HOW-TO

APNUS025
How to configure SLAAC and RA Server

March 2023

Content

1. Glossary

NDP :	Network Discovery Protocol
SLAAC :	Stateless Local Autoconfiguration Address
RA :	Router Avertissement
DHCPv6 :	Dynamic Host Configuration Protocol version 6
EUI :	Extended Unique Identifier
IPv6:	Internet Protocol version 6

2. Introduction

There are different type of IPv6 configuration in WaveOs available in version 4.22.0.1 to provide a solution to address the global issue of depleting address spaces due to increased demand for IP addresses due to technological advancements.

In this test, we will use RA server stands for DHCPv6 SLAAC only in WaveOs therefore IPv6 client addresses can be allocated by automatic addressing through SLAAC.

This post provides an extensive configuration example with details on how to configure SLAAC in WaveOS for Acksys Router, AirBox in AP mode with RA Server enabled and another Acksys Router, Airlink in IPv6 Client Mode in SLAAC.

# 3. Configuration Overview and Prerequesites

Before we begin, let's overview the configuration that we are attempting to achieve and the prerequisites that make it possible :

- RA server: One AirBox router or any type in WaveOs 4.22.0.1 as AP role in Bridge mode
- SLAAC Wi-Fi node: Airlink Router as Client in Bridge mode or any device supporting dhcpv6 client
- Laptop to configure the routers

4.   Configuration architecture

In this network architecture, there are a Router Advertising Server and IPv6 node autoconfiguring in SLAAC.

SLAAC NODE autoconfigured with ULA Prefix

RA SERVER announcing ULA Prefix
IPv6:fdaa:ade3:621::1:/64
MAC: 00:09:90:01:1d:cd

WIFI CLIENT

SLAAC Wi-Fi NODE autoconfigured with ULA Prefix
IPv6:
fdaa:ade3:621:0:209:90ff:fe01:203/64
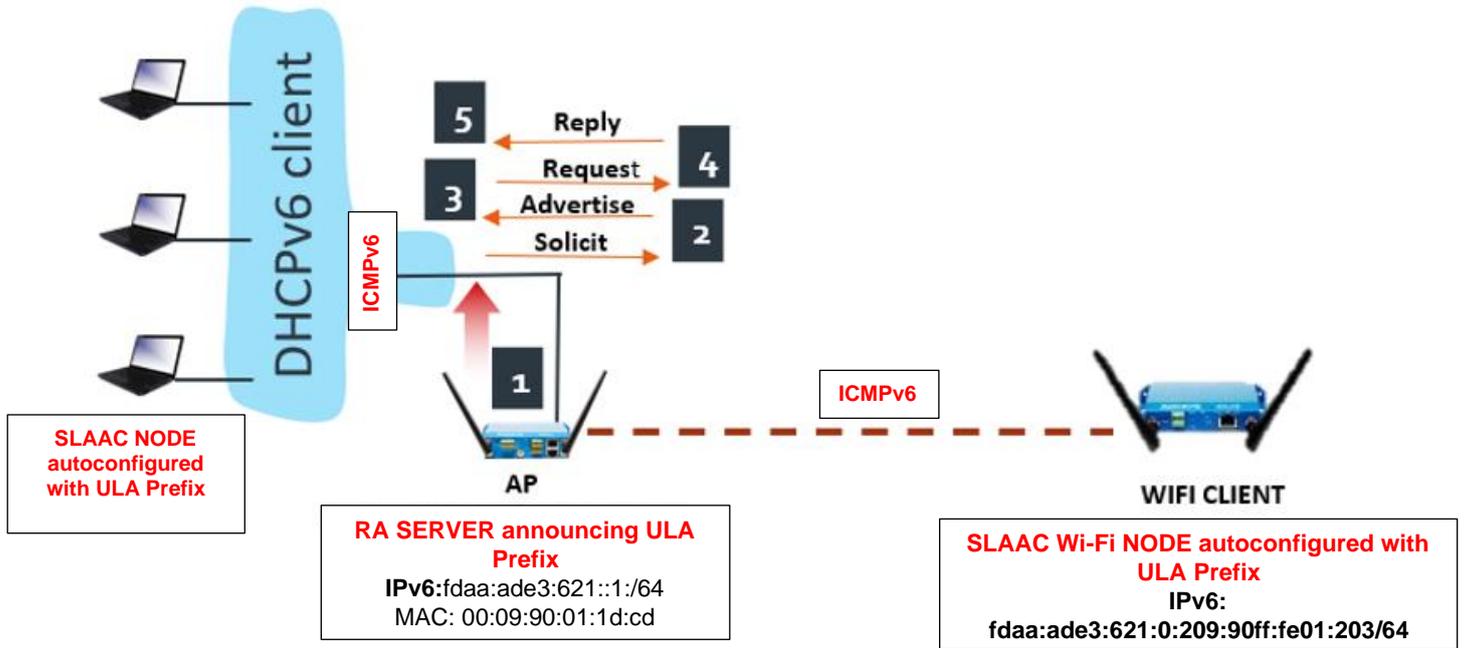
5.   Devices configuration

If you have familiarized yourself with the configuration scheme and have all of the devices in order, we can start configuring the routers using instructions provided in this section.

Configuring AirBox Router in AP mode

LAN interface configuration:

By default, the LAN1 and LAN2 interfaces are bridged with WIFI interface in case of dual LAN interfaces (Acksys AirBox) and in this test, the WIFI Adapter will be associated to the IPv6 interface we will create.
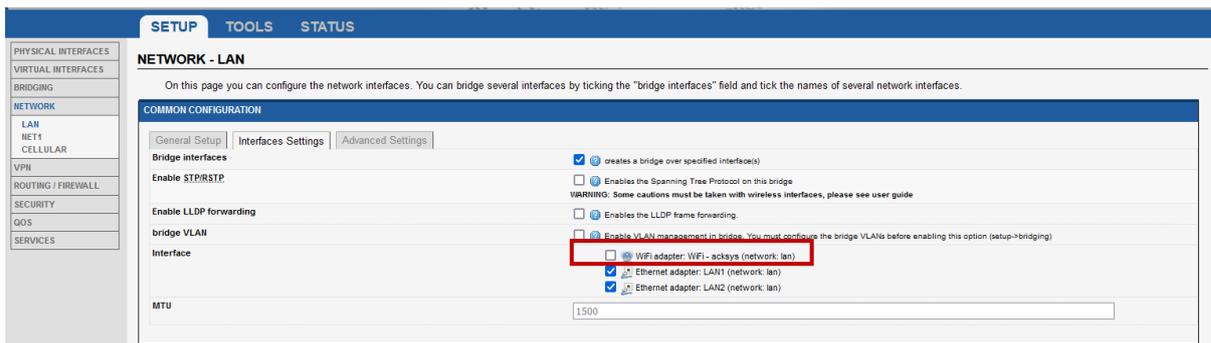
Wi-Fi IPV6 interface configuration (used by the RA server to distribute the ULA prefix):

- Let configure Networks by login to the router's GUI and go to **Setup → Network→ Add Network**. Enter a name for the network and click the "Add" button.

- You will be redirected to the Network settings window where you can start configuring the WIFI interface. Below is screenshot of configurations WIFI interface :
  - Description interface: IPv6
  - Protocol: SLAAC
  - Delegated prefix length: 60
  - Allowed prefix classes: all
  - IPv6 ULA Prefix: fdaa:ade3:0621::/48
  - Click on Save

- Edit the IPv6 network created and associated its to the WIFI adapter:

NOTE:

Delegated prefix length: 60 as delegated prefix length is applicable to subscriber-hosts with IPv6 Prefix assigned by the **DHCPv6 Server in SLAAC Only** (**RA server**). An IPv6 prefix is more similar to a route than it is to an IP address. The length of the prefix plays crucial role in forwarding decisions and prefix assignment through DHCPv6 pools in the local DHCPv6 server.

IPv6 ULA Prefix: Global unique prefix similar to global unicast address. Range in DHCPv6 pools IPv6 address to each device from the Router Advertisement Server and each subnet in the device will be allocated a /64 IPv6 address range from this /48 ULA range.

AirBox Network Overview

Let have a look on the network where the only interesting Network to be used is IPv6.

In this note, WAN interface (Cellular) is disable therefore it is not configured as shown below:

Configuring RA server on the AirBox Router

The AirBox router as AP have different type of DHCPv6 server and in this note, DHCPv6 server is configured in SLAAC OFNLY.DHCPv6 Server in SLAAC Only works as Router Advertising Server in charge of IPv6 addresses in SLAAC for End devices.

Let configure DHCP Server in SLAAC Only (RA server Enabled) for node to configure their address in SLAAC **Setup → Services→DHCPv6** and enter the following information below:

- SLAAC only
- No need to configure RA announce DNS
- No need to configure DNS server as local test
- Announce as default route : "set default router" to tell RA server to push default gateway

Configuring the AP role on the WiFi interface:

By default, the WIFI interface is disable and need to be enabled before configuring the AP and for this note, we will configure the Access Point with the following information:

- in GUI and go to **Setup → Physical Interfaces →Enable the WIFI Interface**.

- Click the "Edit" button located to the right and configure your WIFI SSID.

- You will be redirected to the settings window where you can start configuring the WIFI interface. Below is capture of configurations WIFI interface :
    - ESSID : IPv6
    - Network : WIFI Interface associated to IPv6 network
    - Wireless Security : No encryption
    - Apply and save

Configuring SLAAC WIFI node: Airlink

To fully understand how the IPv6 auto-addressing work, we are going to configure the client therefore it can be configured via SLAAC. Stateless address autoconfiguration (SLAAC) as the IPv6 type makes the operating system attempt to configure the IPv6 address for the interface from router advertisements (RA) that advertise the prefix and related information

Configuring Wi-Fi interface in SLAAC mode:

Let configure Networks by login to the router's GUI and go to **Setup → Network→ Add Network**. Enter a name for the network and click the "Add" button.
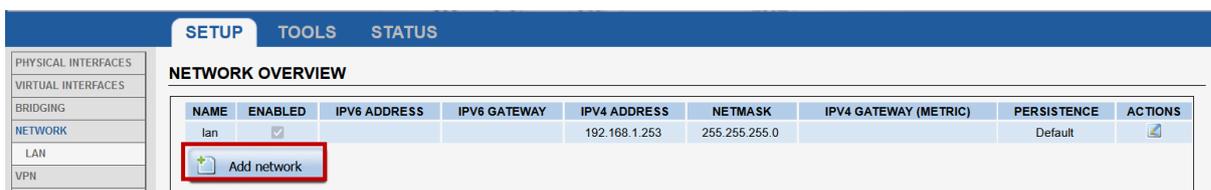
You will be redirected to the Network settings window where you can start configuring the WIFI interface. Below is capture of configurations WIFI interface :

- Description interface :IPv6
- Protocol : SLAAC
- Delegated prefix length : 64
- Allowed prefix classes : all
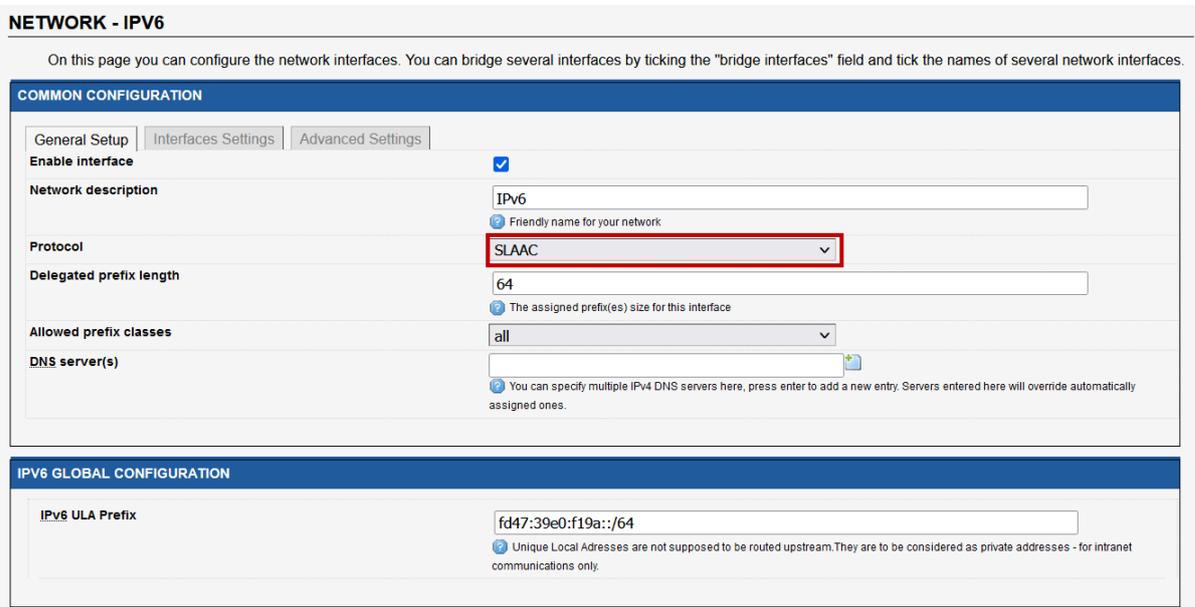
- Edit the IPv6 network and associated to the WIFI adapter:
- Apply and save
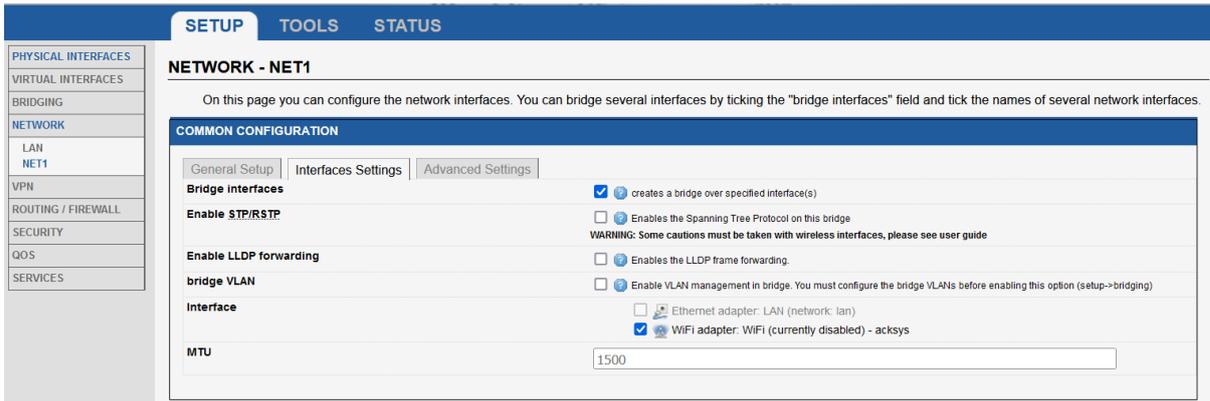
NOTE

The length of a delegated prefix always be a multiple of 4. A single network at a customer site will be a /64 and user-provided IPv6 prefix for distribution to clients

Protocol:SLAAC (Stateless Address Autoconfiguration) which IPv6 auto-addressing via RA server.

Airlink Router Network Overview

NOTE : We have changed the client IPv4 LAN address to avoid conflict with the router in AP mode.
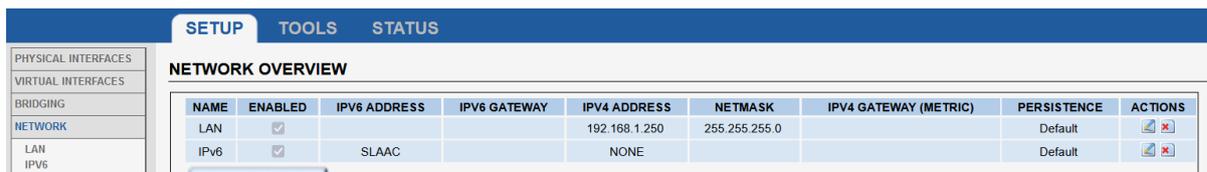
Configuring Wi-Fi Node SSID:

- For IPv6 Node to connect on AP, we have to configure the AP SSID in GUI and go to **Setup → Physical Interfaces →Enable the WIFI Interface**.

- Click the "Edit" button located to the right and configure your WIFI SSID.

You will be redirected to the settings window where you can start configuring the WIFI interface. Below is capture of configurations WIFI interface :

- Role : Client
- ESSID : IPv6
- Network : WIFI Interface associated to IPv6 network
- Wireless Security : No encryption
- Apply and save

6. STATUS

If you've followed all the steps presented above, your configuration should be finished and let have an overview on status of the Network, Wireless.

AirBox Wireless Status

For IPv6 Node to connect in WIFI, we can see the AirLink IPv6 node connected on the AP SSID as below :

In GUI and go to **Status → Wireless**

ASSOCIATED STATIONS

ASSOCIATED STATIONS RESULTS : 1

GRAPH	RADIO	NAME / SSID	MODE	MAC	CHANNEL	SIGNAL	NOISE	SIGNAL/NOISE
	WiFi	IPv6	Infrastructure	00:09:90:01:02:03	6	-32 dBm	-85 dBm	53 dB

AirBox IPv6 Network Status

If you've followed all the steps presented above, after configuring RA server and restarting the services, the IPv6 address of the bridge interface is predictable.

INTERFACES

IPV6

IP CONFIGURATION						
IPv4 Stack not configured						
IPv6 Stack IPv6: fdaa:ade3:621::1 Netmask: 64 Scope: global IPv6: fe80::209:90ff:fe01:1dcd Netmask: 64 Scope: link						

GRAPH	PHYSICAL INTERFACE	MAC ADDRESS	TX COUNT (IN BYTES)	RX COUNT (IN BYTES)	INTERFACE MODE	MTU
	WiFi	00:09:90:01:1d:cd	4574	1934	**Role:** Access Point (infrastructure) **SSID:** IPv6 **Channel:** 6	1500

NOTE:
The Interface is finished with prefix::1 and in this case, the router can be reached on GUI with the URL [fdaa:ade3:621::1]/cgi-bin/guiweb.
IPv6: fdaa:ade3:621::1 Netmask: 64 Scope: global
IPv6: fe80::209:90ff:fe01:1dcd Netmask: 64 Scope: link

Airlink Wi-Fi Status

If you've followed all the steps presented above, your configuration should be finished and see the AP on which AirLink router is associated as below :

ASSOCIATED STATIONS

ASSOCIATED STATIONS RESULTS : 1

GRAPH	RADIO	NAME / SSID	MODE	MAC	CHANNEL	SIGNAL	NOISE	SIGNAL/NOISE
	WiFi	IPv6	Infrastructure	00:09:90:01:1D:CD	6	-30 dBm	-95 dBm	65 dB

Airlink IPv6 Network Status

If you've followed all the steps presented above, your configuration should be finished. But as with any other configuration, it is always wise to test the setup in order to make sure that it works properly.

The Client is well associated to the access point and had received SLAAC IP address from the DHCPv6 in SLAAC only configured on the AP.

Then Go to Status → Network in order to check if the client receive IP address from AP via RA Server

	IPV6					
		IP CONFIGURATION				
		IPv4 Stack **not configured**				
		IPv6 Stack **IPv6: fdaa:ade3:621:0:209:90ff:fe01:203 Netmask: 64 Scope: global** **IPv6: fe80::209:90ff:fe01:203 Netmask: 64 Scope: link**				
GRAPH	**PHYSICAL INTERFACE**	**MAC ADDRESS**	**TX COUNT (IN BYTES)**	**RX COUNT (IN BYTES)**	**INTERFACE MODE**	**MTU**
	WiFi	00:09:90:01:02:03	3440	314	**Role:** Client (infrastructure) **SSID:** IPv6 **Channel:** 6	1500

Now Acksys Router as Client IPv6 node for the AP has a global unicast address and a default gateway from the Router Advertisement Router (DHCP SLAAC only).

When the Airlink as client IPv6 nodes is connected to an IPv6 enabled network (AirBox in AP role), the first thing it typically do is to auto-configure themselves with a link-local address use to communicate at Layer 3 with other IPv6 devices in the local segment.

The most widely adopted way of auto-configuring a link-local address is by combining the link-local prefix FE80::/64 and the MAC address of the interface as shown on the screenshot of the Client Network Status.

> **IPv6: fdaa:ade3:621:0:209:90ff:fe01:203 Netmask: 64 Scope: global**
>
> **Mac Address: 00:09:90:01:02:03**

Once the Client Airlink gets back the Router Advertisement from AP (RA Server), it combines the prefix **fdaa:ade3:621::1/64** with its MAC address (**00:09:90:01:02:03**) resulting in the global unicast address **fdaa:ade3:621:0:209:90ff:fe01:203/64**. Because the Router Advertisement came from AP Router, Airlink sets its IPv6 default gateway to the link-local address of RA.

7. Configuring IPv6 on Windows 10

In this case, Windows is configured in its IPv6 settings in an IPv6 address automatically therefore only the allocation address is done the Router Advertisements (DHCPv6 server in SLAAC only) sent by the Acksys Router in AP mode.

```
Propriétés de : Protocole Internet version 6 (TCP/IPv6)                    ×

 Général

 Les paramètres IPv6 peuvent être déterminés automatiquement si votre réseau le permet. Sinon,
 vous devez demander les paramètres IPv6 appropriés à votre administrateur réseau.

    ◉ Obtenir une adresse IPv6 automatiquement
    ○ Utiliser l'adresse IPv6 suivante :
       Adresse IPv6 :                          [                          ]
       Longueur du préfixe de                  [     ]
       sous-réseau :
       Passerelle par défaut :                 [                          ]

    ◉ Obtenir les adresses des serveurs DNS automatiquement
    ○ Utiliser l'adresse de serveur DNS suivante :
       Serveur DNS préféré :                   [                          ]
       Serveur DNS auxiliaire :                [                          ]

    ☐ Valider les paramètres en quittant                         Avancé...

                                                        OK          Annuler
```

```
Carte réseau sans fil Wi-Fi :

   Suffixe DNS propre à la connexion. . . :
   Description. . . . . . . . . . . . . . : Intel(R) Wi-Fi 6E AX211 160MHz
   Adresse physique . . . . . . . . . . . : 28-6B-35-92-66-39
   DHCP activé. . . . . . . . . . . . . . : Oui
   Configuration automatique activée. . . : Oui
   Adresse IPv6. . . . . . . . . . . . . .: fdaa:ade3:621:0:b72:1d18:3c71:63e9(préféré)
   Adresse IPv6 temporaire . . . . . . . : fdaa:ade3:621:0:d439:1f98:7bf6:1b6b(préféré)
   Adresse IPv6 de liaison locale. . . . .: fe80::ed67:f6c6:a214:86ea%18(préféré)
   Adresse d'autoconfiguration IPv4 . . . : 169.254.33.47(préféré)
   Masque de sous-réseau. . . . . . . . . : 255.255.0.0
   Passerelle par défaut. . . . . . . . . :
   IAID DHCPv6 . . . . . . . . . . . : 254307125
   DUID de client DHCPv6. . . . . . . : 00-01-00-01-2B-15-E0-55-C4-CB-E1-06-E6-F3
   Serveurs DNS. . . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                          fec0:0:0:ffff::2%1
                                          fec0:0:0:ffff::3%1
   NetBIOS sur Tcpip. . . . . . . . . . . : Activé
```

The output of ipconfig /all command show the link-local address is not created using the MAC address 28-6B-35-92-66-39 but a Random Interface Identifier native with Windows devices.

Windows hosts used only MAC addresses to create Interface Identifiers (EUI-64). Globally unique addresses and Link-local ones were created using the segment's prefix plus the EUI-64 identifier which is generated from the physical address of the host.

8. TESTING

If you've followed all the steps presented above, your configuration should be finished as expected.

AirLink Network Testing

If you've followed all the steps presented above, your configuration should be finished and you can ping the Airbox IPv6 address with success as below :

```
root@CLIENT:~# ping -6 fdaa:ade3:621::1 -w 10
PING fdaa:ade3:621::1 (fdaa:ade3:621::1): 56 data bytes
64 bytes from fdaa:ade3:621::1: seq=0 ttl=64 time=1.670 ms
64 bytes from fdaa:ade3:621::1: seq=1 ttl=64 time=1.455 ms
64 bytes from fdaa:ade3:621::1: seq=2 ttl=64 time=1.500 ms
64 bytes from fdaa:ade3:621::1: seq=3 ttl=64 time=5.500 ms
64 bytes from fdaa:ade3:621::1: seq=4 ttl=64 time=2.639 ms
64 bytes from fdaa:ade3:621::1: seq=5 ttl=64 time=1.472 ms
64 bytes from fdaa:ade3:621::1: seq=6 ttl=64 time=1.886 ms
64 bytes from fdaa:ade3:621::1: seq=7 ttl=64 time=4294962.832 ms
64 bytes from fdaa:ade3:621::1: seq=8 ttl=64 time=1.607 ms
64 bytes from fdaa:ade3:621::1: seq=9 ttl=64 time=1.557 ms

--- fdaa:ade3:621::1 ping statistics ---
10 packets transmitted, 10 packets received, 0% packet loss
round-trip min/avg/max = 1.455/429498.211/4294962.832 ms
```

Windows10 Network Testing

If you've followed all the steps presented above, your configuration should be finished and you can ping the Airbox IPv6 address with success as below :

```
📅 31/03/2023  🕐 10:40.41  📂 /home/mobaxterm  ping -6 fdaa:ade3:621::1 -w 10

Envoi d'une requête 'Ping'  fdaa:ade3:621::1 avec 32 octets de données :
Réponse de fdaa:ade3:621::1 : temps=4 ms
Réponse de fdaa:ade3:621::1 : temps=2 ms
Réponse de fdaa:ade3:621::1 : temps=1 ms
Réponse de fdaa:ade3:621::1 : temps=2 ms

Statistiques Ping pour fdaa:ade3:621::1:
    Paquets : envoyés = 4, reçus = 4, perdus = 0 (perte 0%),
Durée approximative des boucles en millisecondes :
    Minimum = 1ms, Maximum = 4ms, Moyenne = 2ms
```

Email : support@acksys.fr