Telit Modules Linux USB Drivers User Guide

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APPLICABILITY TABLE

PRODUCTS	MINIMUM KERNEL VERSION
DE910 SERIES	3.4
FN980 SERIES	5.4
GE910 SERIES	4.4
HE910 SERIES	4.4
LE866 SERIES	2.6.39
LE910 SERIES	3.18
LE910CX SERIES	4.11
LE910D1 SERIES	2.6.39
LE910 V2 SERIES	3.12
LM940 SERIES	4.10
LM960 SERIES	4.10
LN940 SERIES	4.20
ME910C1 SERIES	4.15
ME*X*10G1 SERIES	5.5
ML865C1 SERIES	4.15
ML865G1 SERIES	5.5
UE866 SERIES	4.4
UE910 SERIES	4.4
UL865 SERIES	4.4

CONTENTS

1. INTRODUCTION

1.1. Scope

This document explains which Linux kernel drivers should be used for Telit modules listed in the Applicability Table and how Linux devices can be used for typical use cases.

1.2. Audience

This document targets software developers who are using Telit modules listed in the Applicability Table in a Linux environment.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com (for Short Range Devices)

Alternatively, use:

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For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. Related Documents

- 80455NT11504A - Using NetworkManager with Telit Modems
- 80455NT11505A - Using ModemManager with Telit Modems
- 1VV0301045 - Linux XFP User Guide
- AT Commands Reference Guide of Telit modules listed in the Applicability Table.

2. OPERATING SYSTEM SETUP

2.1. Summary

Telit modules listed in the Applicability Table expose different kinds of devices according to the Product ID (PID) in use. The table below lists the association between the device type and the used kernel driver:

Device type	Kernel driver
Serial port following the CDC-ACM standard	cdc_acm
Serial port (reduced ACM)	option
Network adapter following the CDC-ECM standard	cdc_ether
Network adapter following the CDC-NCM standard	cdc_ncm
Network adapter following Microsoft RNDIS specification	rndis_host
Mobile broadband adapter following CDC-MBIM standard	cdc_mbim
Rmnet mobile broadband adapter	qmi_wwan
Android Debug Bridge (ADB)	N/A (managed at the user space)
Audio device	snd-usb-audio

In order to use a specific device type the related driver should be included in the kernel.

Some drivers can be found starting from a specific kernel version (e.g. cdc_mbim is available since 3.8). If the driver is not supported by the kernel version in use consider upgrading the kernel or backporting the needed patches.

2.2. USB compositions

2.2.1. PIDs and related compositions

The table below lists the currently supported USB compositions in Linux according to the PID:

PID	Composition
0x0021	6 CDC-ACM devices
0x0022	3 CDC-ACM devices
0x0023	6 CDC-ACM devices + 1 CDC-ECM network adapter
0x0032	6 CDC-ACM devices + 1 MBIM adapter
0x0035	6 CDC-ACM devices

0x0036	6 CDC-ACM devices + 1 CDC-NCM network adapter
0x0100	4 CDC-ACM devices + 1 CDC-NCM network adapter
0x1003	3 reduced ACM devices
0x1004	4 reduced ACM devices
0x1005	4 reduced ACM devices
0x1006	3 reduced ACM devices
0x1010	4 reduced ACM devices
0x1012	3 reduced ACM devices
0x1040	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0x1041	5 reduced ACM devices + 1 MBIM adapter + 1 ADB
0x1042	5 reduced ACM devices + 1 RNDIS network adapter + 1 ADB
0x1043	5 reduced ACM devices + 1 ECM network adapter + 1 ADB
0x1045	5 reduced ACM devices + 1 RNDIS network adapter + 1 ADB + 1 audio device
0x1050	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0x1051	5 reduced ACM devices + 1 MBIM adapter + 1 ADB
0x1052	5 reduced ACM devices + 1 RNDIS network adapter + 1 ADB
0x1053	5 reduced ACM devices + 1 ECM network adapter + 1 ADB
0x1100	2 reduced ACM devices + 1 rmnet adapter + 1 QDSS device (not supported)
0x1101	3 reduced ACM devices + 1 rmnet adapter
0x1102	3 reduced ACM devices + 1 ECM network adapter
0x110a	3 reduced ACM devices. The composition presents also 1 rmnet adapter, but it can’t be used for data calls, just for controlling the device.
0x110b	3 reduced ACM devices + 1 ECM network adapter
0x1200	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0x1201	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0x1206	5 reduced ACM devices + 1 ECM network adapter + 1 ADB
0x1207	2 reduced ACM devices
0x1208	3 reduced ACM devices + 1 ADB
0x1211	1 reduced ACM device + 1 ECM network adapter + 1 ADB
0x1212	1 reduced ACM device + 1 ADB
0x1213	1 reduced ACM device + 1 ECM network adapter

0x1214	2 reduced ACM devices + 1 ECM network adapter + 1 ADB
0x1260	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0X1261	5 reduced ACM devices + 1 rmnet adapter + 1 ADB
0x1900	4 reduced ACM devices + 1 rmnet adapter
0x1901	4 reduced ACM devices + 1 MBIM adapter
0x2300	Config. 1: 3 CDC-ACM devices + 1 RNDIS network adapter Config. 2: 3 CDC-ACM devices + 1 ECM network adapter

For additional details on the composition please refer to the software user guide of the module in use.

The command

```
user@pc:~$ lsusb
```

can be used for retrieving the current modem PID

The command

```
user@pc:~$ ifconfig -a
```

can be used to show the network adapter.

Please refer to AT#USBCFG command description of the modem in use for further details about how to change the USB composition.

Not all the serial ports exposed in the composition can be used for AT commands sending: please refer to the proper AT commands User Guide for port arrangement description.

2.2.2. Driver option

When using one of the supported compositions that requires the option driver, if the serial ports are not available it is possible that modem support in option driver has been added in a more recent kernel version than the one in use.

The solution is to upgrade the kernel version in use or backport the needed patch among the ones listed in chapter 5.

It is possible to add runtime support for serial ports. With root privileges, type in a shell:

```
user@pc:~$ modprobe option
user@pc:~$ echo 1bc7 <PID> > /sys/bus/usb-serial/drivers/option1/new_id
```

where <PID> is the current pid of the modem.

If a composition presents a network adapter make sure that it has been properly recognized before adding runtime support for serial ports.
If a composition presents an ADB device, when adding runtime support for serial ports, it will be recognized as a serial port, preventing it from working properly.

To have the most updated list of Telit PIDs currently supported in option please refer to the master branch of Linux git repository (drivers/usb/serial/option.c).

If support is needed for a composition not listed among the supported ones please contact customer support with your request.

2.2.3. Driver qmi_wwan

When using one of the supported compositions that requires the qmi_wwan driver, if the network adapter is not available it is possible that modem support in qmi_wwan driver has been added in a more recent kernel version than the one in use.

The solution is to upgrade the kernel version in use or backport the needed patch among the ones listed in chapter 5.

To have the most updated list of Telit PIDs currently supported in qmi_wwan please refer to the master branch of Linux git repository (drivers/net/usb/qmi_wwan.c).

Composition 0x1201 of LE910Cx requires commit *14cf4a771b3098e431d2677e3533bdd962e478d8* for proper working: please see patch list in chapter 5.
If macro QMI_QUIRK_SET_DTR is missing add the commit listed in paragraph 6.1.

If the kernel in use has commit *833415a3e781a26fe480a34d45086bdb4fe1e4c0*, it should be reverted as done in commit *19445816996d1a89682c37685fe95959631d9f32*.

LE910Cx, LM940, LM960 require also the commits listed in paragraph 6.2.

If support is needed for a composition not listed among the supported ones please contact customer support with your request.

3. USING THE MODEM

3.1. Using the serial ports

According to the driver in use, the following devices are created for serial ports:

Device name	Kernel driver
/dev/ttyACMx	cdc_acm
/dev/ttyUSBx	Option

These are normal Linux character devices and support most of the features implemented by the tty layer.

For sending AT commands a terminal emulator like minicom can be used.

When writing code for using these devices please refer to the programming language API related to character devices. As an example, C applications can use the functions exported in the system header files fcntl.h and unistd.h. Please refer to the related man page for further details.

It is mandatory to have the DTR asserted for receiving an answer after having sent an AT command.

3.1.1. Data connection through serial ports

For creating dial-up connections through serial ports the software pppd can be used. Please refer to pppd official website for further details and updated source code.

3.2. Using the network adapter

If the USB composition in use presents a network adapter and the related driver is properly loaded, a network interface is created.

Shell command ifconfig or ip can be used for configuring the network interface or retrieving the network interface related details (please refer to the man page of the command for further details).

3.2.1. Data connection through the network adapter

For establishing a data connection through the network interface refer to the instructions in the following table according to the driver in use:

Driver	
qmi_wwan	qmicli or qmi-network from libqmi project can be userd. Please refer to the project documentation for further details.
cdc_mbim	mbimcli or mbim-network from project libmbim can be used. Please refer to the project documentation for further details.
cdc_ether	AT commands should be used. Please refer to modem documentation for further details.
cdc_ncm	AT commands should be used. Please refer to modem documentation for further details.

rndis_host	AT commands should be used. Please refer to modem documentation for further details.

MBIM PID 0x1041 requires for proper working commit

7b8076ce8a00d553ae9d3b7eb5f0cc3e63cb16f1: please see patch in chapter 5.

3.3. Using the modem with ModemManager and NetworkManager

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.

NetworkManager is the standard Linux network configuration tool suite. It supports large range of networking setups, from desktop to server and mobile, integrating well with popular desktop environments and server configuration management tools.

NetworkManager provides a complete D-Bus API used to access the NetworkManager daemon. This interface can be used to query network state and the details of network interfaces like current IP addresses or DHCP options. The API can be also used for managing the connections (creation, activation, deactivation…).

NetworkManager uses freedesktop.org ModemManager for mobile broadband device support.

Please refer to documents *"**80455NT11505A - Using ModemManager with Telit Modems**"* and *"**80455NT11504A - Using NetworkManager with Telit Modems**"* for further details.

4. FLASHING DEVICES

4.1. Overview

The modems listed in the following table support firmware update through special flashing devices when using Telit lxfp application (for further details please refer to document *"**1VV0301045 - Linux XFP User Guide**"*).

These flashing devices should be bound to a specific driver according to the PID:

Product	Flashing device (VID/PID)	Kernel driver	Flashing device name to be used with lxfp
FN980	0x1bc7/0x9010	option. If the driver is not available, the flashing device can be managed at the userspace level with uxfp and libusb	/dev/ttyUSBx
GE/HE/UE910, UE866, UL865	0x058b/0x0041	usb-serial-simple	/dev/ttyUSBx
LE910, LE920, LE920A4, LE922A6, LE940A6, LM940, LM960	0x18d1/0xd00d	option	/dev/ttyUSBx
LE910 V2	0x8087/0x0716	usb-serial-simple	/dev/ttyUSBx
LE940B6	0x8087/0x0801	usb-serial-simple	/dev/ttyUSBx
LE866, LE910D1	0x216F/0x0051	cdc_acm	/dev/ttyACMx

Flashing devices available in GE/HE/UE910, UE866, UL865, LE910 V2, LE940B6 and LE866 appear for a few seconds when the modem is turned on: if the flashing application is not running, the flashing device disconnects and the modem proceeds in normal operative mode.

4.2. Flashing device: 0x18d1/0xd00d

For using flashing device 0x18d1/0xd00d with lxfp, it should be added to the Linux kernel option driver.

Retrieve your kernel sources and open source file drivers/usb/serial/option.c

Add to the struct usb_device_id option_ids the following line:

```
{ USB_DEVICE(0x18d1, 0xd00d) }
```

For production systems it is suggested to modify option source code, in order to permanently link the flashing device to the driver.

For testing purposes support could be added at runtime; in a shell with root privileges type:

```
user@pc:~$ modprobe option
user@pc:~$ echo 18d1 d00d > /sys/bus/usb-serial/drivers/option1/new_id
```

uxfp does not require driver binding when built with libusb support

4.3. Flashing device: 0x058b/0x0041

Even though the flashing device 0x058b/0x0041 presents as an ACM device, it should be driven by the kernel driver usb-serial-simple. Support for this device is available since kernel version 4.4-rc8.

For previous kernel versions commit *f33a7f72e5fc033daccbb8d4753d7c5c41a4d67b* and *a0e80fbd56b4573de997c9a088a33abbc1121400* should be backported. Please see chapter 5 for further details.

4.4. Flashing device: 0x8087/0x0716

Support for flashing device 0x8087/0x0716 is available since kernel version 3.12 with driver usb-serial-simple.

For previous kernel version commit *1f9230713af17657f7ed503a12ddd739d0f48089* should be backported.

Runtime support can be added with the following steps: with root privileges unload usbserial driver

```
user@pc:~$ rmmod usbserial
```

Load again usbserial with the following line:

```
user@pc:~$ modprobe usbserial vendor=0x8087 product=0x0716
```

4.5. Flashing device: 0x8087/0x0801

Support for flashing device 0x8087/0x0801 is available since kernel version 4.8-rc7 with driver usb-serial-simple.

For previous kernel version commit *f190fd92458da3e869b4e2c6289e2c617490ae53* should be backported. Please see chapter 5 for further details.

Runtime support can be added with the following steps: with root privileges unload usbserial driver

```
user@pc:~$ rmmod usbserial
```

Load again usbserial with the following line:

```
user@pc:~$ modprobe usbserial vendor=0x8087 product=0x0801
```

5. TELIT KERNEL COMMITS

Following the kernel commits related to the modems listed in the Applicability Table. Consider backporting them according to the PID in use if not available in your current kernel version.

Summary	Commit	PID	Availability
USB: option driver: adding support for Telit CC864-SINGLE, CC864-DUAL and DE910-DUAL modems	7204cf584836c24b4b06e4ad4a8e6bb8ea84908e	0x1005, 0x1006, 0x1010	3.4-rc1
usb: option driver, add support for Telit UE910v2	d6de486bc22255779bd54b0fceb4c240962bf146	0x1012	3.15-rc2
USB: option: add support for Telit LE920	03eb466f276ceef9dcf023dc5474db02af68aad9	0x1200	3.8-rc7
NET: qmi_wwan: add Telit LE920 support	3d6d7ab5881b1d4431529410b949ba2e946f3b0f	0x1200	3.8-rc7
net: qmi_wwan: add Telit LE920 newer firmware support	905468fa4d54c3e572ed3045cd47cce37780716e	0x1201	3.13-rc1
usb: option: add support for Telit LE910	2d0eb862dd477c3c4f32b201254ca0b40e6f465c	0x1201	3.18-rc3
USB: cdc_acm: Ignore Infineon Flash Loader utility	f33a7f72e5fc033daccbb8d4753d7c5c41a4d67b	VID 0x058b PID 0x0041	4.4-rc5
USB: serial: Another Infineon flash loader USB ID	a0e80fbd56b4573de997c9a088a33abbc1121400	VID 0x058b, PID 0x0041	4.4-rc5
USB: serial: option: Adding support for Telit LE922	ff4e2494dc17b173468e1713fdf6237fd8578bc7	0x1042, 0x1043	4.5-rc2
USb: serial: option: add support for Telit LE922 PID 0x1045	5deef5551c77e488922cc4bf4bc76df63be650d0	0x1045	4.5-rc7
net: usb: cdc_ncm: adding Telit LE910 V2 mobile broadband card	79f4223257bfef52b0a26d0d7ad4019e764be6ce	0x0036	4.6-rc2
USB: serial: option: add support for Telit LE910 PID 0x1206	3c0415fa08548e3bc63ef741762664497ab187ed	0x1206	4.8-rc1
USB: serial: option: add support for Telit LE920A4	01d7956b58e644ea0d2e8d9340c5727a8fc39d70	0x1207, 0x1208, 0x1211, 0x1212, 0x1213, 0x1214	4.8-rc3
USB: serial: simple: add support for another Infineon flashloader	f190fd92458da3e869b4e2c6289e2c617490ae53	VID 0x8087, PID 0x0801	4.8-rc7
NET: usb: qmi_wwan: add support for Telit LE922A PID 0x1040	9bd813da24cd49d749911d7fdc0e9ae9a673d746	0x1040	4.9-rc8

NET: usb: cdc_mbim: add quirk for supporting Telit LE922A	7b8076ce8a00d553ae9d3b7eb5f0cc3e63cb16f1	0x1041	4.9
USB: serial: option: add support for Telit LE922A PIDs 0x1040, 0x1041	5b09eff0c379002527ad72ea5ea38f25da8a8650	0x1040, 0x1041	4.10-rc1
net: usb: qmi_wwan: add QMI_QUIRK_SET_DTR for Telit PID 0x1201	14cf4a771b3098e431d2677e3533bdd962e478d8	0x1201	4.11-rc7
net: usb: qmi_wwan: add Telit ME910 support	4c54dc0277d0d55a9248c43aebd31858f926a056	0x1100	4.12-rc1
usb: serial: option: add Telit ME910 support	40dd46048c155b8f0683f468c950a1c107f77a7c	0x1100	4.12-rc2
net: usb: qmi_wwan: add Telit ME910 PID 0x1101 support	c647c0d62c82eb3ddf78a0d8b3d58819d9f552aa	0x1101	4.15-rc4
USB: serial: option: add support for Telit ME910 PID 0x1101	08933099e6404f588f81c2050bfec7313e06eeaf	0x1101	4.15-rc6
net: usb: cdc_mbim: add flag FLAG_SEND_ZLP	9f7c728332e8966084242fcd951aa46583bc308c	0x1041	4.17
qmi_wwan: Added support for Telit LN940 series	1986af16e8ed355822600c24b3d2f0be46b573df	0x1900	4.20
USB: serial: option: add Telit LN940 series	28a86092b1753b802ef7e3de8a4c4a69a9c1bb03	0x1900, 0x1901	4.20
usb: cdc_acm: send ZLP for Telit 3G Intel based modems	34aabf918717dd14e05051896aaecd3b16b53d95	0x0021, 0x0023	5.0-rc2
USB: serial: option: add Telit ME910 ECM composition	6431866b6707d27151be381252d6eef13025cfce	0x1102	5.1-rc1
net: usb: qmi_wwan: add Telit 0x1260 and 0x1261 compositions	b4e467c82f8c12af78b6f6fa5730cb7dea7af1b4	0x1260, 0x1261	5.2-rc2
USB: serial: option: add Telit 0x1260 and 0x1261 compositions	f3dfd4072c3ee6e287f501a18b5718b185d6a940	0x1260, 0x1261	5.2-rc5
USB: serial: option: add Telit FN980 compositions	5eb3f4b87a0e7e949c976f32f296176a06d1a93b	0x1050, 0x1051, 0x1052, 0x1053	5.4-rc3
net: usb: qmi_wwan: add Telit 0x1050 composition	e0ae2c578d3909e60e9448207f5d83f785f1129f	0x1050	5.4-rc4
USB: serial: option: add Telit ME910G1 0x110a composition	0d3010fa442429f8780976758719af05592ff19f	0x110a	5.5-rc6
USB: serial: option: add ZLP support for 0x1bc7/0x9010	2438c3a19dec5e98905fd3ffcc2f24716aceda6b	0x9010	5.5-rc6
USB: serial: option: add ME910G1 ECM composition 0x110b	8e852a7953be2a6ee371449f7257fe15ace6a1fc	0x110b	5.6-rc7

6. ADDITIONAL KERNEL COMMITS

6.1. QUIRK DTR

QMI_QUIRK_SET_DTR was introduced in kernel version 4.9-rc1, with the following commit:

Commit name	Commit	Availability
qmi_wwan: add support for Quectel EC21 and EC25	9a765881bf3dcd32847d7108cf48cb04a4ed993f	4.9-rc1

6.2. RAW-IP support and general fixes for rmnet

The following commits are needed for having recent rmnet based modems to work properly:

Commit name	Commit	Availability
net: qmi_wwan: MDM9x30 specific power management	93725149794d3d418cf1eddcae60c7b536c5faa1	4.5-rc1
usbnet: allow mini-drivers to consume L2 headers	81e0ce79f2919dbd5f025894d29aa806af8695c7	4.5-rc1
net: qmi_wwan: support "raw IP" mode	32f7adf633b9f99ad5089901bc7ebff57704aaa9	4.5-rc1
net: qmi_wwan: should hold RTNL while changing netdev type	6c730080e663b1d629f8aa89348291fbcdc46cd9	4.5-rc1
net: qmi_wwan: ignore bogus CDC Union descriptors	34a55d5e858e81a20d33fd9490149d6a1058be0c	4.5-rc1
qmi_wwan: set FLAG_SEND_ZLP to avoid network initiated disconnect	245d21190aec547c0de64f70c0e6de871c185a24	4.16-rc1

7. GLOSSARY AND ACRONYMS

ACM	Abstract Control Model
ECM	Ethernet Control Model
MBIM	Mobile Broadband Interface Model
NCM	Network Control Model
PPP	Point to Point Protocol
USB	Universal Serial Bus

8. DOCUMENT HISTORY

Revision	Date	Changes
0	2017-04-28	• First revision
1	2017-11-24	• Added LE920A4 and LE910C1 composition 0x1201 kernel commit • Added LM940 in Applicability Table • Added reference to commit “cdc-wdm: fix "out-of-sync" due to missing notifications”
2	2018-02-13	• Added LM960 in Applicability Table • Added ME910 composition 0x1101 • Added “Additional Kernel Commits” chapter • Added “Minimum Kernel Version” in Applicability Table
3	2018-05-07	• Added LE866 flashing device details • Added kernel commit for PID 0x0036 • Added LE910D1 in Applicability Table
4	2019-05-24	• Removed automotive modules from Applicability Table • Added LN940 and UE866 in Applicability Table • Added LM940, kernel patches for fixing big data packets issue • Added ME910 ECM composition 0x1102, LECx compositions 0x1260 and 0x1261 • Updated kernel patches list
5	2019-10-21	• Added FN980 in Applicability Table and related kernel commits
6	2020-01-13	• Added ME910G1 0x110a composition • Added FN980 0x9010 flashing device composition • Updated kernel patches list • Updated Applicability Table
7	2020-03-27	• Changed ME910G1 to MEx10G1 in Applicability Table • Added ML865C1 and ML865G1 in Applicability Table • Updated kernel patches list for composition 0x110b

SUPPORT INQUIRIES

Link to **www.telit.com** and contact our technical support team for any questions related to technical issues.

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