vs. RouterOS
  - TUN - RouterOS: IP
  - TAP - RouterOS: ethernet

- Unsupport
  - UDP
  - LZO Compression

Topology


VPN Tunnel
Remote Users
INTERNET
VPN Tunnel
OVPN interface
192.168.8.1
HQ NETWORK
Mikrotik Router
Public WAN IP
192.168.0.1
SEVER
192.168.0.254
LAN
192.168.0.0/24
OVPN interface
192.168.8.x
Dynamic WAN IP
Mikrotik Router
192.168.10.1
LAN
192.168.10.0/24
BRANCH NETWORK

Topology

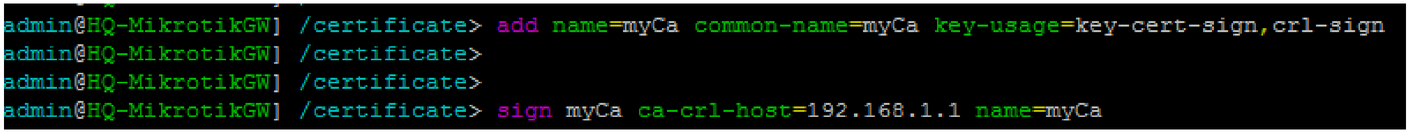

Remote Users
INTERNET
VPN Tunnel
Public WAN IP
HQ NETWORK
Modem Router
192.168.0.1
OVPN interface
192.168.8.1
Mikrotik Router
192.168.0.2
NAT inside
SEVER
192.168.0.254
LAN
192.168.0.0/24
OVPN interface
192.168.8.x
Dynamic WAN IP
Mikrotik Router
192.168.10.1
LAN
192.168.10.0/24
BRANCH NETWORK

How to?

- 1. Certificate Generation
- 2. Server site VPN gateway setup
- 3. Branch site VPN Client setup
- 4. Routing & Check connection

Certificates generation

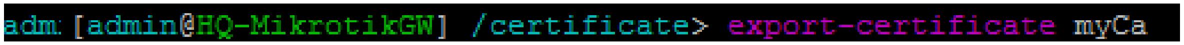
- ssh/telnet to HQ Mikrotik gateway, create your own certificate authority (CA) named myCA and.



```
admin@HQ-MikrotikGW] /certificate> add name=myCa common-name=myCa key-usage=key-cert-sign,crl-sign
admin@HQ-MikrotikGW] /certificate>
admin@HQ-MikrotikGW] /certificate>
admin@HQ-MikrotikGW] /certificate> sign myCa ca-crl-host=192.168.1.1 name=myCa
```

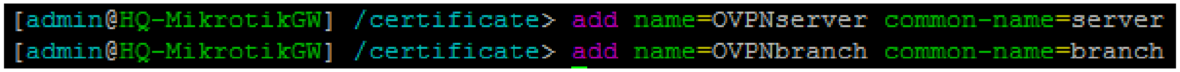
  - 192.168.1.1 is LAN interface

- export the CA certificate



```
adm: [admin@HQ-MikrotikGW] /certificate> export-certificate myCa
```

- Create a private and public key pair for the VPN Server and another key pair for the VPN Client.



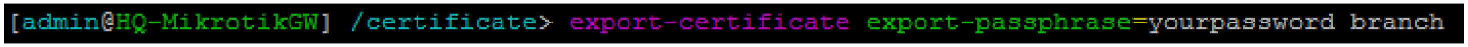
```
[admin@HQ-MikrotikGW] /certificate> add name=OVPNserver common-name=server
[admin@HQ-MikrotikGW] /certificate> add name=OVPNbranch common-name=branch
```

Certificates generation (cont.)

- Sign both public keys with new CA

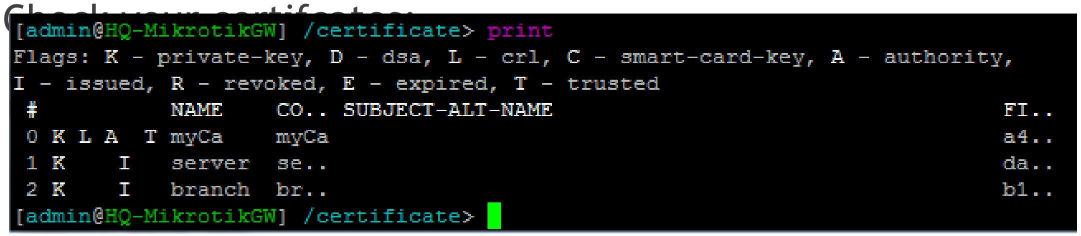
```
#/certificate sign OVPNserver ca=myCA name=server
#/certificate sign OVPNbranch ca=myCA name=branch
```

- Export the VPN branch's private key and public key+certificate files.



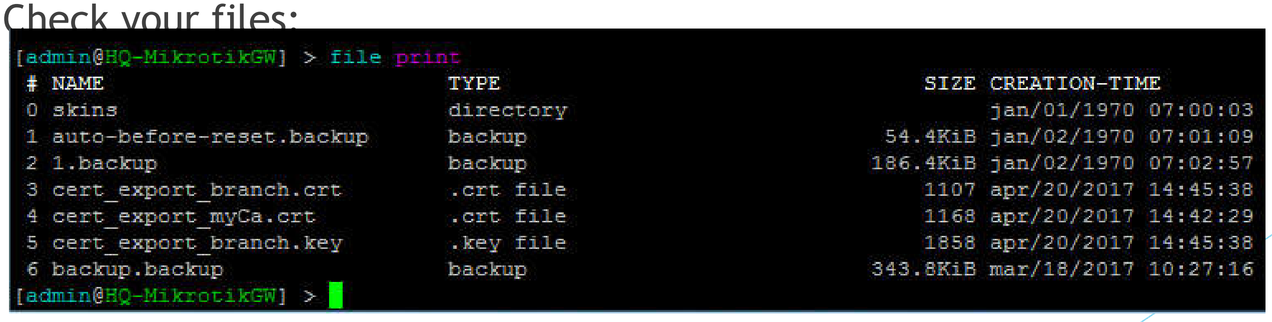
```
[admin@HQ-MikrotikGW] /certificate> export-certificate export-passphrase=yourpassword branch
```

- Check your certificates:



```
[admin@HQ-MikrotikGW] /certificate> print
Flags: K - private-key, D - dsa, L - crl, C - smart-card-key, A - authority,
I - issued, R - revoked, E - expired, T - trusted
 #          NAME    CO.. SUBJECT-ALT-NAME                                  FI..
 0 K L A  T myCa    myCa                                                   a4..
 1 K     I  server  se..                                                   da..
 2 K     I  branch  br..                                                   b1..
[admin@HQ-MikrotikGW] /certificate>
```

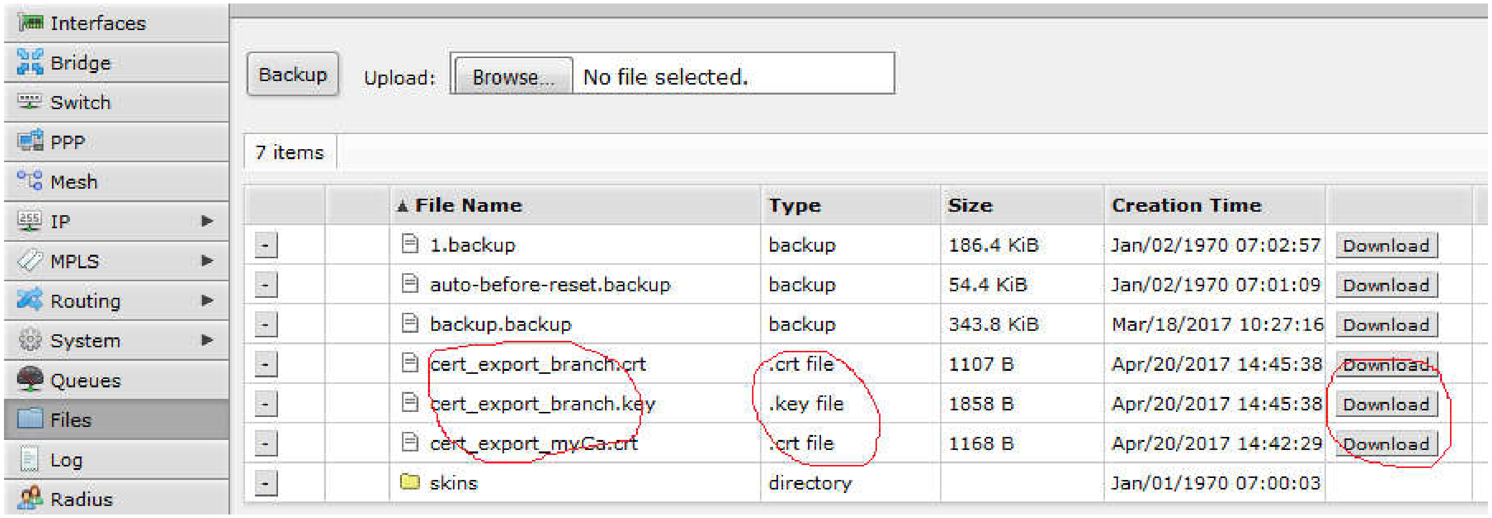
- Check your files:



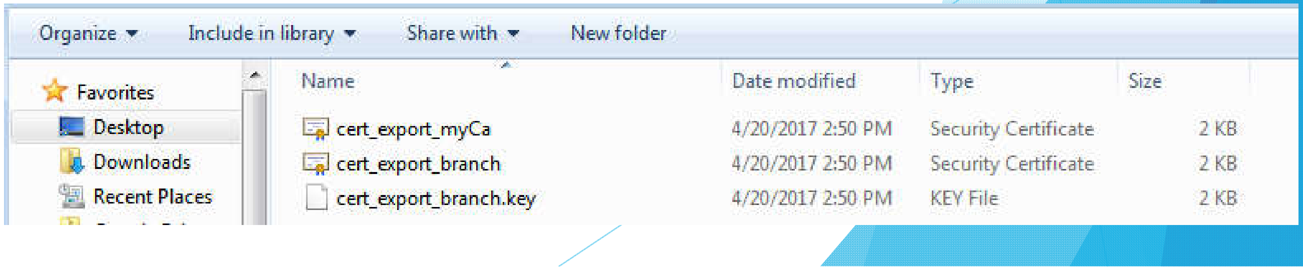
```
[admin@HQ-MikrotikGW] > file print
 # NAME                           TYPE                           SIZE CREATION-TIME
 0 skins                          directory                           jan/01/1970 07:00:03
 1 auto-before-reset.backup       backup                     54.4KiB jan/02/1970 07:01:09
 2 1.backup                       backup                    186.4KiB jan/02/1970 07:02:57
 3 cert_export_branch.crt         .crt file                      1107 apr/20/2017 14:45:38
 4 cert_export_myCa.crt           .crt file                      1168 apr/20/2017 14:42:29
 5 cert_export_branch.key         .key file                      1858 apr/20/2017 14:45:38
 6 backup.backup                  backup                    343.8KiB mar/18/2017 10:27:16
[admin@HQ-MikrotikGW] >
```

Certificates generation (cont.)

- Download branch’s certificate files, using sftp/winbox or webfig.



	File Name	Type	Size	Creation Time	
-	1.backup	backup	186.4 KiB	Jan/02/1970 07:02:57	Download
-	auto-before-reset.backup	backup	54.4 KiB	Jan/02/1970 07:01:09	Download
-	backup.backup	backup	343.8 KiB	Mar/18/2017 10:27:16	Download
-	cert_export_branch.crt	.crt file	1107 B	Apr/20/2017 14:45:38	Download
-	cert_export_branch.key	.key file	1858 B	Apr/20/2017 14:45:38	Download
-	cert_export_myCa.crt	.crt file	1168 B	Apr/20/2017 14:42:29	Download
-	skins	directory		Jan/01/1970 07:00:03	



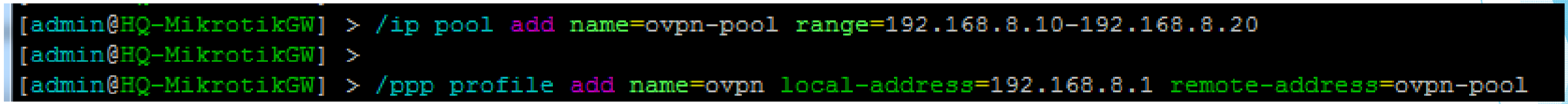
Name	Date modified	Type	Size
cert_export_myCa	4/20/2017 2:50 PM	Security Certificate	2 KB
cert_export_branch	4/20/2017 2:50 PM	Security Certificate	2 KB
cert_export_branch.key	4/20/2017 2:50 PM	KEY File	2 KB

Server site VPN gateway setup

- VPN parameters:
  - HQ LAN networks: 192.168.0.0/24; Branch LAN network: 192.168.10.0/24
  - VPN Network: 192.168.8.0/24, VPN Gateway: 192.168.8.1
  - IP Range for VPN Clients/Branch: 192.168.8.10-192.168.8.20
  - Server Certificate = yes
  - Auth = SHA1
  - Cipher = AES256
  - VPN TCP port = 1194
  - Client Certificate = Yes
  - Mode = IP (Layer 3 routing)

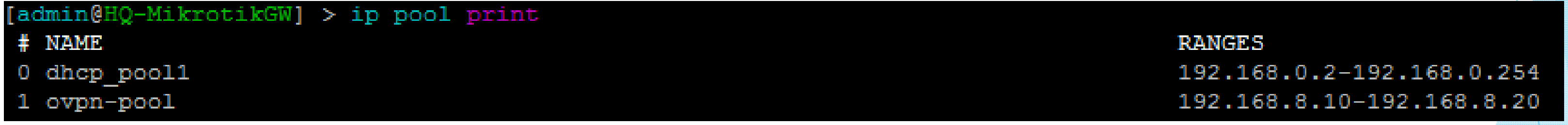
Server site VPN gateway setup (cont.)

- Create the PPP profile and IP address pool

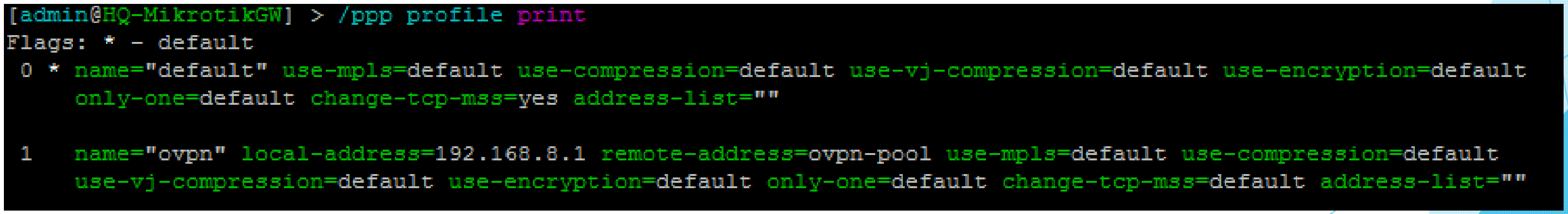


```
[admin@HQ-MikrotikGW] > /ip pool add name=ovpn-pool range=192.168.8.10-192.168.8.20
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] > /ppp profile add name=ovpn local-address=192.168.8.1 remote-address=ovpn-pool
```

- Check your configuration



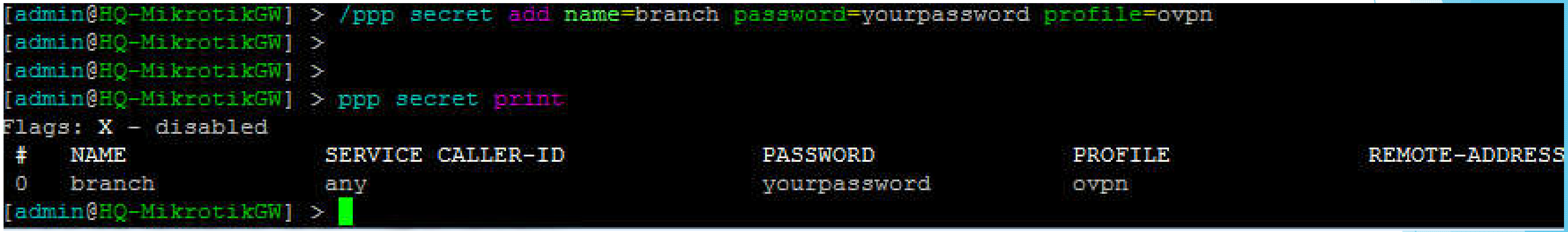
```
[admin@HQ-MikrotikGW] > ip pool print
 # NAME                                                                    RANGES
 0 dhcp_pool1                                                              192.168.0.2-192.168.0.254
 1 ovpn-pool                                                               192.168.8.10-192.168.8.20
```



```
[admin@HQ-MikrotikGW] > /ppp profile print
Flags: * - default
 0 * name="default" use-mpls=default use-compression=default use-vj-compression=default use-encryption=default
     only-one=default change-tcp-mss=yes address-list=""

 1   name="ovpn" local-address=192.168.8.1 remote-address=ovpn-pool use-mpls=default use-compression=default
     use-vj-compression=default use-encryption=default only-one=default change-tcp-mss=default address-list=""
```

Server site VPN gateway setup (cont.)

- Add “branch” user with second factor secret and check your configure

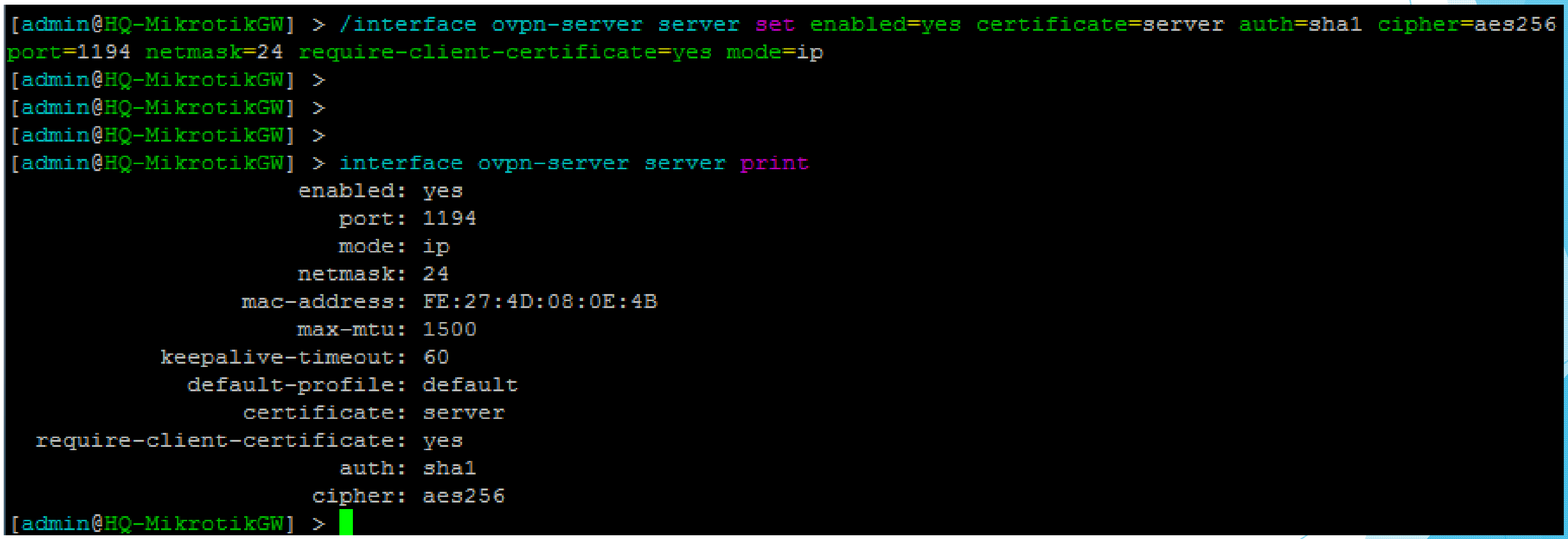


```
[admin@HQ-MikrotikGW] > /ppp secret add name=branch password=yourpassword profile=ovpn
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] > ppp secret print
Flags: X - disabled
 #   NAME                 SERVICE CALLER-ID                PASSWORD            PROFILE             REMOTE-ADDRESS
 0   branch               any                              yourpassword        ovpn
[admin@HQ-MikrotikGW] >
```

  - Replace yourpassword by your own password. This password must match both HQ and Branch configure.

Server site VPN gateway setup (cont.)

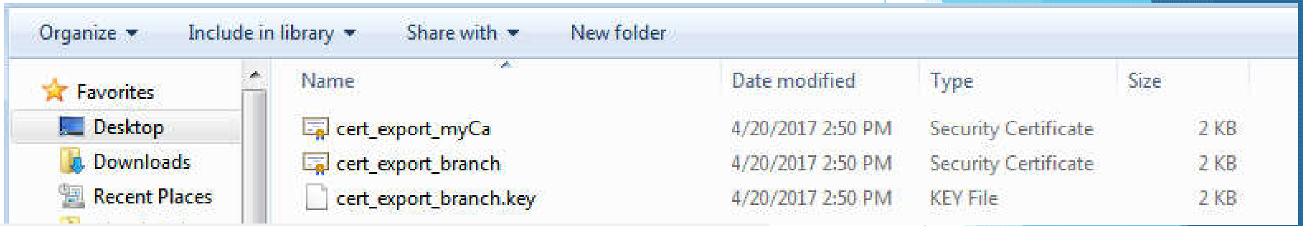
- Create OVPN interface in the HQ-MikrotikGW using certificate, authentication SHA1, cipher AES256, port 1194, mode IP.



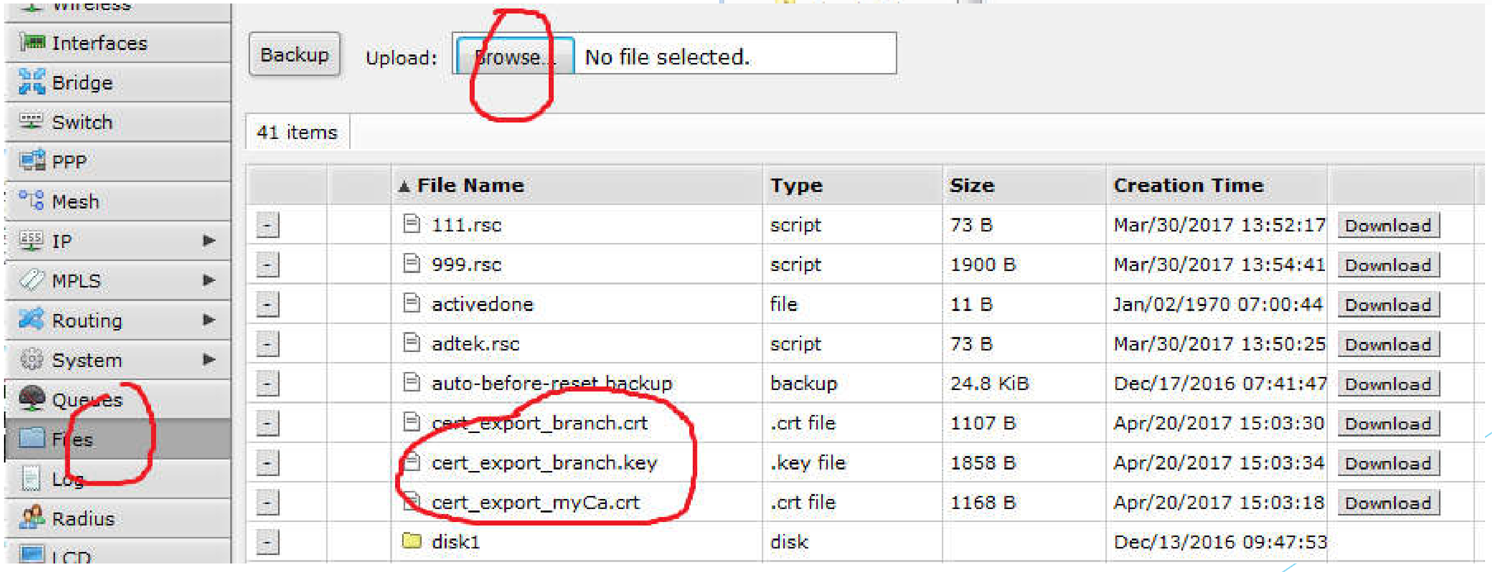
```
[admin@HQ-MikrotikGW] > /interface ovpn-server server set enabled=yes certificate=server auth=sha1 cipher=aes256
port=1194 netmask=24 require-client-certificate=yes mode=ip
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] > interface ovpn-server server print
                     enabled: yes
                        port: 1194
                        mode: ip
                     netmask: 24
                 mac-address: FE:27:4D:08:0E:4B
                     max-mtu: 1500
           keepalive-timeout: 60
             default-profile: default
                 certificate: server
  require-client-certificate: yes
                        auth: sha1
                      cipher: aes256
[admin@HQ-MikrotikGW] >
```

Branch site VPN Client setup

- Import certificate downloaded before to Branch Mikrotik Router using sftp/webfig/winbox



Name	Date modified	Type	Size
cert_export_myCa	4/20/2017 2:50 PM	Security Certificate	2 KB
cert_export_branch	4/20/2017 2:50 PM	Security Certificate	2 KB
cert_export_branch.key	4/20/2017 2:50 PM	KEY File	2 KB



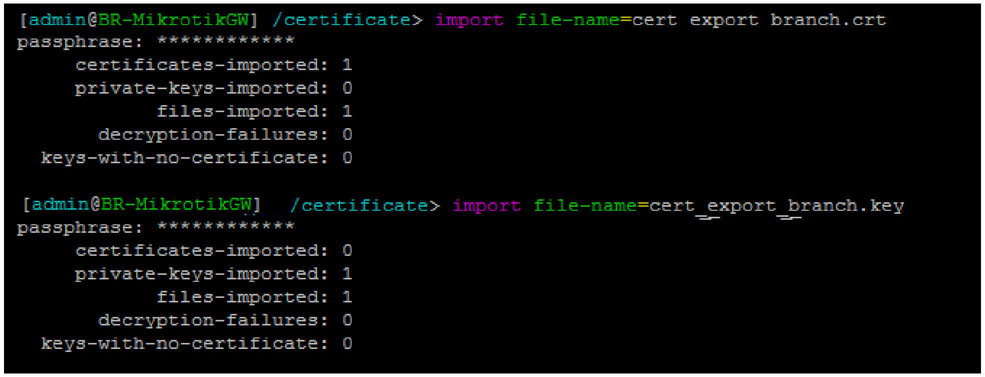
No file selected.

41 items

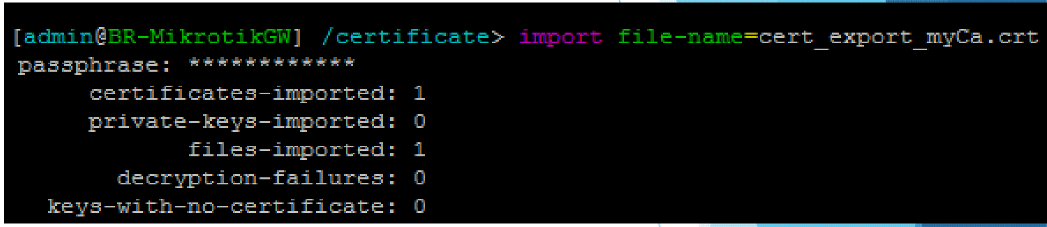
	File Name	Type	Size	Creation Time	
-	111.rsc	script	73 B	Mar/30/2017 13:52:17	Download
-	999.rsc	script	1900 B	Mar/30/2017 13:54:41	Download
-	activedone	file	11 B	Jan/02/1970 07:00:44	Download
-	adtek.rsc	script	73 B	Mar/30/2017 13:50:25	Download
-	auto-before-reset.backup	backup	24.8 KiB	Dec/17/2016 07:41:47	Download
-	cert_export_branch.crt	.crt file	1107 B	Apr/20/2017 15:03:30	Download
-	cert_export_branch.key	.key file	1858 B	Apr/20/2017 15:03:34	Download
-	cert_export_myCa.crt	.crt file	1168 B	Apr/20/2017 15:03:18	Download
-	disk1	disk		Dec/13/2016 09:47:53	

Branch site VPN Client setup (cont.)

- Import certificates. Using your own password created before for passphrase

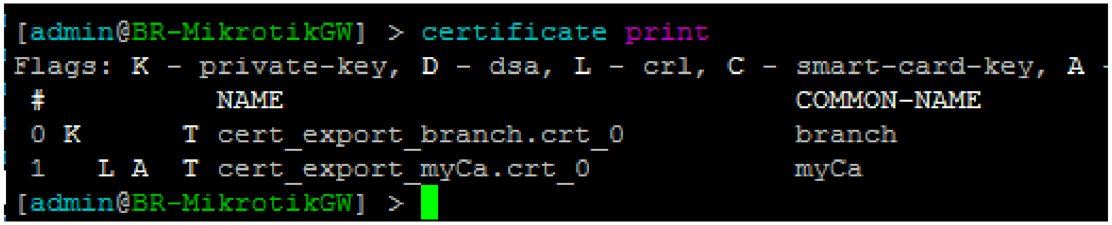


```
[admin@BR-MikrotikGW] /certificate> import file-name=cert export branch.crt
passphrase: *************
     certificates-imported: 1
     private-keys-imported: 0
            files-imported: 1
       decryption-failures: 0
  keys-with-no-certificate: 0

[admin@BR-MikrotikGW]  /certificate> import file-name=cert_export_branch.key
passphrase: *************
     certificates-imported: 0
     private-keys-imported: 1
            files-imported: 1
       decryption-failures: 0
  keys-with-no-certificate: 0
```



```
[admin@BR-MikrotikGW] /certificate> import file-name=cert_export_myCa.crt
passphrase: *************
     certificates-imported: 1
     private-keys-imported: 0
            files-imported: 1
       decryption-failures: 0
  keys-with-no-certificate: 0
```

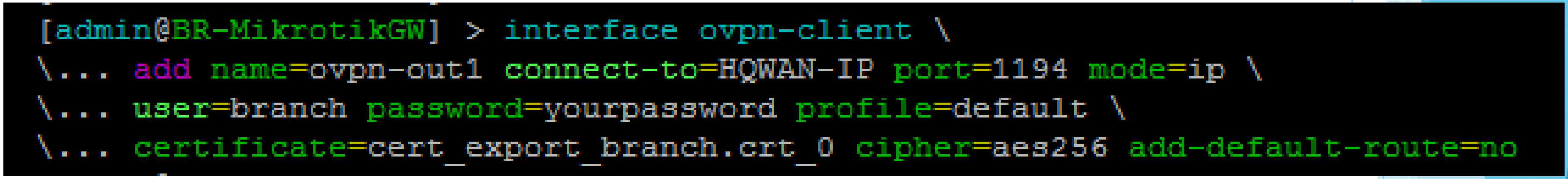
- Check your imported certificates:



```
[admin@BR-MikrotikGW] > certificate print
Flags: K - private-key, D - dsa, L - crl, C - smart-card-key, A -
 #          NAME                                COMMON-NAME
 0 K        T cert_export_branch.crt_0           branch
 1   L A    T cert_export_myCa.crt_0             myCa
[admin@BR-MikrotikGW] >
```

Branch site VPN Client setup (cont.)

- Add VPN client interface.

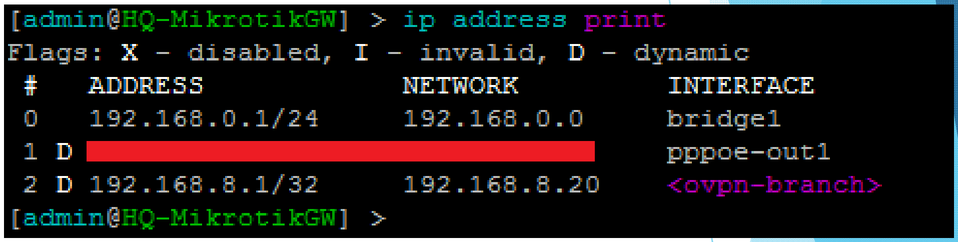


```
[admin@BR-MikrotikGW] > interface ovpn-client \
\... add name=ovpn-out1 connect-to=HQWAN-IP port=1194 mode=ip \
\... user=branch password=yourpassword profile=default \
\... certificate=cert_export_branch.crt_0 cipher=aes256 add-default-route=no
```

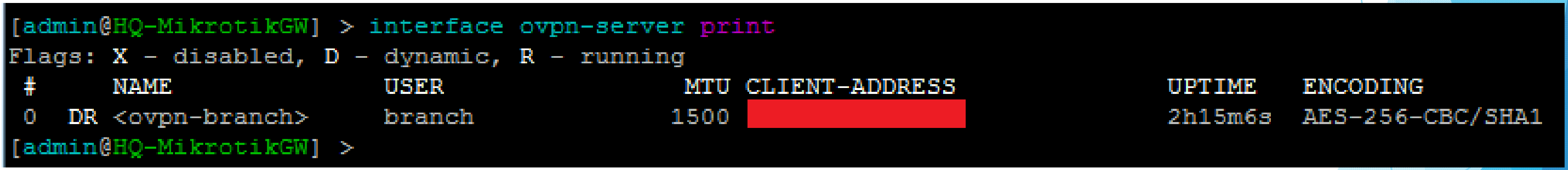
- Note:
  - Change HQWAN-IP to your HQ Public IP address of HQ-MikrotikGW. If you are using dynamic IP address, please enable cloud and using domain name.
  - Change yourpassword to your own password

Routing & Check connection

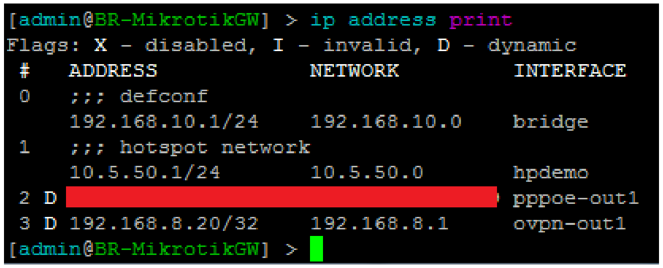
- Check VPN Connection.



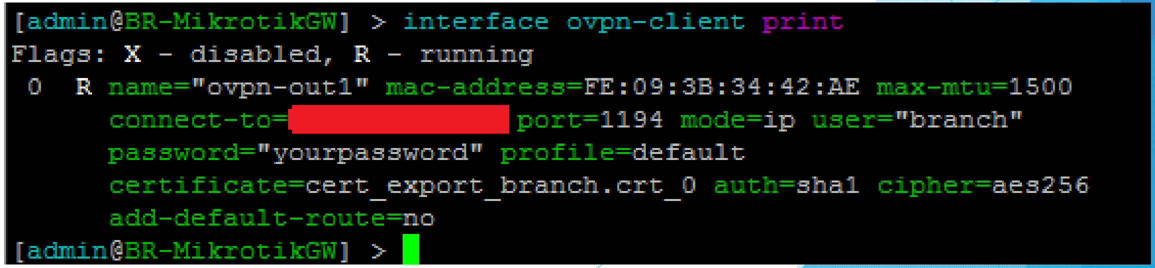
```
[admin@HQ-MikrotikGW] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         INTERFACE
 0   192.168.0.1/24     192.168.0.0     bridge1
 1 D [redacted]                         pppoe-out1
 2 D 192.168.8.1/32     192.168.8.20    <ovpn-branch>
[admin@HQ-MikrotikGW] >
```



```
[admin@HQ-MikrotikGW] > interface ovpn-server print
Flags: X - disabled, D - dynamic, R - running
 #      NAME             USER              MTU  CLIENT-ADDRESS           UPTIME    ENCODING
 0  DR <ovpn-branch>     branch           1500  [redacted]               2h15m6s   AES-256-CBC/SHA1
[admin@HQ-MikrotikGW] >
```

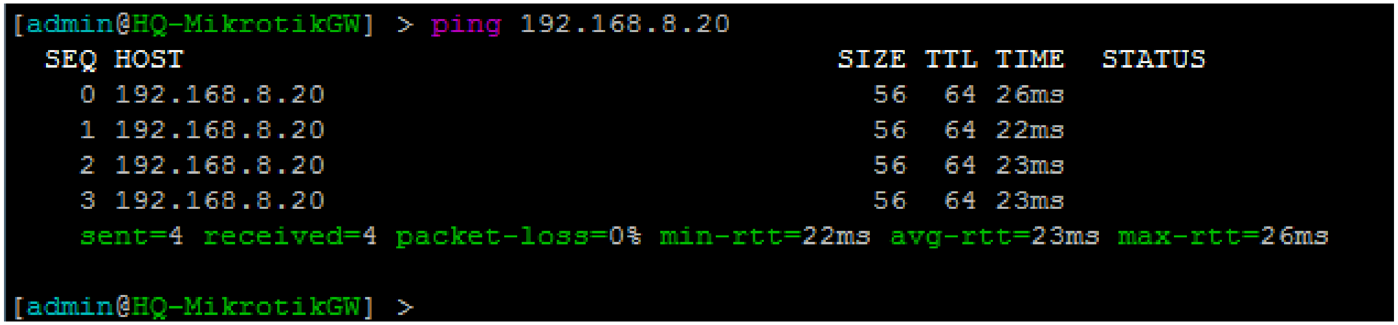


```
[admin@BR-MikrotikGW] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         INTERFACE
 0   ;;; defconf
     192.168.10.1/24    192.168.10.0    bridge
 1   ;;; hotspot network
     10.5.50.1/24       10.5.50.0       hpdemo
 2 D [redacted]                         pppoe-out1
 3 D 192.168.8.20/32    192.168.8.1     ovpn-out1
[admin@BR-MikrotikGW] >
```

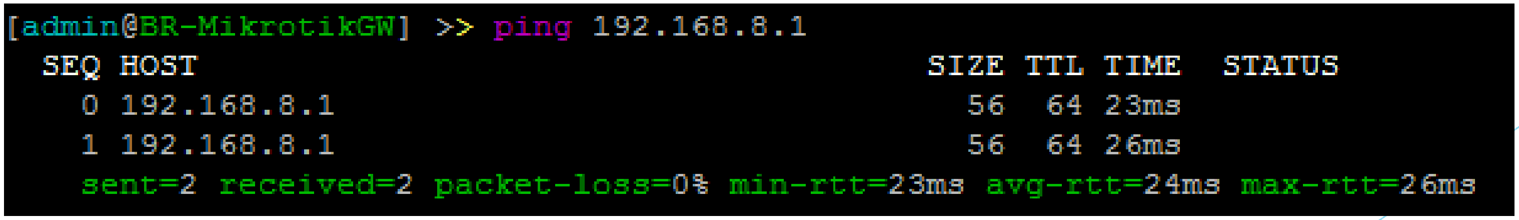


```
[admin@BR-MikrotikGW] > interface ovpn-client print
Flags: X - disabled, R - running
 0  R name="ovpn-out1" mac-address=FE:09:3B:34:42:AE max-mtu=1500
      connect-to=[redacted] port=1194 mode=ip user="branch"
      password="yourpassword" profile=default
      certificate=cert_export_branch.crt_0 auth=sha1 cipher=aes256
      add-default-route=no
[admin@BR-MikrotikGW] >
```

Routing & Check connection (cont)



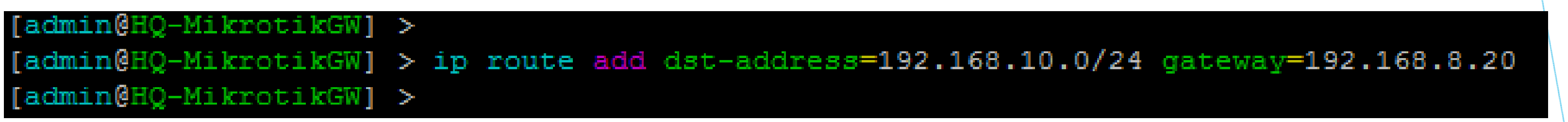
```
[admin@HQ-MikrotikGW] > ping 192.168.8.20
  SEQ HOST                                     SIZE TTL TIME   STATUS
    0 192.168.8.20                               56  64 26ms
    1 192.168.8.20                               56  64 22ms
    2 192.168.8.20                               56  64 23ms
    3 192.168.8.20                               56  64 23ms
    sent=4 received=4 packet-loss=0% min-rtt=22ms avg-rtt=23ms max-rtt=26ms

[admin@HQ-MikrotikGW] >
```



```
[admin@BR-MikrotikGW] >> ping 192.168.8.1
  SEQ HOST                                     SIZE TTL TIME   STATUS
    0 192.168.8.1                                56  64 23ms
    1 192.168.8.1                                56  64 26ms
    sent=2 received=2 packet-loss=0% min-rtt=23ms avg-rtt=24ms max-rtt=26ms
```

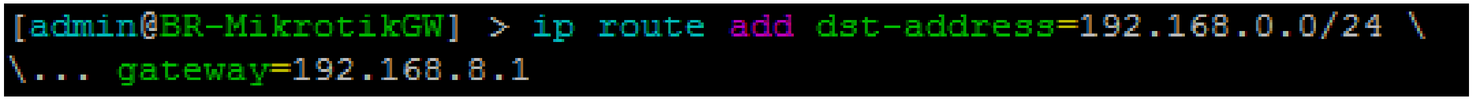
Routing & Check connection (cont.)

- On HQ Router:



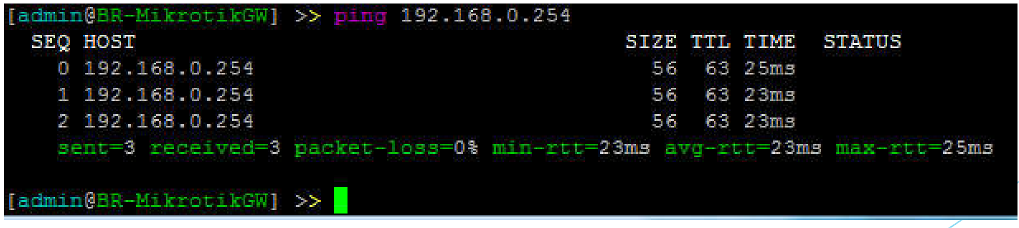
```
[admin@HQ-MikrotikGW] >
[admin@HQ-MikrotikGW] > ip route add dst-address=192.168.10.0/24 gateway=192.168.8.20
[admin@HQ-MikrotikGW] >
```

- On Brand Router:



```
[admin@BR-MikrotikGW] > ip route add dst-address=192.168.0.0/24 \
\... gateway=192.168.8.1
```

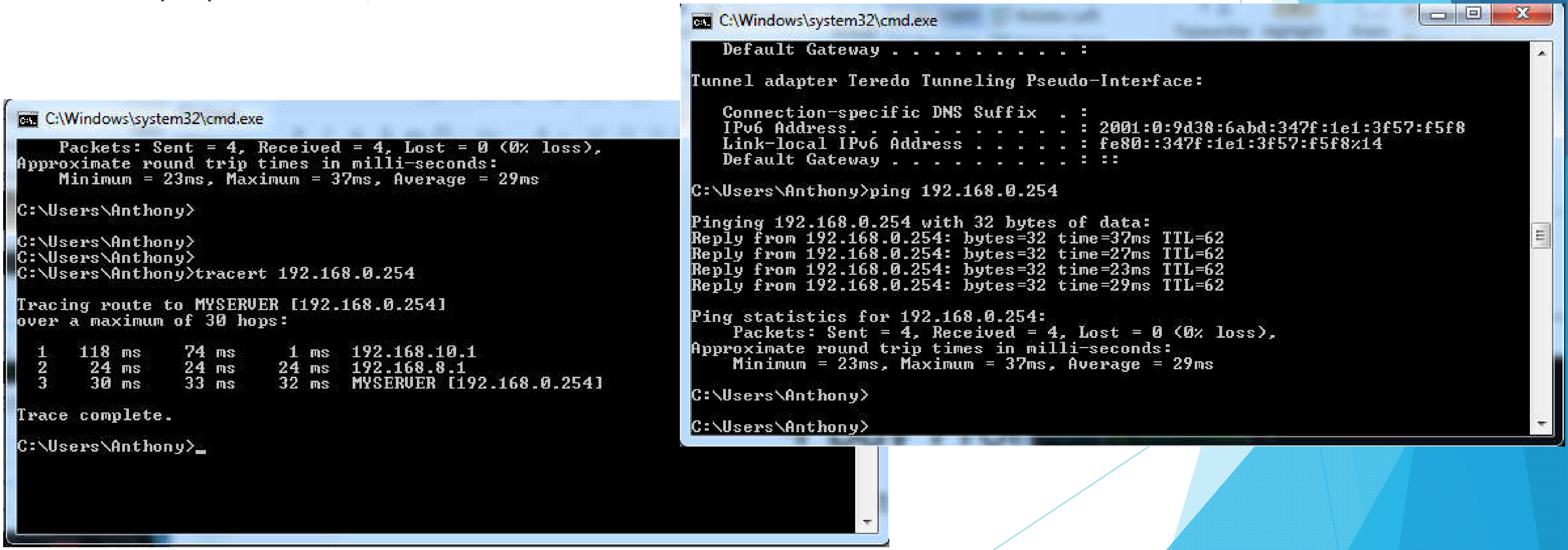
- Check Routing



```
[admin@BR-MikrotikGW] >> ping 192.168.0.254
  SEQ HOST                                     SIZE TTL TIME   STATUS
    0 192.168.0.254                              56  63 25ms
    1 192.168.0.254                              56  63 23ms
    2 192.168.0.254                              56  63 23ms
    sent=3 received=3 packet-loss=0% min-rtt=23ms avg-rtt=23ms max-rtt=25ms

[admin@BR-MikrotikGW] >>
```

Routing & Check connection (cont.)

- From Laptop in Branch, connect to HQ Server



```
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 23ms, Maximum = 37ms, Average = 29ms

C:\Users\Anthony>

C:\Users\Anthony>
C:\Users\Anthony>
C:\Users\Anthony>tracert 192.168.0.254

Tracing route to MYSERVER [192.168.0.254]
over a maximum of 30 hops:

  1   118 ms    74 ms     1 ms  192.168.10.1
  2    24 ms    24 ms    24 ms  192.168.8.1
  3    30 ms    33 ms    32 ms  MYSERVER [192.168.0.254]

Trace complete.

C:\Users\Anthony>_
```

```
   Default Gateway . . . . . . . . . :

Tunnel adapter Teredo Tunneling Pseudo-Interface:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:0:9d38:6abd:347f:1e1:3f57:f5f8
   Link-local IPv6 Address . . . . . : fe80::347f:1e1:3f57:f5f8%14
   Default Gateway . . . . . . . . . : ::

C:\Users\Anthony>ping 192.168.0.254

Pinging 192.168.0.254 with 32 bytes of data:
Reply from 192.168.0.254: bytes=32 time=37ms TTL=62
Reply from 192.168.0.254: bytes=32 time=27ms TTL=62
Reply from 192.168.0.254: bytes=32 time=23ms TTL=62
Reply from 192.168.0.254: bytes=32 time=29ms TTL=62

Ping statistics for 192.168.0.254:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 23ms, Maximum = 37ms, Average = 29ms

C:\Users\Anthony>

C:\Users\Anthony>
```

THANK YOU

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