



FT980 Family Software User Guide

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APPLICABILITY TABLE

PRODUCTS

	SW Versions	Modules
■ ■ FT980	38.22.201	5G
■ ■ FT980m	38.22.001	5G

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1. INTRODUCTION

1.1. Scope

The aim of this document is to introduce Telit FT980 module as well as present possible and recommended Software solutions useful for developing a product based on the FT980 family module. All the features and solutions detailed are applicable to all FT980 variants, where “FT980” refers to the variants listed in the applicability table.

If a specific feature is applicable to a specific product, it will be clearly highlighted.



The description text “FT980” refers to all modules listed in the [APPLICABILITY TABLE 1](#).

In this document all the basic functions of a wireless module will be taken into account; for each one of them a valid hardware solution will be suggested and usually incorrect solutions and common errors to be avoided will be highlighted. Obviously, this document cannot embrace every hardware solution or every product that may be designed. Obviously avoiding invalid solutions must be considered as mandatory. Whereas the suggested hardware configurations need not be considered mandatory, the information given should be used as a guide and a starting point for properly developing your product with the Telit FT980 module.



The integration of the WCDMA/HSPA+/LTE/5G NR FT980 cellular module within user application must be done according to the design rules described in this manual.

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1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using our FT980 module.

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:

<http://www.telit.com/support>

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

<http://www.telit.com>

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.

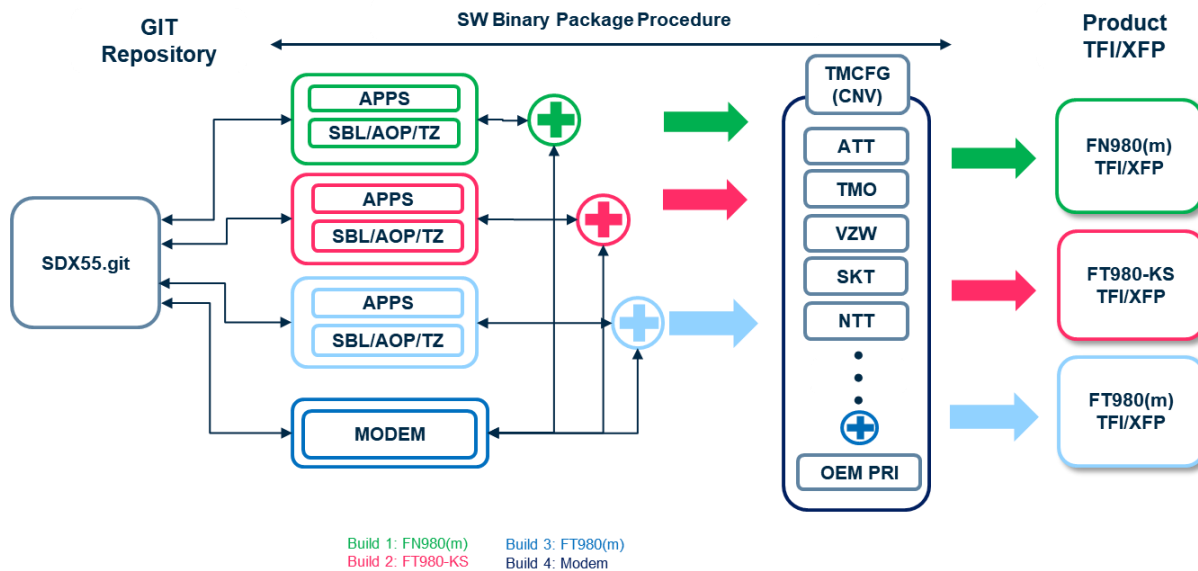
All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. Related Documents

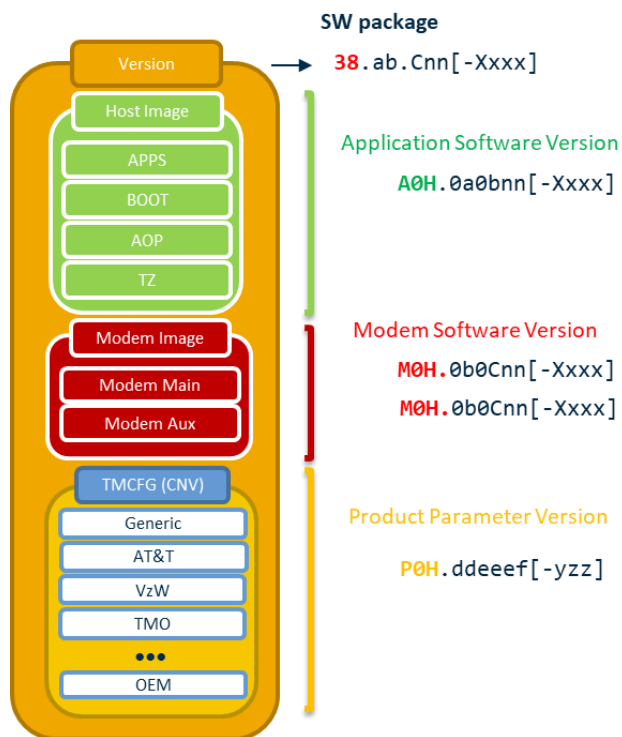
- [1] AT Commands Reference Guide, 80000ST10025a
- [2] Refer to the specific "Telit Product Description" document
- [3] Refer to the specific "Telit Hardware User Guide" document
- [4] ETSI GSM 07.07, 27.07
- [5] EVK2 User Guide, 1vv0300704
- [6] ETSI GSM 03.38, 23.038
- [7] Device Requirements AT&T, Document Number 13340
- [8] Telit 3G Modules Ports Arrangements User Guide, 1vv0300971
- [9] Enhanced JDR Technical Note, 30353NT11086A
- [10] ITU-T Recommendation E.164
- [11] ETSI GSM 11.11, 51.011, 31.101, 31.102
- [12] ITU-T Recommendation V.24
- [13] ETSI GSM 11.14, 51.014
- [14] ETSI GSM 27.005
- [15] uxfp User Guide, 1VV0301613

2. INFORMATION FOR SW PACKAGE

2.1.1. SW Image concept



2.1.2. Basic concept for SW package



Platform Version: 38

Modem Platform: M0H

Application Platform: A0H

Product Parameter: P0H

a: product variant (0:FN980x, 1:FT980-KS, 2:FT980x)

b: major version (0:LE1.0, 1:LE1.1, 2:LE1.2)

C: product variant

C: 0- FR1/FR2, 2 - FR1 only

nn: minor software version

X: build type (**B**eta , **A**lpha , **T**est)

xxx: build number (000-999)

dd: MNO id

00: GEN GCF,01: GEN PTCRB,10: ATT,11: TMO,12: VZW,20: SKT,30: NTT, ...

eee: CNV version number (000-999)

f: CNV extension number (0-9)

yzz: OEM PRI version

It's shown only if OEM PRI, customer configuration activated

y – OEM ID (1-9) , zz – PRI version number (1-99)

0: reserved field

Index	Mobile Network Operator	
	Region	Operator
0	Rest of World	Generic-GCF
1	North America	Generic-PTCRB
10	North America	AT&T
11	North America	T-Mobile
12	North America	Verizon Wireless
20	Korea	SK Telecom
30	Japan	NTT
31	Japan	KDDI
40	Australia	Telstra

How to check current SW version

AT#SWPKGV – Show SW package version

AT#SWPKGV

<Telit Software Package Version>-<Production Parameters Version>

<Modem Package Version>

<Production Parameters Version>

<Application Version>

OK

Example)

```
AT#SWPKGV
38.00.000-A003-POH.000050
M0H.000001-B007
A0H.000000-B007

OK
```

AT+GMR or AT#CGMR – Show modem version

Example)

```
AT+GMR
M0H.000001-B007

OK
```

AT#CGMF – Show product parameter version

Example)

```
AT#CGMF
POH.001050

OK
```

2.1.3. How to check current SW version

AT#FWSWITCH – Change modem FW binary and network configuration

Example)

```
Switch to AT&T configuration
AT#FWSWITCH=10
OK

Switch to Rest of World. Generic GCF Config
AT#FWSWITCH=0
OK
```

More detailed information described in Reference [1]. AT command Reference Guide.

3. FUNCTIONAL DESCRIPTION

3.1. General Functionality and Main Features

The FT980 family of cellular modules feature 5G NR / LTE and multi-RAT modem together with an on-chip powerful application processor and a rich set of interfaces.

Some product features are listed below:

- Multi RAT cellular modem for data communication
 - 3GPP Rel 15, 5G NR compliant
 - 5G NR mmW
 - Support of n257 band
 - 5G NR sub-6
 - Support of n78 band
 - 256 QAM for UL/DL
 - LTE Cat16 (1Gbps/150Mbps DL/UL)
 - WCDMA
 - Support of SIM profile switching
- USB 3.1 Gen2
- PCI Express Gen3 1-Lane
 - AQC107 10GBase-T Ethernet Controller
- IPA 4.5
- Tools for firmware update (TFI)
- Stream download protocol (SDL)
- FOTA
- M.2 form factor

3.2. Application system overview

The Application Processor is a 32bit ARM Cortex-A7 up to 1.5 GHz running Linux operating system. The following software runs on the application processor:

- 32bit Cortex-A7@1.5GHz running.
- Telit Unified AT command set. this is the main control interface, including the following:
 - Hayes standard AT command set
 - Standard 3GPP AT command and GPRS-specific commands.
 - Standard 3GPP AT commands for SMS (Short Message Service) and CBS (Cell Broadcast Service)
- Firmware Over-The-Air (FOTA) update supporting selective update.

3.2.1. USB Interface

The FT980 family includes a USB3.1 Gen2 compliant Universal Serial Bus (USB), which operates at USB super-speed (10Gbits/sec). By default, the module is configured as a USB peripheral.

The USB port is typically used for:

- Flashing of firmware and module configuration
- Production testing
- Accessing the Application Processor's filesystem (debug bridge)
- AT command access (2 modem ports)
- High speed WWAN access to external host

- Diagnostic monitoring and debugging
- NMEA data to an external host CPU

The following standardized device classes can be supported:

- CDC-ACM, CDC-ECM, MBIM, RNDIS, RMNET (Qualcomm proprietary)

The following USB compositions are available:

- 1050 - DIAG + ADB + RMNET + NMEA + MODEM + MODEM + AUX
- 1051 - DIAG + ADB + MBIM + NMEA + MODEM + MODEM + AUX
- 1052 - RNDIS + DIAG + ADB + NMEA + MODEM + MODEM + AUX
- 1053 - DIAG + ADB + ECM + NMEA + MODEM + MODEM + AUX

The USB composition can be changed by using the #USBCFG command.



FT980 family doesn't support hot-plug on USB.

3.2.2. PCI Express

PCIe for FT980 has following features:

- Support only PCI Express Root Complex (RC) mode
- Support Gen3 1-Lane connected to AQC107 Ethernet Controller
- Support 8.0GT/s maximum rate per lane

Following section describes a device connected to PCI Express.

3.2.2.1. AQC107 Ethernet Controller

AQC107 is 10GBase-T Ethernet Controller with PCI Express which is compatible with following specification.

- IEEE 802.3an
- IEEE 802.3bz
- NBASE-T Alliance PHY

AQC107 also has following features.

Features	Benefits
PHY	
Integrated Aquantia AQRate PHY featuring NBASE-T technology	<ul style="list-style-type: none"> • 100 meters over Cat 6a at 10 Gbps • 100 meters over Cat 5e (or better) at 5Gbps/2.5Gbps/1Gbps/100Mbps
Advanced cable diagnostics	On-chip high resolution cable analyzer
Audio Video Bridging (AVB) and PTP/1588v2	Management of time-sensitive traffic packets
EEE support	PHY power savings mode
MAC	

<ul style="list-style-type: none"> • Large Send Offload (LSO) • Receive Side Scaling (RSS) • Direct Cache Access (DCA) • Header checksum 	Increased network performance and lower host CPU utilization
Wake-on-LAN (WoL) power management	Supports lower power modes
On-chip CPU DASH	Desktop management
MACsec (IEEE 802.1ae, MAC security standard) <ul style="list-style-type: none"> • Full support for Advanced Encryption Standard (AES-256) and stand-alone operation 	MACsec provides for secure, encrypted data communications across networks
Internet Control Message Protocol (ICMP)	Supports diagnostic, error, and operational information messages
Address Resolution Protocol (ARP)	Resolves network layer addresses into link layer addresses
Multicast Domain Name System (mDNS)	Resolves host names to IP addresses
Transmission Control Protocol (TCP) Keepalives (KA)	Supports link checking between devices
Quality of Service (QoS)	Supports up to eight traffic classes and Data Center Bridging (DCB)
Jumbo Frames (up to 16 Kbytes)	Improves network performance while reducing CPU utilization
IPv4/6, IPv6/TCP and IPv6/UDP checksum offload	Offloads calculations and improves CPU usage

3.3. LED

FT980 has three types of LED, Power / Ethernet / Network.

Following sections describe each type of LED.

3.3.1. Power LED

The scenario of this LED is as following.

Colors	Scenarios
RED	Module is in an abnormal state.
GREEN	Module power on.

3.3.2. Ethernet LED

The scenario of this LED is as following.

Colors	Scenarios
RED	Both of USB and Ethernet Link are all not established
GREEN	One or more among USB and Ethernet Link is established.

3.3.3. Network LED

The scenario of this LED is as following.

Colors	Scenarios
RED	Need to network provisioning.
Blink RED	Not available network service
GREEN	Registered LTE/NR network and assigned IP from network
Blink GREEN	Registered to WCDMA network

4. SERVICE AND FIRMWARE UPDATE

4.1. Firmware Update

The Telit Modules firmware is updated through the USB Interface.

If not already included in the design, it is suggested to provide an USB interface on the User Printed Circuit Board (where the Telit Module is soldered) to perform the physical connection between the Telit module and a Windows-based PC. That simple circuitry makes the firmware updating easy when a new firmware version is released.

During the User Application development or evaluation phase of the Telit module, the USB port implemented on the **Telit Evaluation Board (Telit EVB)** can be used to connect the Telit module to a Windows-based PC on which a dedicated tool for firmware updating is running.

Telit provides the User with two tools to update the firmware of the module. The following paragraphs describe them.



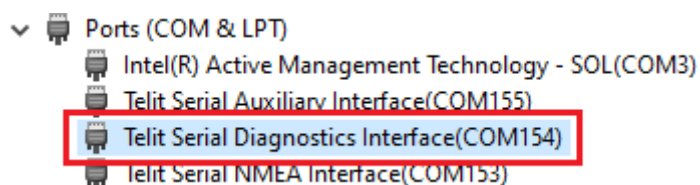
The firmware update tools (TFI/XFP) does not support multi-device update at the same time and It does not support update when multi-device connected on the same PC. Please proceed firmware update with connect only one device to the PC.

4.1.1. TFI update

The firmware update can be performed with a specific software tool provided by Telit running on Windows-based PCs. The program will erase the content of flash memory, and then the program will write on the flash memory. "FT980_xxx_TFI.exe" file includes binary image. The binary image included in the TFI package will be checked with SHA256 hash before start of the TFI firmware update procedure. The TFI will be stop update if there are any corruption of data has been detected.

The following is procedure of TFI update through the USB interface on the Windows OS.

1. Before update with TFI, please check "Telit Serial Diagnostics Interface" in your Windows device manager.



2. If you run FT980_xxx_TFI.exe, Windows CMD prompt will be popped up.

3. TFI downloader detects “Telit Serial Diagnostics Interface” port automatically and start download.

```

=====
TFI V2 (Version 1.58)
=====
Update started at Thu Dec 03 12:15:17 2020

Verifying hash...DONE

File name: C:\Work\SDX55\FT980_38.22.X20-B014_CUST_0530_TFI.exe
Product: FT980
Version: 38.22.X20-B014
TFI ST Ver : 1
EX Opt : 0x00000040

Starting update process...
Waiting module...
Using device COM154

```

4. Modem will reset several times during upgrade process.
5. Programming completed message will be displayed after all flashing done and the module boot up successfully.

```

Checking device COM154
New version : 38.22.020-B014
Update succeed.
-----
All DONE.
-----
Total elapsed time : 1 min 57 sec

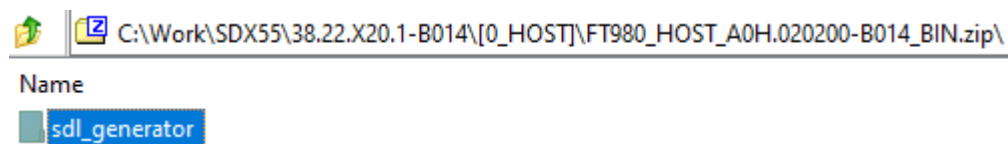
```

6. Telit FT980 module is now programmed with the new firmware.

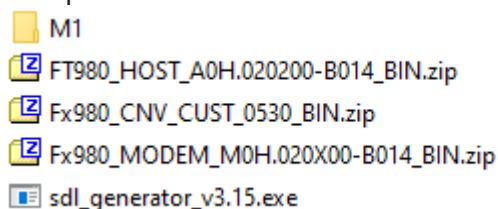
4.1.2. XFP generator

The streaming binary generator is tool for generate custom streaming binary on the Windows OS. You can be generating your own streaming binary with below process.

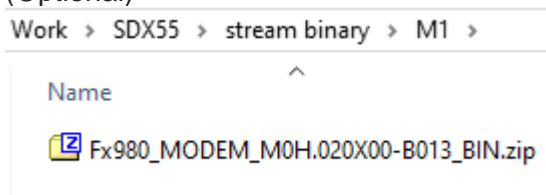
1. Extract and copy the sdl_generator directory to the workspace from the HOST_BIN package (Please always use the latest version)



- Copy all the BIN packages what you like to include to the streaming binary to the workspace



- Copy additional modem image to M1 folder if you like to add secondary modem image. (Optional)

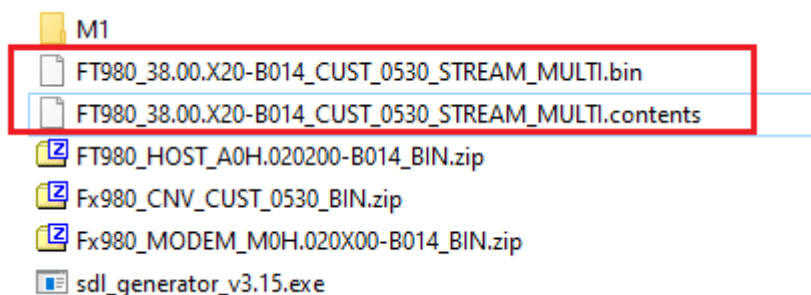


- Open CMD and execute `sdl_generator_v3` exe with below format
`sdl_generator_v3 <PRODUCT> <PACKAGE VERSION>`
<PRODUCT> : the name of the product. E.g.> FN980m
<PACKAGE VERSION> : the streaming binary package version string. The format is 38.00.xxx. E.g.> 38.00.X00-B015

The `sdl_generator` will search the BIN package and start generation after decompressing the BIN packages.

```
C:\Work\SDX55\stream binary>sdl_generator_v3.15.exe FT980 38.00.X20-B014
INFO: Start searching package at C:\Work\SDX55\stream binary (dest = C:\Work\SDX55\stream binary\temp)
INFO: Skip dir .
INFO: Skip dir ..
INFO: Checking FT980_38.00.X20-B014_CUST_0530_STREAM_MULTI.bin
INFO: Checking FT980_38.00.X20-B014_CUST_0530_STREAM_MULTI.contents
INFO: Checking FT980_HOST_A0H.020200-B014_BIN.zip
INFO: Extracting FT980_HOST_A0H.020200-B014_BIN.zip - image (HOST), Version (A0H.020200-B014)
INFO: Checking Fx980_CNV_CUST_0530_BIN.zip
INFO: Extracting Fx980_CNV_CUST_0530_BIN.zip - image (CNV), Version (CUST_0530)
INFO: Checking Fx980_MODEM_M0H.020X00-B014_BIN.zip
INFO: Extracting Fx980_MODEM_M0H.020X00-B014_BIN.zip - image (MODEM), Version (M0H.020X00-B014)
INFO: Skip dir M1
INFO: Checking sdl_generator_v3.15.exe
INFO: Skip dir temp
INFO: Start searching package at C:\Work\SDX55\stream binary\M1 (dest = C:\Work\SDX55\stream binary\temp\M1)
INFO: Skip dir .
INFO: Skip dir ..
INFO: Checking Fx980_MODEM_M0H.020X00-B013_BIN.zip
INFO: Extracting Fx980_MODEM_M0H.020X00-B013_BIN.zip - image (MODEM), Version (M0H.020X00-B013)
INFO: CNV file name = Fx980.cnv
```

- Check generated binary and contents file.



The “contents” file shown each sub-system version string included in the bin

```

PRODUCT: FT980
PKG VER: 38.00.X20-B014
HOST VER: A0H.020200-B014
M0 VER: M0H.020X00-B014
M1 VER: M0H.020X00-B013
CNV VER: CUST_0530
  
```

Below are all the supported option parameters of the `sdl_generator_v3`

Option	Description	Example
-o <OUTPUT NAME>	Set the binary name. It will be automatically determined if this option is not used.	-o test.bin
-p <PACKET SIZE>	Set the maximum packet size. Default is 65536	-p 8196
-a <SLOT>	Change the active slot to <SLOT> after download the binary. Note: The active slot will be maintained as default. Note: 1 means active M0 slot after download and 2 means active M1 slot after download)	-a 2
-b <BIN_PATH>	Change the location of the BIN package from same folder with exe to the <BIN_PATH>	-b c:\bin\
-d <DEBUG_LEVEL>	Set the debug level during download the streaming binary	-d 1
-v	Output more detailed debug log of the generator	-v

4.1.3. XFP update

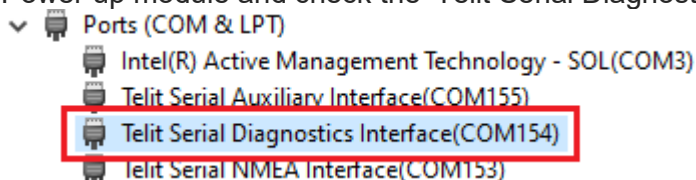
The XFP is firmware update method that provided from Telit for porting to the customer’s host unit. The XFP firmware image have CRC for each block and this CRC value transferred to the module with the binary data. The update will be stop if there are any corrupted data detected on the module.

4.1.3.1. Windows OS

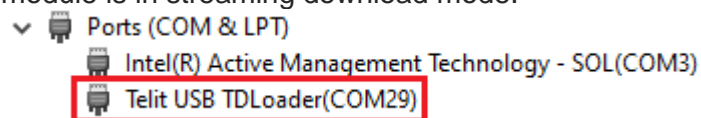
Telit provide the Windows XFP tool for perform module firmware update with XFP binary. It runs on Windows based PCs. It erases the flash memory contents, and then it downloads the new firmware on the flash memory.

Please follow below steps for perform firmware update with Windows XFP tool.

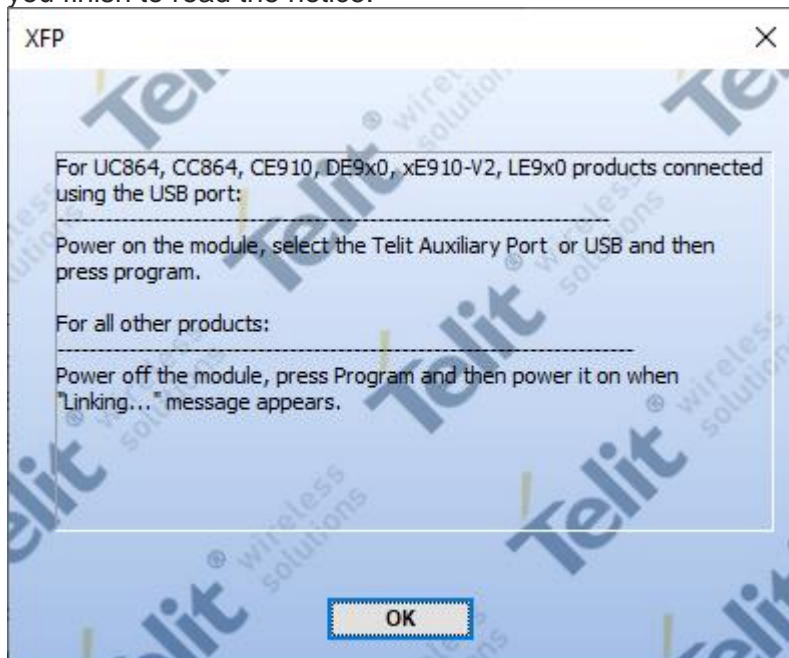
- 1) Power up module and check the 'Telit Serial Diagnostics Interface' port is enumerated.



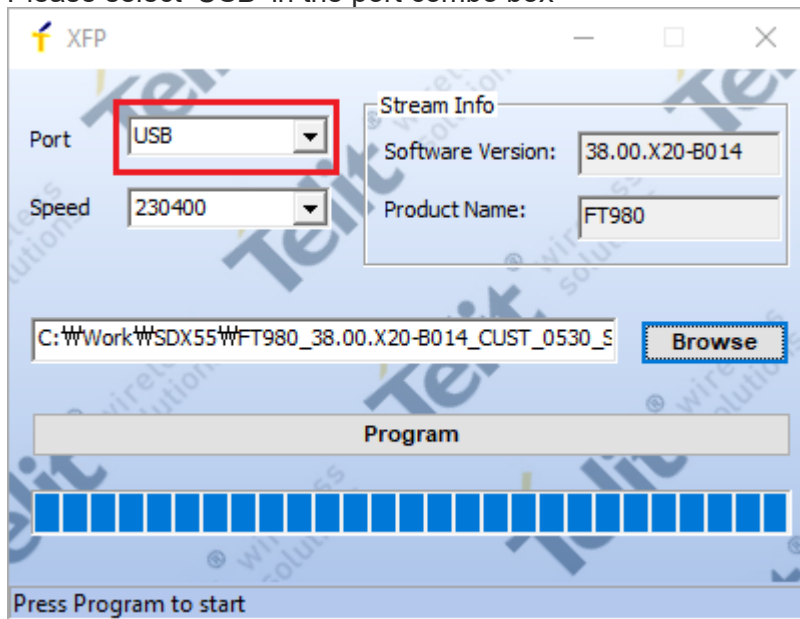
Note) The 'Telit USB TDLoader' port with PID 0x9010 will be enumerated when the module is in streaming download mode.



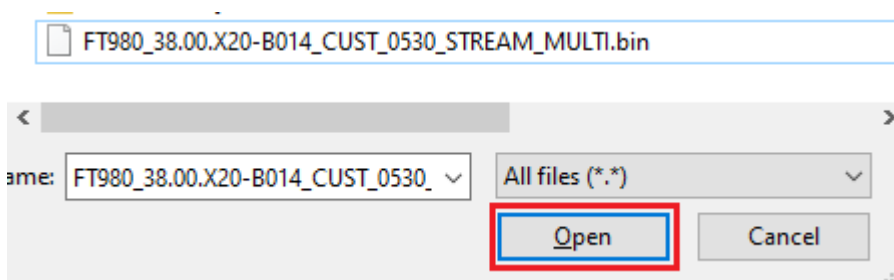
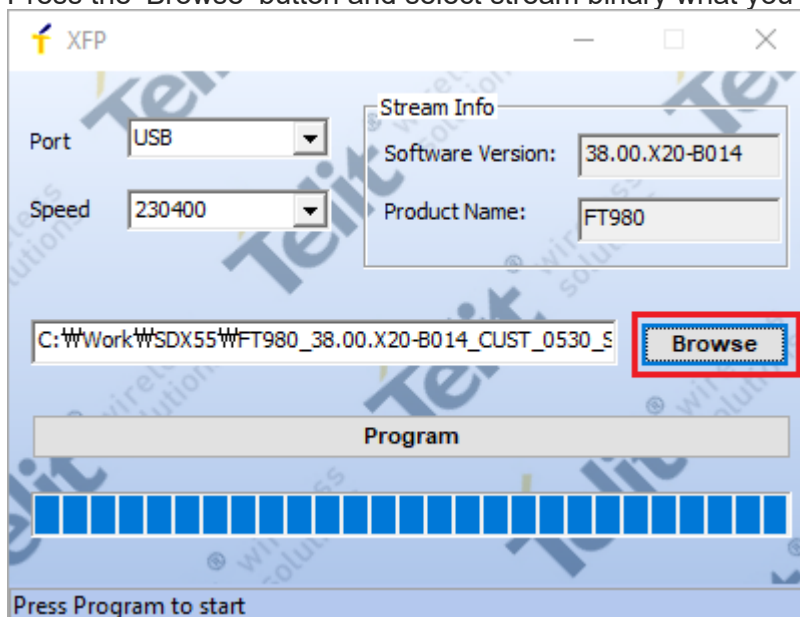
- 2) Run the 'Xfp.exe', the following windows are displayed. Please press 'OK' button after you finish to read the notice.



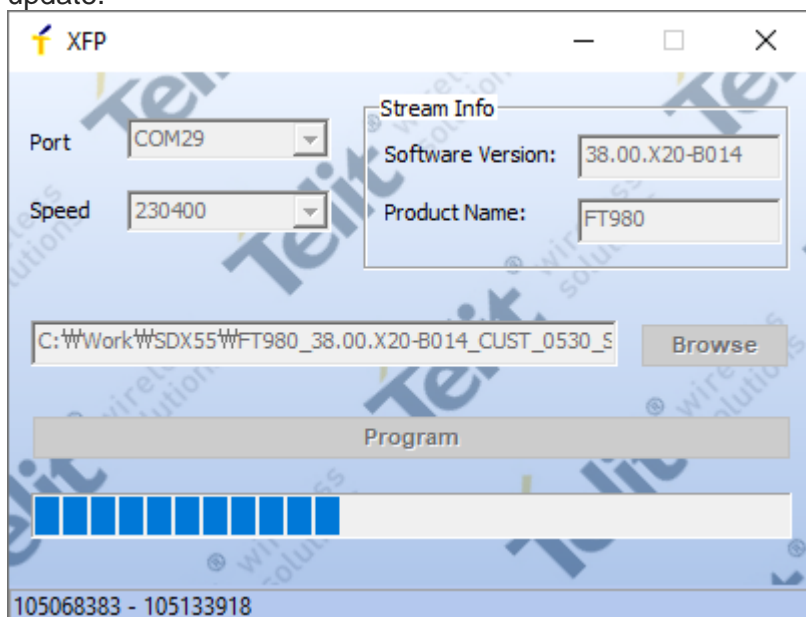
- 3) Please select 'USB' in the port combo box



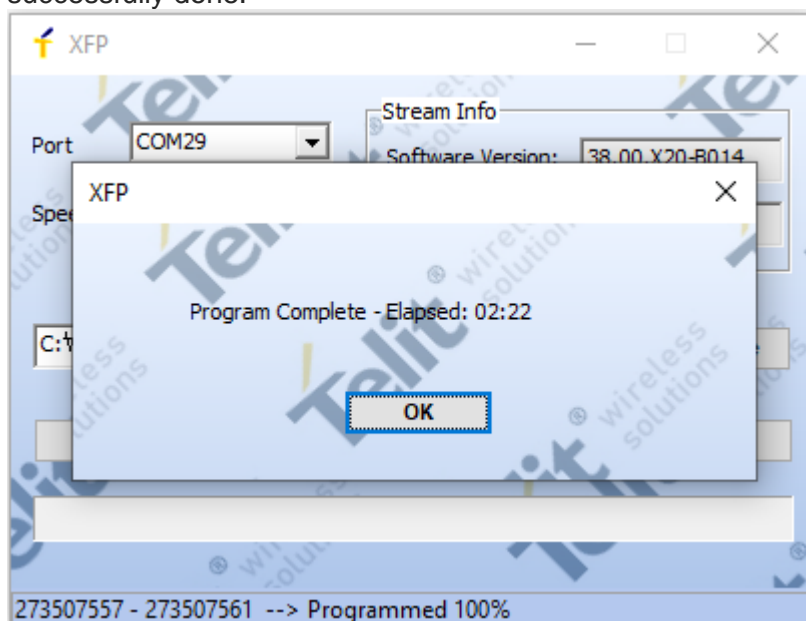
- 4) Press the 'Browse' button and select stream binary what you like to use for update.



- 5) Press the 'Program' button for start update. The progress bar will be increased during update.



- 6) The following pop-up will be displayed on the screen when the module update has been successfully done.



4.1.3.2. Linux OS

Telit will supply reference HOST tool source called uxfp for the customer proceed porting on the own host. More detailed information described in Reference [15]. uxfp User Guide.

4.2. AQC107 Firmware Update

A new firmware of AQC107 Ethernet controller is included in FT980 firmware binary.

Updating the new AQC107 firmware is proceeded on boot-up, and It needs a reboot of target to make the new firmware working properly.

So the target will be rebooted twice, if the a new FT980 binary including a new AQC107 firmware is updated.

5. GUIDELINE TO TEST GIGA BYTES THROUGHPUT BASED ON 5G-NR

5.1. Requirement

- Test PC side
 - Higher performance CPU recommended
 - 10 giga ethernet port or data port such as Thunderbolt™ 3 and USB Type C 3.1 Gen2.
 - No firewall
 - No background application running
- Tethering Cable
 - Higher category ethernet cable over Cat.6a/7
 - USB 3.1 gen 2 cable
- Test condition
 - mmWave has too short wavelength so throughput may be effected by test condition such as antenna direction, weather condition.
- FT980m mmWave antenna direction
 - View from -X axis



- View from -Y axis



6. GLOSSARY AND ACRONYMS

APN	Access Point Name
BCCH	Broadcast Control Channel
CSD	Circuit Switched Data
CTM	Cellular Text Telephone Modems
CTS	Clear To Send
DCE	Data Circuit-Terminating Equipment (refer to [14])
DRX	Discontinuous Reception
DTE	Data Terminal Equipment (refer to [14])
DTMF	Dual Tone Multiple Frequency
DTR	Data Terminal Ready
GBR	Guaranteed Bit Rate
GERAN	GSM EDGE Radio Access Network
GPIO	General Purpose Input/Output
GUI	Graphic User Interface
HF	Hands Free (old terminology)
HS	Hand Set (old terminology)
HSPA	High Speed Packet Access
IMS	IP Multimedia Subsystem
IRA	International Reference Alphabet
ME	Mobile Equipment
MSISDN	Mobile Station International Subscriber Directory Number
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
NR	New Radio
PDN	Public Data Network
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PIN	Personal Identification Number
PPP	Point to Point Protocol
QoS	Quality of Service

SIM	Subscriber Identification Module
SMS	Short Message Service
SMSC	Short Message Service Center
TCP/IP	Transmission Control Protocol / Internet Protocol
TTY	Text Telephone Typewriter
UART	Universal Asynchronous Receiver Transmitter
UE	User Equipment
URC	Unsolicited Result Code
USIM	Universal Subscriber Identification Module
UTRAN	Universal Terrestrial Radio Access Network

7. DOCUMENT HISTORY

Revision	Date	Changes
Rev.1	2020-12-03	Initial version



SUPPORT INQUIRIES

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

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