FN980 on Jetson AGX Orin™ Enablement

Application Note
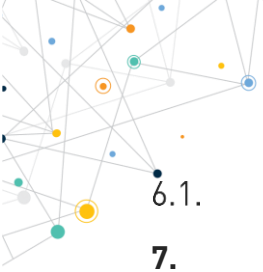
Telit Technical Documentation

APPLICABILITY TABLE

PRODUCTS
FN980
FN980m

CONTENTS

1. INTRODUCTION

1.1. Scope

This document describes the standard operating procedure to enable Telit FN980 in the NVIDIA® Jetson AGX Orin™ Developer Kit. The features and solutions described in this document are applicable to all variants listed in the applicability table.

1.2. Audience

This document is intended for developers using Telit FN980 in the NVIDIA® Jetson AGX Orin™ Developer Kit.

1.3. Contact Information, Support

For technical support and general questions please e-mail:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*
- *TS-ONEEDGE@telit.com*

Alternatively, use:

https://www.telit.com/contact-us/

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1.4. Symbol Conventions

⚠️	**Danger:** This information MUST be followed or catastrophic equipment failure or personal injury may occur.

✋	**Warning:** Alerts the user on important steps about the module integration.

📌	**Note/Tip:** Provides advice and suggestions that may be useful when integrating the module.

⚡	**Electro-static Discharge:** Notifies the user to take proper grounding precautions before handling the product.

All dates are in ISO 8601 format, that is YYYY-MM-DD.

2. FN980 AND JETSON AGX ORIN

2.1. Overview

The Telit FN980 and FN980m data cards enable a new generation of 5G state-of-the-art data cards featuring both sub-6 and mmWave (FN980m only) technologies with LTE, WCDMA and GNSS support. These data cards lay the foundation for businesses worldwide to future-proof IoT, enterprise applications and video while leveraging all 5G's and Gigabit LTE's benefits immediately.

NVIDIA® Jetson is the world's leading platform for AI at the edge. It combines high-performance, low-power compute modules with the NVIDIA AI software stack. It's the ideal platform for advanced robotics and other autonomous products. The NVIDIA® Jetson AGX Orin™ Developer Kit includes a high-performance, power-efficient Jetson AGX Orin module.

This Application Note explains the steps needed to enable Telit FN980 on the NVIDIA® Jetson AGX Orin™ Developer Kit.

2.2. Initial Prerequisites

The following mandatory prerequisites must be fulfilled for successfully implementing the contents of this Application Note:

- The Orin™ Developer Kit in use must be running Jetson Linux 34.1.1. If this prerequisite is not verified, please update the Developer Kit to Jetson Linux 34.1.1 following the Jetson Linux Developer Guide.
- Telit FN980 USB composition is 0x1051 (MBIM): in paragraph 4.2 it is explained how to set the correct USB composition in case this prerequisite is not verified.
- The initial Orin™ Developer Kit setup requires Internet connection (e.g. through WiFi or Ethernet).

2.3. Writing Conventions

In this Application Note the commands to be typed in a Linux terminal are written in `Courier New`, with the following prefix meaning:

- `telit@JetsonAgxOrin`: commands to be typed in the Orin™ Developer Kit.
- `telit@buildMachine`: commands to be typed in a x64 Intel Linux build machine.

3. CUSTOMIZING JETSON LINUX 34.1.1 KERNEL

3.1. Understanding the Need for Customizing the Kernel

Jetson Linux 34.1.1 comes with Linux kernel v5.10.65, as can be seen sending the following command through a terminal in the Developer Kit:

```
telit@JetsonAgxOrin:~$ uname -r
5.10.65-tegra
```

The kernel modules needed to drive Telit FN980 mobile broadband device using the USB composition 0x1051 are not available in the default Jetson Linux 34.1.1 kernel build: in the following paragraphs it is explained how to build these kernel modules and how to copy them to the Developer Kit.

3.2. Building the Kernel Modules

There are various methods to build the kernel modules: in this Application Note it is explained how to cross-compile the kernel in a Linux Intel x64 host to get the needed modules.

Performing a kernel build requires the presence of specific packages in the build machine: please refer to the instructions for the Linux distribution used in the build machine for further instructions.

As an example, when using Ubuntu 21.04 the following command should be enough to collect all the needed packages to perform a kernel build:

```
$ sudo apt install build-essential binutils-doc debian-
keyring g++-multilib g++-10-multilib gcc-10-doc gcc-multilib
autoconf automake libtool flex bison gcc-doc gcc-10-multilib
gcc-10-locales glibc-doc git bzr libstdc++-10-doc make-doc
diffutils-doc autoconf-archive gnu-standards autoconf-doc
gettext libncurses-dev pkg-config libssl-dev libelf-dev
libdwarf-dev dwarves zstd
```

Download Bootlin Toolchain gcc 9.3 and extract the package as explained in Jetson Linux Toolchain page.

Download L4T Driver Package (BSP) having the kernel sources and extract them as explained in the Kernel Customization page.

In the build machine, go to the directory *Linux_for_Tegra/source/public* and type in a terminal:

```
telit@buildMachine:~$ export ARCH=arm64
telit@buildMachine:~$ export CROSS_COMPILE_AARCH64_PATH=$HOME/l4t-gcc
```

Modify the script nvbuild.sh, adding the highlighted line:

```
"${MAKE_BIN}" -C "${source_dir}" ARCH=arm64 \
        LOCALVERSION="-tegra" \
        CROSS_COMPILE="${CROSS_COMPILE_AARCH64}" \
        "${O_OPT[@]}" "${config_file}"

        "${MAKE_BIN}" -C "${source_dir}" menuconfig ARCH=arm64 "${O_OPT[@]}"

"${MAKE_BIN}" -C "${source_dir}" ARCH=arm64 \
        LOCALVERSION="-tegra" \
        CROSS_COMPILE="${CROSS_COMPILE_AARCH64}" \
        "${O_OPT[@]}" -j"${NPROC}" \
        --output-sync=target Image
```

> The modified script is available in Telit github repository dedicated to FN980 enablement on NVIDIA® Jetson AGX Orin™
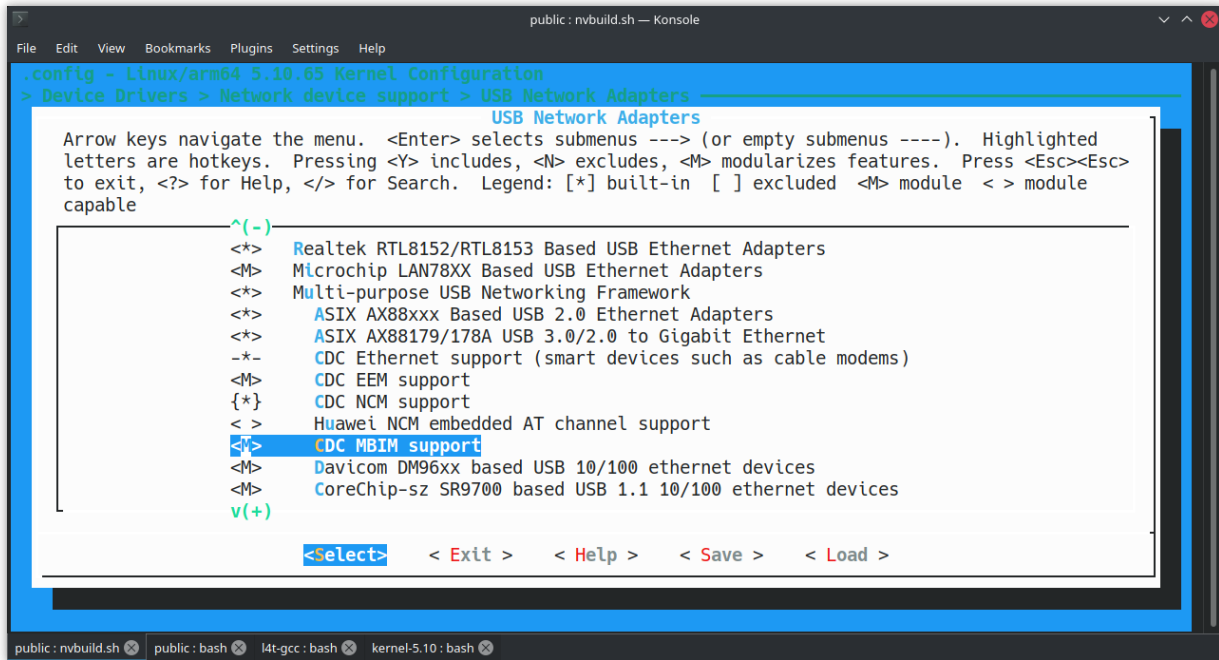
Create the kernel output directory:

```
telit@buildMachine:~$ mkdir kernel_out
```

And start the build:

```
telit@buildMachine:~$ ./nvbuild.sh -o $PWD/kernel_out
```

Once the kernel configuration menu shows, add the following module (<M>):

```
Device Drivers  ---> Network device support  ---> USB Network Adapters
    <M>      CDC MBIM support
```

Save the configuration, exit and the build will start.

Once the build is finished, checkout the following files availability:

kernel_out/drivers/net/usb/cdc_mbim.ko
kernel_out/drivers/usb/class/cdc-wdm.ko

The prebuilt kernel modules are available in Telit github repository dedicated to FN980 enablement on NVIDIA® Jetson AGX Orin™

3.3. Copying the Kernel Modules to the Developer Kit

The built kernel modules need to be copied to the Developer Kit: choose the most convenient way for your setup (e.g. using an USB Flash drive).

In this Application Note it is supposed the kernel modules to be available in path *<kernel modules origin>* accessible from the Developer Kit.

In the Developer Kit open a terminal and type:

```
telit@JetsonAgxOrin:~$ sudo cp <kernel modules origin>/cdc_mbim.ko
/lib/modules/5.10.65-tegra/kernel/drivers/net/usb
telit@JetsonAgxOrin:~$ sudo cp <kernel modules origin>/cdc-wdm.ko
/lib/modules/5.10.65-tegra/kernel/drivers/usb/class
telit@JetsonAgxOrin:~$ sudo depmod -a
telit@JetsonAgxOrin:~$ sudo modprobe cdc_mbim
```

Check the result of the operation by typing:

```
telit@JetsonAgxOrin:~$ dmesg | grep -i cdc_mbim
```

The output of this command should be something like:

```
[  397.313608] usbcore: registered new interface driver cdc_mbim
```

On the kernel side everything is now ready for using the modem.

4. USING FN980 WITH MODEMMANAGER

4.1. What is ModemManager

Freedesktop.org ModemManager is a DBus-activated daemon which controls mobile broadband (2G/3G/4G) devices and connections.

ModemManager provides a unified high level API for communicating with mobile broadband modems, regardless of the protocol used to communicate with the actual device (AT commands, MBIM, QMI).

For managing non AT-based modems, ModemManager uses external libraries: freedesktop.org libqmi for QMI-based modems, libmbim for MBIM-based modems.

ModemManager can be used with freedesktop.org NetworkManager for easier network connections management.

Jetson Linux comes by default with ModemManager 1.16.6:

```
telit@JetsonAgxOrin:~$ mmcli -V
mmcli 1.16.6
Copyright (2011 - 2021) Aleksander Morgado
License GPLv2+: GNU GPL version 2 or later http://gnu.org/licenses/gpl-
2.0.html
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
```

Though this version is no more actively developed, it can be used for managing FN980. Chapter 5 explains how to move to a more recent ModemManager version.

	If ModemManager is not installed in the used setup, type:
	`telit@JetsonAgxOrin:~$ sudo apt install modemmanager`

4.2. Setting FN980 MBIM Composition

The first step is to set the correct MBIM composition (0x1051).

Stop ModemManager service by typing:

```
telit@JetsonAgxOrin:~$ sudo service ModemManager stop
```

Plug the modem to the Developer Kit through the USB-C cable and turn it on. Verify the modem presence in the kernel log:

```
telit@JetsonAgxOrin:~$ dmesg | grep -I =1050
```

This command should return an output like the following:

```
[ 3644.097734] usb 1-1: New USB device found, idVendor=1bc7, idProduct=1050,
bcdDevice= 4.14
```

If the number highlighted in the line above is 1051, skip the following steps and move to the next paragraph, otherwise install the serial terminal emulator minicom by typing:

```
telit@JetsonAgxOrin:~$ sudo apt install minicom
```

Start the terminal emulator:

```
telit@JetsonAgxOrin:~$ sudo minicom -D /dev/ttyUSB2
```

and type the following AT command:

```
AT#USBCFG=2
```

There should be an output like the following:

```
Welcome to minicom 2.7.1

OPTIONS: I18n
Compiled on Dec 23 2019, 02:06:26.
Port /dev/ttyUSB2, 10:33:17

Press CTRL-A Z for help on special keys

AT#USBCFG=2
OK
```

This command makes the modem to reboot. Wait until the new composition shows-up:

```
telit@JetsonAgxOrin:~$ dmesg -w | grep -I =1051
[ 3644.097734] usb 1-1: New USB device found, idVendor=1bc7, idProduct=1051,
bcdDevice= 4.14
```

The modem is now ready for use.

4.3. Checking Modem Detection

Verify that ModemManager is properly running by typing:

```
telit@JetsonAgxOrin:~$ systemctl status ModemManager.service
```

The returned output should be like:

```
● ModemManager.service - Modem Manager
    Loaded: loaded (/lib/systemd/system/ModemManager.service; enabled;
vendor preset: enabled)
    Active: active (running) since Thu 2022-06-09 12:06:25 CEST; 4s ago
```

If ModemManager is not running, start the service:

```
telit@JetsonAgxOrin:~$ sudo service ModemManager start
```

After a while (up to 90 seconds) the modem should be detected by ModemManager. Verify its presence by typing:

```
telit@JetsonAgxOrin:~$ mmcli -L
    /org/freedesktop/ModemManager1/Modem/0 [Telit Wireless Solutions] FN980m
```

and for additional details on the modem:

```
telit@JetsonAgxOrin:~$ mmcli -m 0
  -----------------------------------
  General  |                    path: /org/freedesktop/ModemManager1/Modem/0
           |               device id: c7244bee3c978377afcf894ac0ddd30d1a0d3f71
  -----------------------------------
  Hardware |            manufacturer: Telit Wireless Solutions
           |                   model: FN980m
           |       firmware revision: SDX55.LE.1.4.r1-00046-NBOOT.CP
           |          carrier config: default
           |            h/w revision: FN980m
           |               supported: cdma-evdo, gsm-umts, lte, 5gnr
           |                 current: gsm-umts, lte
           |            equipment id: 350313450033520
  -----------------------------------
  System   |                  device:
/sys/devices/platform/3610000.xhci/usb1/1-1
           |                 drivers: cdc_mbim, option
           |                  plugin: telit
           |            primary port: cdc-wdm0
           |                   ports: cdc-wdm0 (mbim), ttyUSB0 (ignored),
ttyUSB1 (ignored),
           |                          ttyUSB2 (at), ttyUSB3 (at), ttyUSB4
(ignored), wwan0 (net)
  -----------------------------------
  Status   |          unlock retries: sim-pin2 (3)
           |                   state: registered
           |             power state: on
           |             access tech: lte
           |          signal quality: 19% (recent)
  -----------------------------------
  Modes    |               supported: allowed: 3g; preferred: none
           |                          allowed: 4g; preferred: none
           |                          allowed: 3g, 4g; preferred: none
           |                          allowed: 3g, 4g, 5g; preferred: none
           |                 current: allowed: 3g, 4g; preferred: none
  -----------------------------------
  IP       |               supported: ipv4, ipv6, ipv4v6
  -----------------------------------
  3GPP     |                    imei: 350313450033520
           |           enabled locks: fixed-dialing
           |             operator id: 22210
           |           operator name: vodafone IT
           |            registration: home
```

```
--------------------------------
3GPP EPS |    ue mode of operation: csps-2
         |     initial bearer path: /org/freedesktop/ModemManager1/Bearer/0
         | initial bearer ip type: ipv4v6
--------------------------------
SIM      |       primary sim path: /org/freedesktop/ModemManager1/SIM/0
```

where the argument of the flag -m is the index of the modem found with the previous command.

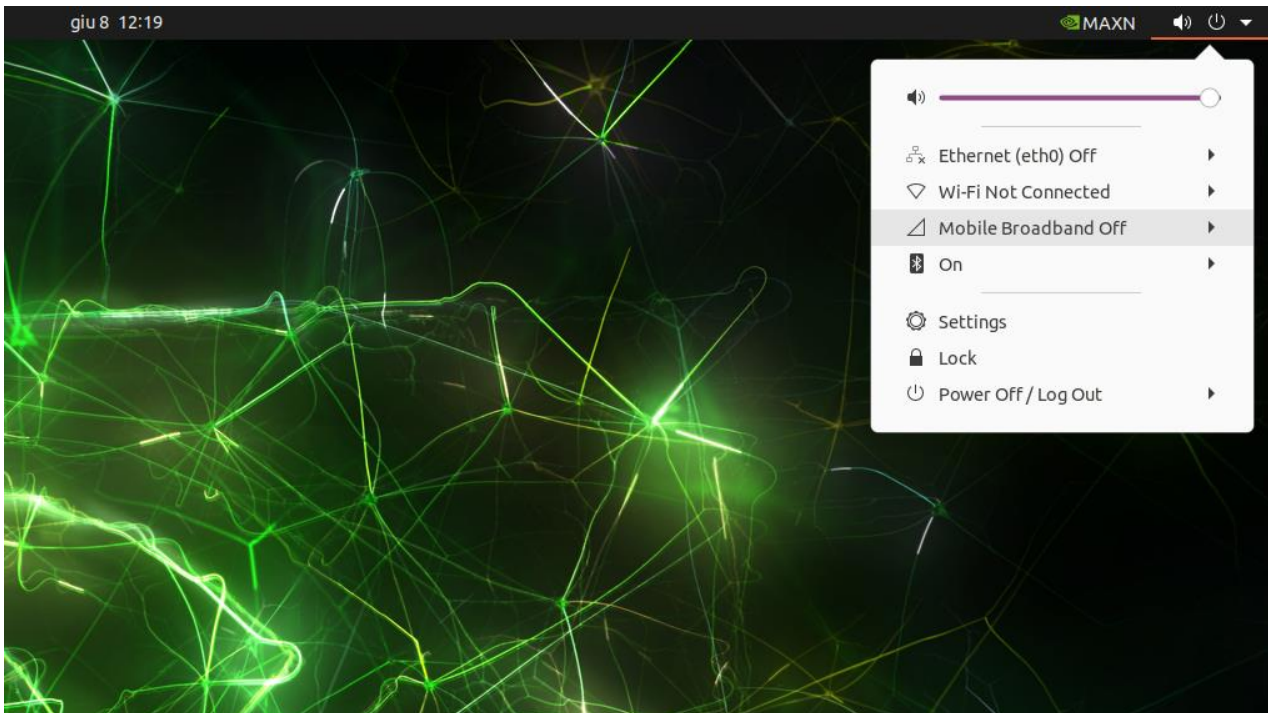Modem availability should also be indicated in the Network menu of the GUI:

Figure 1: FN980 mobile broadband device in Network menu

> If modem is not available please verify the modem setup (e.g. power, SIM, antenna…)

4.4. Setting-up the Data Connection

To setup the data connection through the GUI, left-click on the *Mobile Broadband Off* entry in the Network GUI and then click on *Connect*:
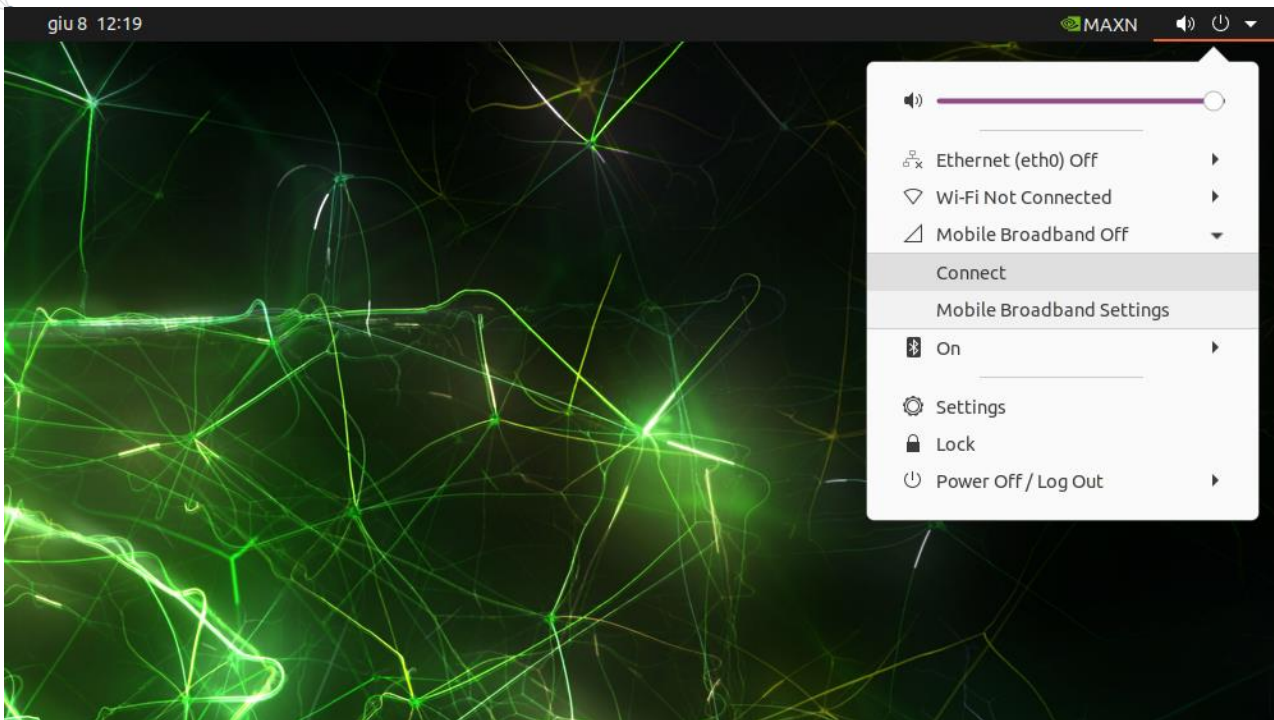
Figure 2: Connect menu entry

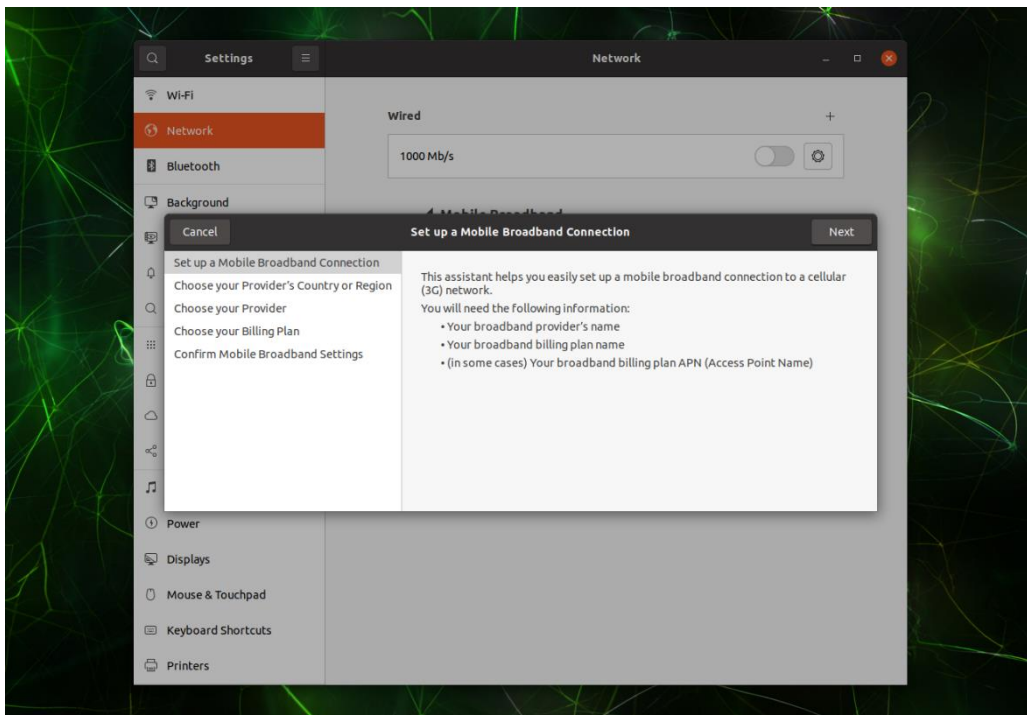The Mobile Broadband Connection Wizard shows-up:

Figure 3: Mobile broadband connection wizard

Follow the instructions according to the network operator in use. If everything is fine the created data connection will be set as active:
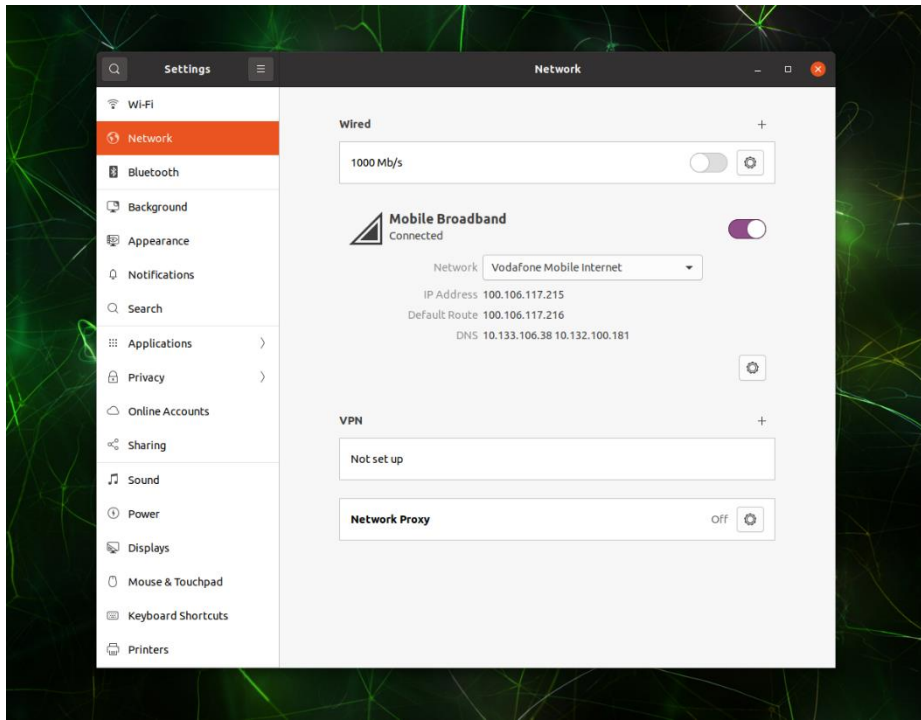
Figure 4: Mobile broadband connected

If the data connection is not able to start please verify the modem setup and the information provided (e.g. antenna, signal level, APN...)

5. UPGRADING MODEMMANAGER

5.1.   Understanding the Need for Upgrading ModemManager

ModemManager is a fast-paced project, constantly evolving. Developers and power-users could decide to upgrade to a more recent ModemManager version than the default one, for taking advantages of bugfixes and new features.

In the following paragraphs two alternative ways of upgrading ModemManager are described.

When using an updated ModemManager the Gnome Mobile Broadband applet version in Jetson Linux 34.1.1 is **not able to show anymore the mobile broadband device in the menu bar**.

For configuring the mobile broadband data connection the Network panel in Gnome Settings can be used.

5.2.   Upgrading from packages in Focal Developer Repositories

Enable focal-proposed updates in *Software & Updates -> Developer Options* settings:
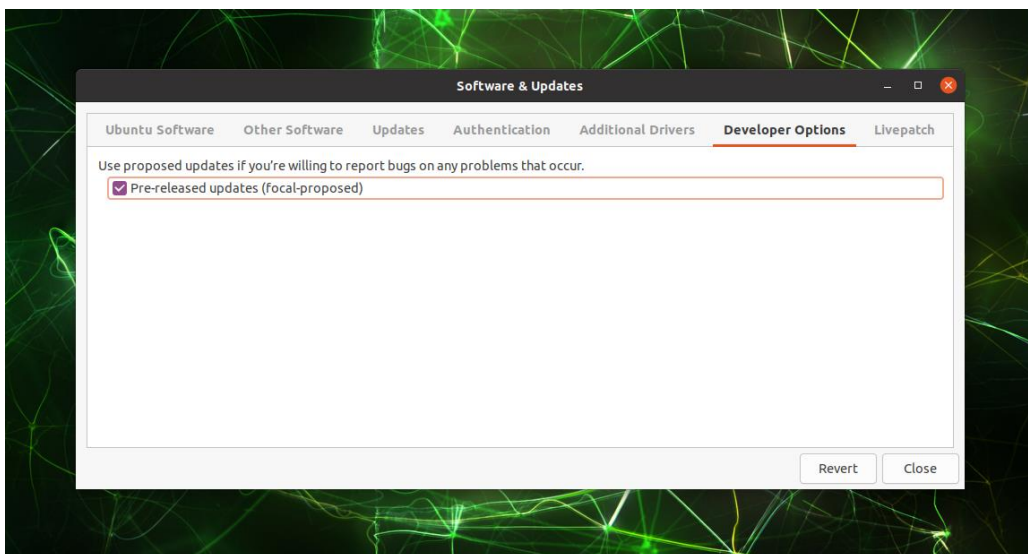

Figure 5: Software & Updates Developer Options settings

Install the updated ModemManager by typing:

```
telit@JetsonAgxOrin:~$ sudo apt install modemmanager
```

Follow the instructions in paragraph [4.3](#).

5.3. Building from freedesktop.org git Repositories

5.3.1. Uninstalling the Default Packages

Building from sources requires first to completely uninstall the previous ModemManager related software versions by typing:

```
telit@JetsonAgxOrin:~$ sudo apt purge modemmanager libmbim-glib4 libmbim-proxy
libqmi-glib5 libqmi-proxy
```

5.3.2. Build Preconditions

To build ModemManager and the related libraries, some additional packages are required. They can be installed by typing:

```
telit@JetsonAgxOrin:~/git$ sudo apt install meson libgudev-1.0-dev help2man
libdbus-1-dev libsystemd-dev libpolkit-gobject-1-dev gettext xsltproc
```

Create the directory for the build:

```
telit@JetsonAgxOrin:~$ mkdir $HOME/git
telit@JetsonAgxOrin:~$ cd $HOME/git/
```

5.3.3. Building libqrtr

Clone the libqrtr git repository by typing:

```
telit@JetsonAgxOrin:~/git$ git clone https://gitlab.freedesktop.org/mobile-
broadband/libqrtr-glib.git
telit@JetsonAgxOrin:~/git$ cd libqrtr-glib
```

Configure the build:

```
telit@JetsonAgxOrin:~/git/libqrtr-glib$ meson setup build --prefix=/usr --
libdir=/usr/lib/aarch64-linux-gnu --buildtype=release -Dgtk_doc=false -
Dintrospection=false
```

Start the build:

```
telit@JetsonAgxOrin:~/git/libqrtr-glib$ cd build/
telit@JetsonAgxOrin:~/git/libqrtr-glib/build$ ninja
```

Install the binaries:

```
telit@JetsonAgxOrin:~/git/libqrtr-glib/build$ sudo ninja install
```

Go back to the git parent directory:

```
telit@JetsonAgxOrin:~$ cd $HOME/git/
```

5.3.4. Building libmbim

Clone the libmbim git repository by typing:

```
telit@JetsonAgxOrin:~/git$ git clone https://gitlab.freedesktop.org/mobile-
broadband/libmbim.git
telit@JetsonAgxOrin:~/git$ cd libmbim
```

Configure the build:

```
telit@JetsonAgxOrin:~/git/libmbim$ meson setup build --prefix=/usr --
libdir=/usr/lib/aarch64-linux-gnu --buildtype=release -Dgtk_doc=false -
Dintrospection=false -Dbash_completion=false
```

Start the build:

```
telit@JetsonAgxOrin:~/git/libmbim$ cd build/
telit@JetsonAgxOrin:~/git/libmbim/build$ ninja
```

Install the binaries:

```
telit@JetsonAgxOrin:~/git/libmbim/build$ sudo ninja install
```

Go back to the git parent directory:

```
telit@JetsonAgxOrin:~$ cd $HOME/git/
```

5.3.5. Building libqmi

Clone the libqmi git repository by typing:

```
telit@JetsonAgxOrin:~/git$ git clone https://gitlab.freedesktop.org/mobile-
broadband/libqmi.git
telit@JetsonAgxOrin:~/git$ cd libqmi
```

Configure the build:

```
telit@JetsonAgxOrin:~/git/libqmi$ meson setup build --prefix=/usr --
libdir=/usr/lib/aarch64-linux-gnu --buildtype=release -Dcollection=full -
Dmbim_qmux=true -Dqrtr=true -Dgtk_doc=false -Dintrospection=false -
Dbash_completion=false
```

Start the build:

```
telit@JetsonAgxOrin:~/git/libqmi$ cd build/
telit@JetsonAgxOrin:~/git/libqmi/build$ ninja
```

Install the binaries:

```
telit@JetsonAgxOrin:~/git/libqmi/build$ sudo ninja install
```

Go back to the git parent directory:

```
telit@JetsonAgxOrin:~$ cd $HOME/git/
```

5.3.6.   Building ModemManager

Clone the ModemManager git repository by typing:

```
telit@JetsonAgxOrin:~/git$ git clone https://gitlab.freedesktop.org/mobile-
broadband/ModemManager.git
telit@JetsonAgxOrin:~/git$ cd ModemManager
```

Configure the build:

```
telit@JetsonAgxOrin:~/git/ModemManager$ meson setup build --prefix=/usr --
sysconfdir=/etc --libdir=/usr/lib/aarch64-linux-gnu --buildtype=release -
Dqmi=true -Dmbim=true -Dqrtr=true -Dsystemd_suspend_resume=false -
Dgtk_doc=false -Dintrospection=false -Dbash_completion=false
```

Start the build:

```
telit@JetsonAgxOrin:~/git/ModemManager$ cd build/
telit@JetsonAgxOrin:~/git/ModemManager/build$ ninja
```

Install the binaries:

```
telit@JetsonAgxOrin:~/git/ModemManager/build$ sudo ninja install
```

ModemManager is now installed: follow the instructions in paragraph 4.3.

6. TROUBLESHOOTING

6.1. Debug Information Retrieval

When contacting customer support for help on troubleshooting issues, please make sure to carefully describe the scenario and provide the following logs:

- Kernel log

- ModemManager and NetworkManager debug log (following the instructions available at mobile-broadband.pages.freedesktop.org)

To have better support and solve the issue quickly, please follow these guidelines when collecting logs:

- Do not mix different issues in a single log
- Do not mix different runs of the same issue
- If the log is huge, provide an indication on the timing of the issue
- Provide a brief description of scenario captured in the logs

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7.2.6.   Waiver of Liability

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7.3.   Safety Recommendations

Make sure the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in areas where:

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.

- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

https://ec.europa.eu/growth/sectors/electrical-engineering_en

8. GLOSSARY

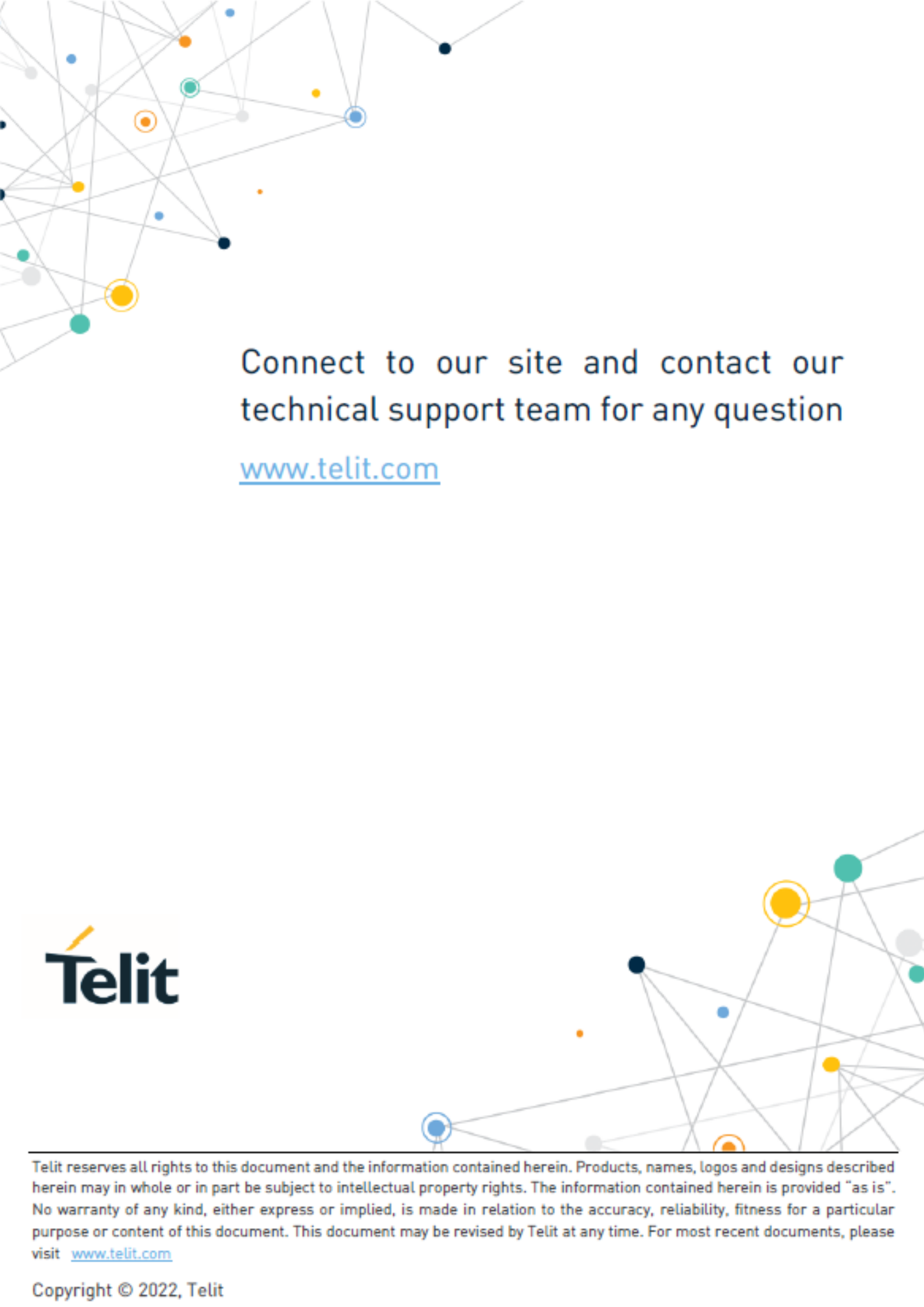|	
MBIM	Mobile Broadband Interface Model
SDK	Software Development Kit
USB	Universal Serial Bus

9. RELATED DOCUMENTS

[1] 1VV0301371   Telit Modules Linux USB Drivers User Guide

10. DOCUMENT HISTORY

Revision	Date	Changes
0	2022-06-08	First issue

From Mod.0809 rev.6

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