



ENF[™] Router Card with Wi-Fi

Model: XAP-RW-001

Quick Start Guide

Introduction

Thank you for purchasing the Xaptum® ENF™ Router Card with Wi-Fi. This Quick Start Guide contains instructions for installing and configuring this card in an edge gateway or IoT device.

Package Contents



XAP-RW-001



DAA Group Label



Full Height Adapter



M2 Phillips Screw
(Qty. 2)

Installation Requirements

- Mini PCIe slot and compatible mounting screw(s)
- U.FL to RP-SMA coaxial pigtail
- RP-SMA external Wi-Fi antenna
- Phillips screwdriver (for *full-height* adapter option)

Host Requirements

- Linux
- USB Ethernet driver
- DHCPv6 client

 **IMPORTANT:** The XAP-RW-001 requires an IPv6 network stack and a compatible USB Ethernet driver. Most Linux distributions include both.

Configuration Requirements

- Edge Network Fabric (ENF) account
- `enfc1i` configuration utility
- QR code scanner or phone app
- Wi-Fi access point

 **IMPORTANT:** The XAP-RW-001 requires an Edge Network Fabric account. Contact your Xaptum sales representative to create one.

 **NOTE:** The `enfc1i` configuration utility is available online at downloads.xaptum.com.

TERMS OF USE: It is the professional installer's responsibility to follow local country regulations, including operation within legal frequency channels, output power, antenna placement, indoor cabling requirements, and Dynamic Frequency Selection (DFS) requirements.

Hardware Overview

Router Card



Edge Connector The Mini PCIe *edge connector* plugs into a Mini PCIe slot on the host. It provides power and a USB 2.0 connection to the router card.

 **NOTE:** The XAP-RW-001 uses only the power and USB pins on the connector. The PCIe lines are not required.

RF Jack The U.FL *RF jack* connects to an external Wi-Fi antenna via a U.FL to RP-SMA coaxial pigtail.

Approved Antennas

Antennas with the following characteristics may be used with the XAP-RW-001.

Approved Antenna Characteristics	
Type	External Dipole
Max Gain	
2.4 GHz	2.2 dBi
5 GHz	5 dBi

DAA Group Label

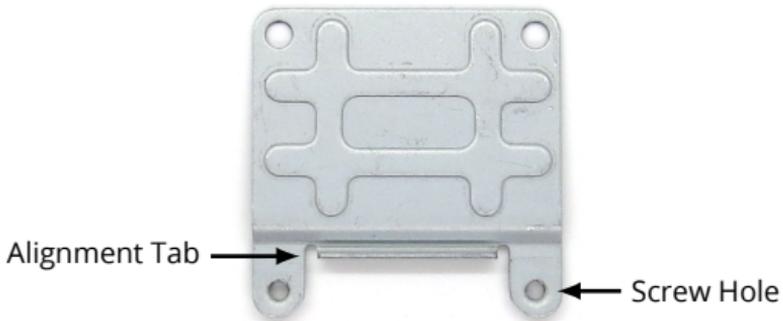


The *DAA group label* displays details about the group of router card(s) in this package.

QR Code The *QR code* contains the group public key used to cryptographically authenticate each router card in this package. When prompted by the `enfcli`, scan this code to assign the group to a network.

- ✓ **NOTE:** Router cards are assigned to `::/64` networks in groups, eliminating time-consuming and error-prone configuration of individual cards.

Full Height Adapter



The *full height adapter* enables installation in a full height Mini PCIe slot on the host. Its use is optional.

Assigning a Network

You must assign the router card(s) in this package to a `::/64` ENF network before they can be used.

1. Launch the `enfcli`, specifying the host and username for your ENF account. Enter your password when prompted.

```
$ enfcli --host demo.xaptum.io --user user@demo
Connecting to 'https://demo.xaptum.io'.....
Enter Password:
```

2. Choose a `::/64` network, and assign these router cards to it using the `iam add-group-to-network` command. Scan¹ the DAA group label QR code when prompted.

```
enfcli-user@demo> iam add-group-to-network --set-as-
default --network=2607:8f80:8080:1::/64
Scan DAA group information:
```

 **IMPORTANT:** On first boot, the router card will be assigned an IPv6 address from this network.

¹If you don't have a barcode scanner, use a smartphone app to scan the code. Paste the resulting text into the `enfcli` prompt.

Installing the Router Card

If installing in a half height Mini PCIe slot, skip to step 2.

1. Align the top edge of the *router card* with the *full height adapter* alignment tab and attach with the provided *Phillips screws*.



2. Insert the *router card* into the Mini PCIe slot on the host device, and secure according to the host device's instructions.



3. Connect the antenna pigtail to the U.FL *RF jack*.



4. Connect an approved external antenna to the RP-SMA connector on the host device.



Connecting to Wi-Fi

The router card is preconfigured to connect to a Wi-Fi network with the following credentials.

SSID	WPA2-PSK
xaprc_default	password123!

Once connected, you can change the configuration remotely using the `enfcli`.

1. Configure a Wi-Fi access point² with the SSID and passphrase listed in the preceding table.

 **IMPORTANT:** The Wi-Fi access point must be connected to the Internet.

2. Power on the host device and wait 30 seconds for the router card to connect. Check the connection status using the `captive get-device-status` command. Use the serial number printed on the router card as the device id.

```
enfcli-user@demo> captive get-device-status
--device-id=XRW04419003028
Serial Number : XRW04419003028
WIFI          :
  connected   : true
  SSID        : xaprc_default
  IPv4 addresses : [ 192.168.1.56 ]
```

The following steps create a new profile and Wi-Fi configuration for this device. To use an existing profile, skip to step 5.

²If you don't have an access point, configure a smartphone *hotspot* instead.



NOTE: A *profile* describes the desired configuration for a router card. Multiple router cards can be easily managed at once by assigning them to the same profile.

3. Create a new wifi config JSON file and upload it using the `captive create-wifi-configuration` command.

```
$ cat <<EOF > wifi.json
{
  "name": "Demo",
  "networks": [
    {
      "name": "Factory",
      "SSID": "ACME-OT",
      "SSID_type": "string",
      "auth": {
        "type": "psk",
        "passphrase": "pass123"
      },
      "IPv4": {
        "type": "dhcp"
      }
    }
  ]
}
EOF
enfcli-user@demo> captive create-wifi-configuration
  --wifi-config-file=wifi.json
ID       : 1aad6bdd-8b09-49bc-bd43-d5255d543c78
Name     : Demo
Networks :
  Name    : Factory
  SSID    : ACME-OT
  auth    : psk
  IPv4    : dhcp
  IPv6    : off
```

4. Create a new profile using the `captive create-profile` command.

```
enfcli-user@demo> captive create-profile --profile-  
name=Demo --device-mode=secure-host --wifi-  
id=1aad6bdd-8b09-49bc-bd43-d5255d543c78  
Name      : Demo  
ID        : 7db6eaae-51e8-49bf-9ab9-1e3315fb8417  
Mode      : secure-host  
Wifi      :  
  ID      : 1aad6bdd-8b09-49bc-bd43-d5255d543c78
```

5. Assign the profile to the router card using the `captive update-device` command.

```
enfcli-user@demo> captive update-device --device-  
id=XRW04419003028 --profile-id=7db6eaae-51e8-49bf-  
9ab9-1e3315fb8417  
Serial    : XRW04419003028  
Profile   :  
  Name    : Demo  
  ID      : 7db6eaae-51e8-49bf-9ab9-1e3315fb8417
```

-  **IMPORTANT:** An access point with the new Wi-Fi credentials must be available and connected to the Internet. Otherwise, the router card will be unable to reconnect.

6. Confirm that the change was applied using the `captive get-device-status` command. The connected Wi-Fi network should be the new SSID.

```
enfcli-user@demo> captive get-device-status
  --device-id=XRW04419003028
Serial Number : XRW04419003028
WIFI          :
  connected   : true
  SSID        : ACME-OT
  IPv4 addresses : [ 10.50.17.132 ]
```

7. Turn off the temporary access point with the default credentials.

Configuring the Host

The router card appears to the host as a USB ethernet device. After powering on the host, you should see a new ethernet network interface.

1. If necessary, enable the interface in the host network manager. Many systems will do this automatically.
2. Verify that the interface has received an ENF IPv6 address using the `ip -6 addr` command.

```
$ ip -6 addr
4: eth2 <BROADCAST,MULTICAST,UP,LOWER_UP> state UP
   inet6 2607:8f80:8080:1:73d:ff2a:2206:8041/128
```

3. That's it! Your host is securely connected to the ENF.



NOTE: If the interface doesn't appear or have an ENF IP address, see Troubleshooting for help.

Specifications

XAP-RW-001	
Dimensions	26.8 × 30 × 4.75 mm (1.06 × 1.18 × 0.19")
Weight	5 g
Max Throughput	2.5 Mbps
Processor	500 MHz ARM with hardware acceleration for cryptographic operations
System Memory	256 MB DDR3 RAM
Code Storage	1 GB Flash
Hardware Secure Element	TPM 2.0
Host Interface	Mini PCI-e
Network Interface	(1) Wi-Fi
Operating Frequency	2.4 GHz 5 GHz
Max. TX Power	
2.4 GHz	17 dBm
5 GHz	13 dBm
Max. Antenna Gain	
2.4 GHz	2.2 dBi
5 GHz	5 dBi
Wi-Fi Standards	802.11 a/b/g/n/ac
Wireless Security	WEP, WPA-PSK, WPA-Enterprise (WPA/WPA2, TKIP/AES)
Operating Temperature	−20 to 70°C
Operating Humidity	5 to 95% RH, non-condensing
Certifications	FCC, IC

Troubleshooting

No Network Interface on Host

If the router card does not appear as a network interface, confirm it is installed properly and a USB ethernet driver is loaded.

Incorrect Physical Installation

Verify that the router card is recognized as a USB device using the `lsusb` command.

```
$ lsusb
Bus 001 Device 005: ID 2fe0:8b02
    Xaptum, Inc. ENF Router Card with Wi-Fi
```

If not, check that the router card is properly installed and that USB is functioning on the host.

Missing USB Ethernet Driver

Ensure that a USB ethernet driver is installed. The Linux kernel might have been compiled without it.

Recompile the Linux kernel with the `CONFIG_USB_NET_CDCETHER` config option to `y` or `m`.

No IPv6 Address on Network Interface

If the network interface does not receive an IPv6 address, confirm that IPv6 support is enabled in the kernel and the host supports DHCPv6.

Kernel IPv6 Support Disabled

Check if the kernel was compiled without support for IPv6 networking. The ENF is an IPv6 overlay network, so this support is required.

Compile the kernel with the `CONFIG_IPV6` option set to `y`.

DHCPv6 Client is Missing

The ENF uses DHCPv6 to assign a static IPv6 address to each endpoint. If the host does not include a DHCPv6 client, it cannot receive that IP address.

Install a DHCPv6 client on the host.

DHCPv6 Not Supported by Network Manager

The ENF uses DHCPv6 to assign a static IPv6 address to each endpoint. If the network manager on the host does not support starting a DHCPv6 client for the interface, it cannot receive that IP address. This is a problem with some versions of `ifupdown` in particular.

Upgrade to a network manager that supports DHCPv6. The most recent versions of `connman`, `NetworkManager`, `systemd-networkd`, and `wicd` all support DHCPv6.

Cannot Connect to Wi-Fi

If the router card is not connecting, confirm that the Wi-Fi configuration includes the credentials for a working access point.

Recovery Wi-Fi Network

If the router card cannot connect using the provided Wi-Fi configuration, it will fallback to the following recovery credentials. This is useful to fix an incorrect Wi-Fi configuration.

SSID	WPA2-PSK
xaprc_recovery	xaprc_recovery

Configure a Wi-Fi access point with the recovery SSID and passphrase. Wait for the router card to connect, and update the Wi-Fi configuration using the `enfcli`.

Safety Notices

Electrical Safety Information

1. Compliance is required with respect to voltage, frequency, and current requirements indicated on the manufacturer's label. Connection to a different power source than those specified may result in improper operation, damage to the equipment or pose a fire hazard if the limitations are not followed.
2. There are no operator serviceable parts inside this equipment. Service should be provided only by a qualified service technician.

Limited Warranty

XAPTUM, Inc ("XAPTUM") warrants that the product(s) furnished hereunder (the "Product(s)") shall be free from defects in material and workmanship for a period of one (1) year from the date of shipment by XAPTUM under normal use and operation. XAPTUM's sole and exclusive obligation and liability under the foregoing warranty shall be for XAPTUM, at its discretion, to repair or replace any Product that fails to conform to the above warranty during the above warranty period. The expense of removal and reinstallation of any Product is not included in this warranty. The warranty period of any repaired or replaced Product shall not extend beyond its original term.

Warranty Conditions

The above warranty does not apply if the Product:

1. has been modified and/or altered, or an addition made thereto, except by XAPTUM or XAPTUM's authorized representatives, or as approved by XAPTUM in writing;
2. has been painted, rebranded or physically modified in any way;
3. has been damaged due to errors or defects in cabling, antennas, or the host device;
4. has been subjected to misuse, abuse, negligence, abnormal physical, electromagnetic or electrical stress, including lightning strikes, or accident;
5. has been damaged or impaired as a result of using third party firmware;
6. has no original XAPTUM serial number label, or is missing any other original XAPTUM label(s); or
7. has not been received by XAPTUM within 30 days of issuance of the RMA.

In addition, the above warranty shall apply only if: the product has been properly installed and used at all times in accordance, and in all material respects, with the applicable Product documentation.

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No Products will be accepted for replacement or repair without obtaining a Return Materials Authorization (RMA) number from XAPTUM during the warranty period, and the Products being received at XAPTUM's facility freight prepaid in accordance with the RMA process of XAPTUM. Products returned without an RMA number will not be processed and will be returned freight collect or subject to disposal. Information on the RMA process and obtaining an RMA number can be found at: www.xaptum.com/warranty

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Compliance

FCC

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions.

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device contains FCC ID: 2AQPLLBE5HY1MW.

ISED Canada

This device complies with ISED Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation. that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'ISDE Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage;
2. l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device contains IC 24659-LBEE5HY1MW.

RF Exposure Warning

The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be located or operating in conjunction with any other antenna or transmitter.

Les antennes utilisées pour ce transmetteur doivent être installé en considérant une distance de séparation de toute personnes d'au moins 20 cm et ne doivent pas être localisé ou utilisé en conflit avec tout autre antenne ou transmetteur.

Online Resources

Website www.xaptum.com

Documentation docs.xaptum.com

Downloads downloads.xaptum.com

Support support@xaptum.com



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