

APPLICATION NOTE

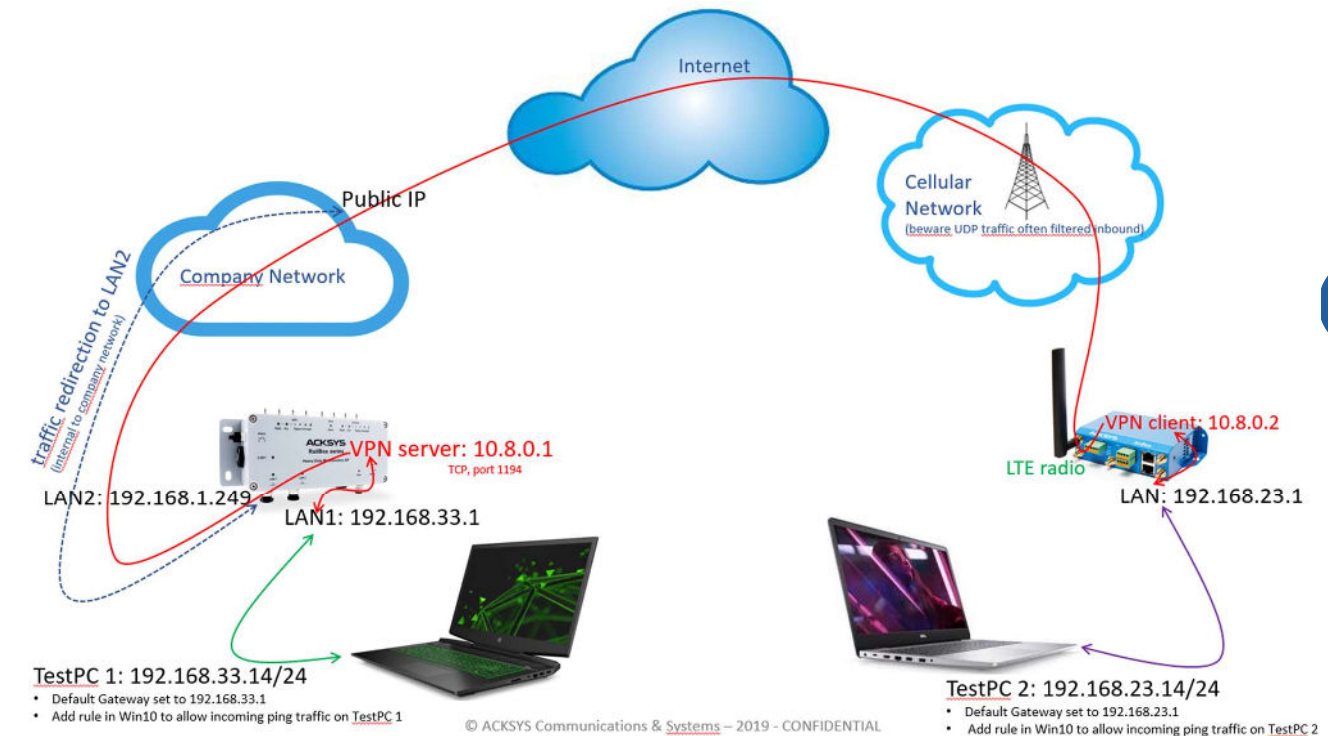
APNUS015 OpenVPN tunnel

January 2020

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I. Architecture diagram



This scenario exhibits a connection from a cellular VPN client, in the field, to a VPN server at a company backbone.

For example's sake we do run both server and client on Acksys devices.

An internal traffic redirection rule forwards incoming VPN traffic from the company public IP address to the VPN server IP in the backbone.

For the sake of clarity and easier troubleshooting it is advised to first build a tunnel without certificate/key. Once the tunnel is up and one can ping from one test pc to the other test pc, authentication and encryption must be added.

II. Read before start

1)

Cellular network operators filter incoming UDP traffic in general and ports (udp or tcp) in general.

This means that vpn client might well be able to send openVPN traffic but VPN server might not receive it (in case one deploys the server over cellular too, running it on a LTE/5G device).

Or in case server is in a wired infrastructure, it might well answer incoming VPN traffic but answers are filtered when entering the cellular network and not forwarded back to the VPN client.

In this case either negotiate with your carrier to have necessary protocols and ports open for your SIM plan, or more easily, tweak the protocols and ports used to bypass the carrier filters (use TCP instead of UDP and/or use other port than 1194).

This is the reason why, in following examples, TCP protocol is used instead of UDP.

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2)

On Windows10 ping answer is disabled by default.

Any incoming ping request is dropped by Windows firewall.

One must add a rule to allow incoming ping traffic on the test PC's. See appropriate section below.

<https://docs.microsoft.com/fr-fr/windows/security/threat-protection/windows-firewall/create-an-inbound-icmp-rule>

3)

Upon creation, VPN instance (client or server) is not explicitly attached to an interface.

When in server mode, it will listen to all available interfaces.

When in client mode, it will mount on the interface from which the VPN server IP address can be reached. On a cellular device, this will typically be the cellular interface.

4)

In case using the cellular device as VPN server :

the SIM card must be able to get a public IP address from the carrier.

Do contact your carrier representative to get such service activated on your SIM.

Standard SIM plans do not provide public IP, only private IP.

With reason. Having a public IP on your device makes it visible and open to any malware and attack from the internet.

In case you need to set the VPN server on the cellular device, you MUST :

- set and define a strong and unique password on the Acksys device (to access the MMI)

- if possible block all incoming traffic on the WAN interface and only allow known traffic

- purchase a private APN at your carrier.

This is to protect you against device being hacked and used for malware purpose, for example generating or receiving loads of traffic in the frame of DoS attacks or flood attacks that will result in bill shock and high data consumption costs charged by the network provider.

III. VPN Server configuration

A. Set LAN1 interface

Go to Setup>Network>Add Network :

Description : LAN,
IPv4 address : 192.168.33.1,
netmask : 255.255.255.0,
Save.

Assign this network to Ethernet port 1.

By default all device interfaces (ethernet ports and WiFi interfaces) are bridged to a common lan.
In this scenario we do not need WiFi and we want to isolate the 2 ethernet interfaces on 2 distinct LAN.

Go to Interface Settings tab.

Bridge Interfaces : unchecked,
Interfaces : assign only the ethernet port 1 (for some reasons called « LAN1 ») to the LAN network.
Save.

B. Set LAN2 interface

Go to Setup>Network>Add Network :

Description : WAN (it is called WAN as this LAN interface will provide a WAN access over the company internal network),
IPv4 address : any relevant IP matching your own setup,
netmask : 255.255.255.0,
Default Gateway : any relevant IP matching your own setup,

Save.

Note if you plan a field-only scenario (where both Acksys devices, client and server are in the field using cellular connection as WAN access) you can skip this step and do not need to create a second LAN network.

Assign this network to Ethernet port 2 :

Go to Interface Settings tab and verify ticked interface is Ethernet adapter LAN2 (WAN).

COMMON CONFIGURATION

General Setup | **Interface Settings** | Advanced Settings

Bridge interfaces ☐ creates a bridge over specified interface(s)

Interface:
☐ WiFi adapter: WiFi (currently disabled) - acksys_nm
☐ Ethernet adapter: LAN1 (network: LAN)
☒ Ethernet adapter: LAN2 (network: WAN)

MTU: 1500

Save.

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C. Set VPN

Go to Setup>VPN>Add Instance :

CONFIGURATION

Tunnel settings | Auth/Crypto | Server settings

Enable virtual network ☒

State at startup: Up
Default is 'up' except for networks with protocol 'none'. Use 'down' if this network should be brought up only by event rules.

OpenVPN instance description: vpn1

Role: Server (called)

Protocol: TCP
Favor UDP, as TCP leads to potential conflicts in the TCP over TCP redundancy mechanisms.

Listener port: 1194

Data channel compression: ☐ UDP or TCP port that the server will listen to, and that the client will call.
☐ Use fast LZO compression

Tunnel type: L3 (IP) tunnel
Only L3 tunnels are supported

VPN subnet local IP address: 10.8.0.1
IP address of the local VPN endpoint, not used in TLS client mode since it is pulled from server

VPN subnet mask: 255.255.255.0
Subnet mask of the VPN subnet, not used in TLS client mode

Keepalive period: 10
Keepalive period (seconds). Every such time, a packet is sent to each peer to elicit a response.

Keepalive timeout: 30
Keepalive timeout (seconds). Connection terminates if no traffic is received from the peer for such time.

State at startup : Up,

Description : vpn1,

Role : Server,

Protocol : TCP. Remember carriers do filter UDP inbound (traffic from the internet to the Airbox LTE),

Listener port : 1194,

Local IP address : 10.8.0.1.

Add route for VPN server to be able to find remote subnet on testPC 2 (beyond VPN client) :

LOCAL ROUTES

This section is used in both Server and Client modes. It lists the routes to be installed in the local IP stack.

- In the client, it lists the server subnets reachable using the server as gateway.
- In the server, it lists the client subnets reachable using the client as gateway.

If the gateway is not indicated, it defaults to the VPN remote address.

TARGET NET	NETMASK	GATEWAY	METRIC	SORT
192.168.23.0	255.255.255.0	10.8.0.2	Default: 0	

Add

Set authentication and cryptographic parameters. As explained above it is advised to set them in a second step only after the tunnel can mount and remote test pc's can see each other.

Save.

D. Set network zones

A zone is a network or a group of networks which will obey user defined firewall policies. We will add 3 zones, one for LAN1 (aka LAN), one for LAN2 (aka WAN), one for the VPN.

1. LAN zone

Go to Setup>Routing / Firewall>Network Zones>Add zone :

ZONE section :

Name : LAN_zone,

Enable NAT : disable (untick) parameter,

Covered network : select (tick) LAN,

INTER ZONE FORWARDING section :

Select « VPN » zone (you might want to create this zone prior to selecting it),

Save.

2. VPN zone

Browse back to Network Zones>Add zone and add a 2nd zone :

ZONE section :

Name : VPN_zone,

Enable NAT : disable (untick) parameter,

Covered network : select (tick) VPN1,

INTER ZONE FORWARDING section :

Select « LAN » zone,

Save.

ZONE "VPN_ZONE"

This section defines common properties of "VPN_zone".
Covered networks specifies which available networks are members of this zone.

General Settings | Advanced Settings

Name: VPN_zone

Enable NAT: ☐ Only on public zones. Warning: If using VRRP, the NATed network must be set to protocol NONE

MSS clamping: ☐

Default acceptance policy for local services: All enabled
You can restrict or open the local services in the firewall section below

Covered networks:

- ☐ LAN
- ☐ WAN
- ☒ vpn1

INTER-ZONE FORWARDING

Use this section only if NAT is disabled on this zone.
The options below control the forwarding policies between this zone (VPN_zone) and other zones. Destination zones cover forwarded traffic originating from "VPN_zone". The forwarding rule is unidirectional, e.g. a forward from lan to wan does not imply a permission to forward from wan to lan as well.

Allow forwarding to destination zones:

- ☒ LAN_zone LAN
- ☐ WAN_zone WAN

3. WAN zone

Browse back to Network Zones>Add zone and add a 3rd zone :

ZONE section :

Name : WAN zone,

Enable NAT : enable (tick) parameter,

Covered network : select (tick) WAN,

Save and apply.

ZONE "WAN_ZONE"

This section defines common properties of "WAN_zone".
Covered networks specifies which available networks are members of this zone.

General Settings | Advanced Settings

Name: WAN_zone

Enable NAT: ☒ Only on public zones. Warning: If using VRRP, the NATed network must be set to protocol NONE

MSS clamping: ☐

Default acceptance policy for local services: All disabled
You can restrict or open the local services in the firewall section below

Covered networks:

- ☐ LAN
- ☒ WAN
- ☐ vpn1

INTER-ZONE FORWARDING

Use this section only if NAT is disabled on this zone.
The options below control the forwarding policies between this zone (WAN_zone) and other zones. Destination zones cover forwarded traffic originating from "WAN_zone". The forwarding rule is unidirectional, e.g. a forward from lan to wan does not imply a permission to forward from wan to lan as well.

Allow forwarding to destination zones:

- ☐ LAN_zone LAN
- ☐ VPN_zone vpn1

At this point you can loose access to the IHM and, in order to get it back, you might want to set your test laptop ip to 192.168.33.14 as explained below in testpc 1 setup.

Note for a field only scenario (server running on a cellular device too) you do not need to create a WAN zone.

IV. VPN client configuration

A. Set LAN1 interface

Go to Setup>Network>Add Network :

Description : Local network,

IPv4 address : 192.168.23.1,

netmask : 255.255.255.0,

Save.

(There is no need to specify the default gateway).

B. Set LTE interface

Go to Setup>Physical Interfaces and enable LTE interface :



Then Edit the network :



Choose the SIM tray (1 or 2). Verify the SIM card is in this tray.

Go to either SIM1 or SIM2 tab :

Populate SIM PIN and SIM APN.

Save.

C. Set VPN interface

Go to Setup>VPN>Add Instance :

CONFIGURATION

Tunnel settings | Auth/Crypto | Client settings

Enable virtual network ☒

State at startup: Up
Default is 'up' except for networks with protocol 'none'. Use 'down' if this network should be brought up only by event rules.

OpenVPN instance description: vpn1
Friendly name for this VPN instance

Role: Client (calling)
Client (calling)

Protocol: TCP
Favor UDP, as TCP leads to potential conflicts in the TCP over TCP redundancy mechanisms

Listener port: 1198
UDP or TCP port that the server will listen to, and that the client will call

Data channel compression: ☐ Use fast LZO compression
Only L3 tunnels are supported

Tunnel type: L3 (IP) tunnel

VPN subnet local IP address: 10.8.0.2
IP address of the local VPN endpoint, not used in TLS client mode since it is pulled from server

VPN subnet mask: 255.255.255.0
Subnet mask of the VPN subnet, not used in TLS client mode

Keepalive period: 10
Keepalive period (seconds). Every such time, a packet is sent to each peer to elicit a response.

Keepalive timeout: 30
Keepalive timeout (seconds). Connection terminates if no traffic is received from the peer for such time.

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State at startup : Up,

Description : vpn1,

Role : client,

Protocol : TCP. Remember carriers do filter UDP inbound (traffic from the internet to the Airbox LTE),
Listener port : 1198.

Note here different port than the actual one the server has been set to listen to. This is due to the redirection rule on the backbone side that listens on this particular port on the public IP and will redirect internally to 192.168.1.249:1194. You might want to set in this parameter any relevant port matching your own setup.

Local IP address : 10.8.0.2.

Set authentication and cryptographic parameters. As explained above it is advised to set them in a second step only after the tunnel can mount and remote test pc's can see each other.

CONFIGURATION

Tunnel settings | Auth/Crypto | Server settings

Key type: No key (entails P2P, cleartext, no auth)

Data channel authentication digest: SHA1 (OpenVPN default)
Data channel authentication algorithm. Adds overhead to frames size and processing time.

In client Settings tab set remote OpenVPN server address :

CONFIGURATION

Tunnel settings | Auth/Crypto | Client settings

Remote OpenVPN server address: [Redacted]
Remote OpenVPN server address

Do populate the relevant IP where the VPN server can be reached. In our case the public IP on the company network.

Add route for VPN client to be able to find remote subnet on testPC 1 (beyond VPN server) :

LOCAL ROUTES

This section is used in both Server and Client modes. It lists the routes to be installed in the local IP stack.

- In the client, it lists the server subnets reachable using the server as gateway.
- In the server, it lists the client subnets reachable using the client as gateway.

If the gateway is not indicated, it defaults to the VPN remote address.

TARGET NET	NETMASK	GATEWAY	METRIC	SORT
192.168.33.0	255.255.255.0	10.8.0.1	Default: 0	

Add

Save.

D. Set network zones

A zone is a network or a group of networks which will obey user defined firewall policies.
We will add 2 zones, one for LAN1 (aka LAN), one for the VPN.

1. LAN zone

Go to Setup>Routing / Firewall>Network Zones>Add zone :

ZONE section :

Name : LAN,

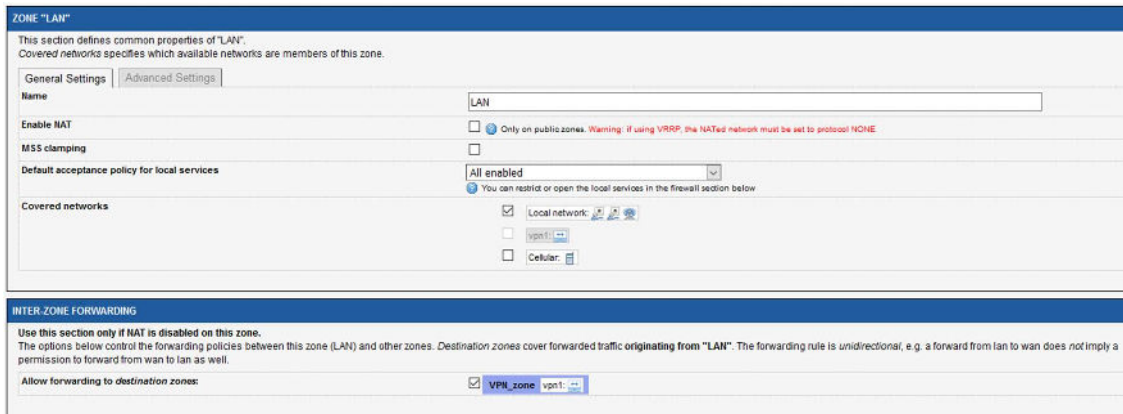
Enable NAT : disable (untick) parameter,

Covered network : select (tick) Local Network,

INTER ZONE FORWARDING section :

Select « VPN » zone (you might want to create this zone prior to selecting it),

Save.



The screenshot shows the 'ZONE "LAN"' configuration window. The 'General Settings' tab is active. The 'Name' field is set to 'LAN'. The 'Enable NAT' checkbox is unchecked. The 'MSS clamping' checkbox is unchecked. The 'Default acceptance policy for local services' is set to 'All enabled'. Under 'Covered networks', the 'Local network' checkbox is checked, and the 'vpn1' checkbox is also checked. The 'INTER ZONE FORWARDING' section is expanded, showing 'Allow forwarding to destination zones' with 'VPN_zone' selected.

2. VPN zone

Browse back to Network Zones and add a 2nd zone :

ZONE section :

Name : VPN_zone,

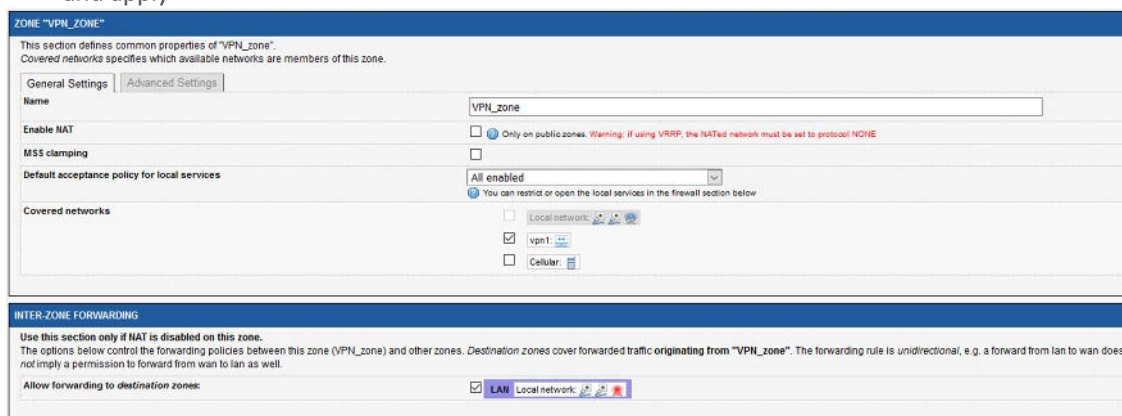
Enable NAT : disable (untick) parameter,

Covered network : select (tick) VPN1,

INTER ZONE FORWARDING section :

Select « Local network » zone,

Save and apply.



The screenshot shows the 'ZONE "VPN_ZONE"' configuration window. The 'General Settings' tab is active. The 'Name' field is set to 'VPN_zone'. The 'Enable NAT' checkbox is unchecked. The 'MSS clamping' checkbox is unchecked. The 'Default acceptance policy for local services' is set to 'All enabled'. Under 'Covered networks', the 'vpn1' checkbox is checked, and the 'Local network' checkbox is also checked. The 'INTER ZONE FORWARDING' section is expanded, showing 'Allow forwarding to destination zones' with 'LAN Local network' selected.

At this point you can loose access to the IHM and, in order to get it back, you might want to set your test laptop ip to 192.168.23.14 as explained below in testpc 2 setup.

V. Test PC's configuration

A. Test PC1 configuration

- Open the network adapter settings and set static IP 192.168.33.14/24 and default Gateway 192.168.33.1
- Allow incoming ping traffic on pc:

<https://docs.microsoft.com/en-us/windows/security/threat-protection/windows-firewall/create-an-inbound-icmp-rule>

([french version](#))

B. Test PC2 configuration

- Open the network adapter settings and set static IP 192.168.23.14/24 and default Gateway 192.168.23.1
- Allow incoming ping traffic on pc:

<https://docs.microsoft.com/en-us/windows/security/threat-protection/windows-firewall/create-an-inbound-icmp-rule>

([french version](#))

C. Debug tips

1. verify the routing tables in the device

Routing table are available under STATUS>NETWORK>ROUTES.

Example here on the routing table from the server side :

ROUTES				
The following rules are currently active on this system.				
ACTIVE IPV4-ROUTES				
NETWORK	TARGET	IPV4-NETMASK	IPV4-GATEWAY	METRIC
WAN	default	0.0.0.0	192.168.1.2	0
vpn1	10.8.0.0	255.255.255.0	local	0
WAN	192.168.1.0	255.255.255.0	local	0
vpn1	192.168.23.0	255.255.255.0	10.8.0.2	0
LAN	192.168.33.0	255.255.255.0	local	0

Do send a screenshot of this table on both client and server side in case you need to contact support.

In case you run the server side on a linux machine (non Acksys) do send the result of route -n command.

2. verify proper IP configuration

in following order :

- Check the public IP address is reachable from the client side

Ping from the Acksys client to the VPN server public IP address. If not working, especially in the case of the VPN server being a cellular device, verify the IP address is well public and possibly come back to your cellular network provider.

- Check both client and server can ping each other

Trigger a ping from 10.8.0.1 to 10.8.0.2 and reverse-wise.

- Check both LAN interfaces can ping each other

Trigger a ping from client to eg 192.168.33.1 and from server to eg 192.168.23.1

- Check both test pc's can ping each other

Trigger a ping from Test PC1 to test PC2 and reverse-wise.

3. wait after boot for tunnel to mount

Tunnel will require a certain time to establish between client and server. Typically a couple of minutes.