LM940 Modules
Software User Guide

1VV0301343 Rev. 1 – 2017-10-20

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APPLICABILITY TABLE

PRODUCTS

	SW Versions	Modules
LM940 SERIES	24.01.5x1	4G

CONTENTS

AT COMMAND LIST

The following list, organized in alphabetical order, shows the AT commands covered by this User Guide. The number close to each command indicates the page of the first AT command occurrence.

1. INTRODUCTION

1.1. Scope

This document covers the more significant standard and proprietary AT/QMI commands provided by Telit's modules. Several module features are described and for each one of them the related AT/QMI commands are explained through examples. This document is not an exhaustive description of the AT/QMI commands implemented on the Telit's modules series, its target is only to give you an entry point to the AT/QMI commands world.

1.2. Audience

The present User Guide is addressed to users that need to learn and use quickly standard and proprietary AT/QMI commands. The reader can learn the use of the AT/QMI commands through simple examples shown in the document, and then deepen the interested AT/QMI commands reading the documents [1]/[2] in accordance with the used 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

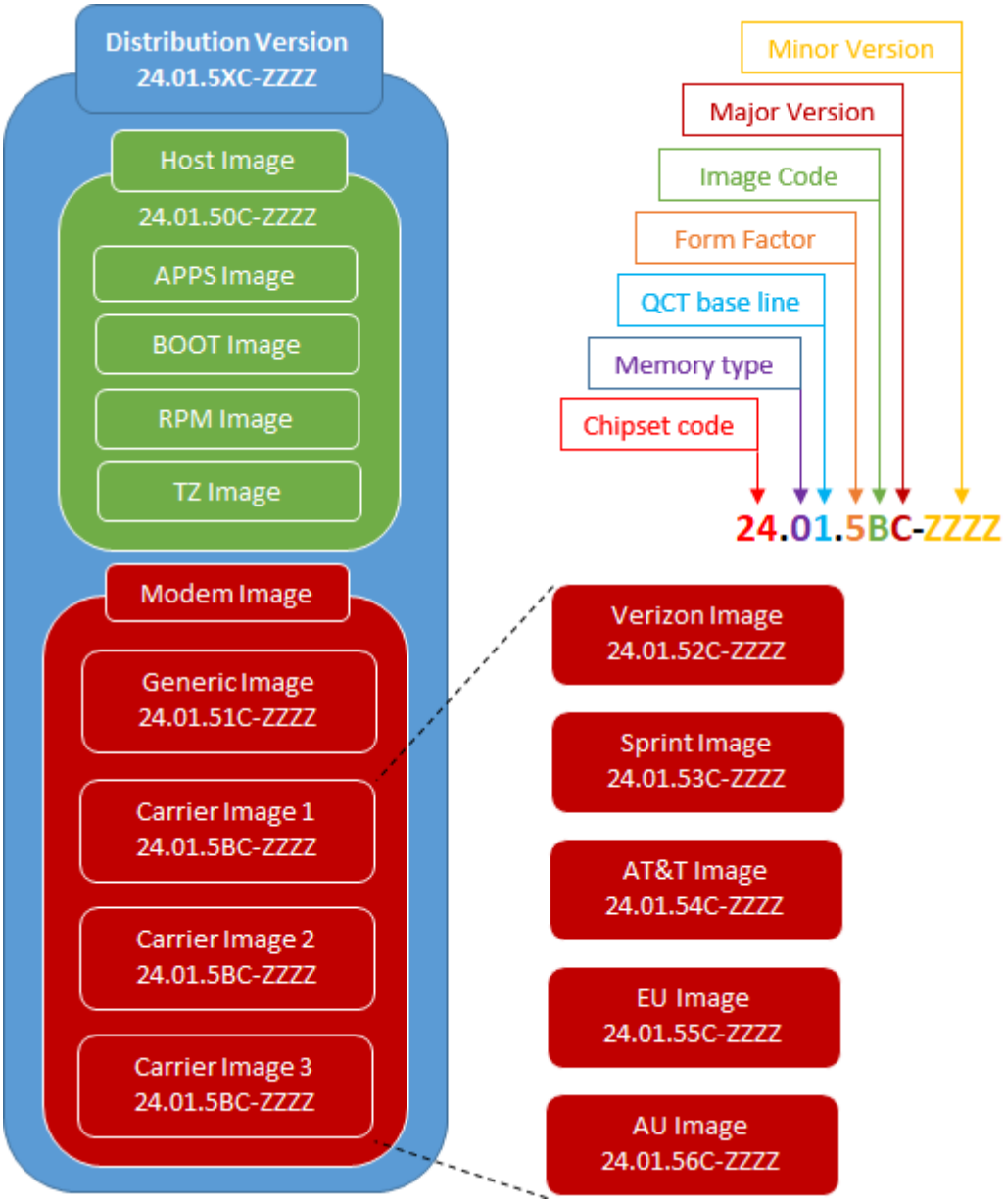
[1] AT Command Reference Guide, 80545ST10791A
[2] LM940 QMI Command Reference Guide, 80545ST10798A

2. BASIC OPERATION

2.1. Multi-modem Image Support

LM940 provides multi-modem image function to support multi carrier(max 4) without firmware flashing. the modem images can be manged through QMI command (swtich, add, remove or replace)

- For QMI command, please refer chapter 5.4.5(QMI_GAS)

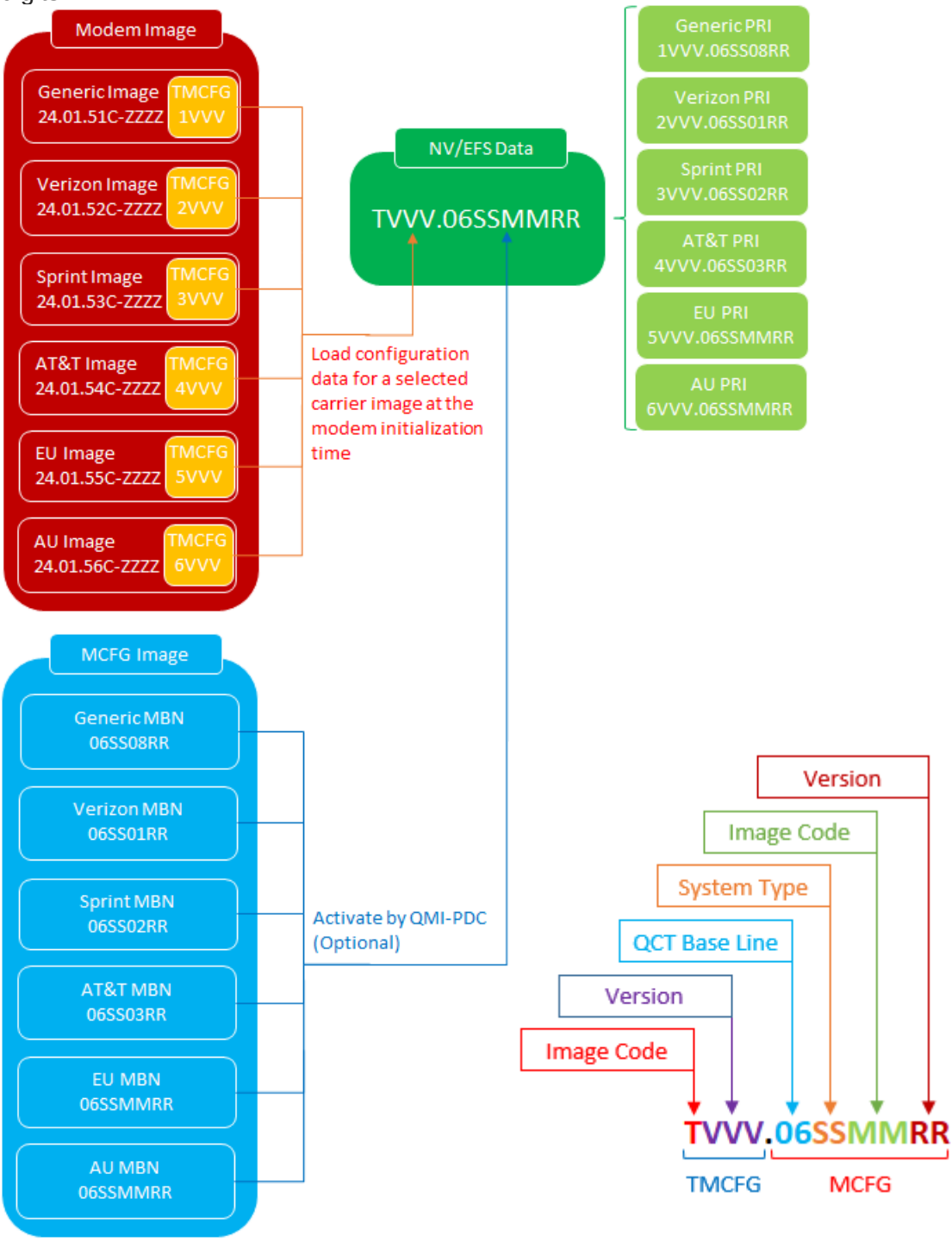


2.2. Modem Configuration and PRI revision

LM940 default configurations called TMCFG are embedded in source codes, and they will be loaded automatically in time of NV task initializing. But if a carrier requires a minor configuration item change, Telit will release the MCFG binary. And if customer can manage & activate the MCFG binary on EFS by using QMI_PDC, then the configuration item values will be changed.

The versioning rule for PRI revision is as follows:

- TMCFG_Version[.MCFG_Version]
- TMCFG_Version : Static, Telit Modem Configuraton, Hexadecimal 4 digits
- MCFG_Version : Optional, Dynamic, Qualcomm Modem Configuration, Hexadecimal 8 digits



2.3. Low Power Mode

LM940 will enter LPM(Low Power Mode) when W_DISABLE_N is asserted to Low. In the other hands, if W_DISABLE_N is asserted to High, the modem will be changed to online mode.

It can also be controlled with **AT+CFUN** and **QMI_DMS_SET_OPERATING_MODE** commands.

For details, refer to the following documents.

- [1] AT Command Reference Guide, 80545ST10791A
- [2] LM940 QMI Command Reference Guide, 80545ST10798A

3. BASIC AT COMMANDS

3.1. Serial Ports Arrangements (USB Configuration)

The LM940 family provides below USB compositions, USB composition can be configured by using #USBCFG command.

Product ID	MI	Service Name
1040	0	DIAG
	1	ADB
	2	RMNET
	3	NMEA
	4	MODEM
	5	MODEM
	6	AUX
1041	0	DIAG
	1	ADB
	2,3	MBIM
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
1042	0,1	RNDIS
	2	DIAG
	3	ADB
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
1043	0	DIAG
	1	ADB
	2,3	ECM
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
1045	0,1	RNDIS
	2	DIAG
	3	ADB
	4	NMEA
	5	MODEM
	6	MODEM
	7	AUX
	8,9,10	AUDIO

Now default USB composition is 1040(PID)

3.1.1. Set and Query composition

#USBCFG command sets USB composition.

Example 1

Set up USB composition to 1040.

AT#USBCFG=1
OK

Query current configuration.

AT#USBCFG?
#USBCFG: 1

3.2. AT Interface Style Selection

Use the following AT command to check the current AT Interface Style.

AT#SELINT?

3.2.1. LM940 Module

Check the supported AT Command Interface Style.

AT#SELINT=?
#SELINT: (2) ← only interface style 2 is supported.
OK

3.3. AT Error Report Format

Disable the Error Report in numerical and verbose format.

AT+CMEE=0
OK

Enable the Error Report in numerical format.

AT+CMEE=1
OK

Enable the Error Report in verbose format.

AT+CMEE=2
OK

3.4. Module Identification

Use the following AT commands to verify the Software Versions and module identification.

Check the Software Versions.

AT+CGMR
24.01.510-B001
OK

Check the module identification.

AT+CGMM
LM940
OK

3.5. Select 3G or 4G Network

The following AT command selects the technology: 3G, 4G, or both.

AT+WS46=[<n>]

AT+WS46=?
+WS46: (22,28,31) ← this command supports only 3 mode.
OK

The <n> parameter is stored in NVM, and the command will take effect on the next power on. If on the air are present both technologies 3G and 4G, the second one is preferred.

Examples

Select 3G Technology only.

AT+WS46=22
OK

Select 4G Technology only.

AT+WS46=28
OK

Select both Technologies: 3G and 4G.

AT+WS46=31
OK

3.6. Band Configuration

In manual band selection the following AT command selects the current band for both technologies UTRAN and EUTRAN:

AT#BND=<GSM band>[,<UMTS band>[,<LTE band>]]

Examples

AT#BND=0,0,2 ← selected band: B1 (3G) + B2(4G)OK

The module uses a band out of the two entered with the previous command. The selected band will be in accordance with the +WS46 command and the technologies available on the air.
LM940 doesn't support GSM and the default value is '0'(dummy).

3.7. SIM/USIM Management

3.7.1. SIM Presence and PIN Request

The following AT command checks if the SIM device needs the PIN code:

AT+CPIN?

Examples

Assume that the SIM is inserted into the module and the PIN code is needed.

AT+CPIN?
+CPIN: SIM PIN
OK

Assume that the SIM is not inserted and Extended Error result code is not enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?
ERROR

Assume that the SIM is not inserted and Verbose Extended error result code is enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?
+CME ERROR: SIM not inserted

Assume that the SIM is not inserted and Numerical Extended error result code is enabled. Check if PIN code is needed, just to see the response command:

AT+CPIN?
+CME ERROR: 10

3.7.2. Enter PIN code

Use the following AT command to enter the PIN code:

AT+CPIN=<pin>

Examples

Assume to enter a wrong PIN code, and Extended Error result is not enabled.

AT+CPIN=1235
ERROR

Now, enter the right PIN code:

AT+CPIN=1234
OK

Enable Verbose Extended error result code:

AT+CMEE=2
OK

Enter a wrong PIN code:

AT+CPIN=1235
+CME ERROR: incorrect password.

After 3 PIN code failed attempts, the PIN code is no longer requested and the SIM is locked. Use SIM PUK to enter a new PIN code and unlock the SIM.

3.7.3. Enter PUK code

Enter the following AT command if PUK or PUK2 code is required:

AT+CPIN=<pin>[,<newpin>]

After 10 PUK code failed attempts, the SIM Card is locked and no longer available.

3.7.4. SIM Status

Use the following AT command to enable/disable the SIM Status Unsolicited Indication.

AT#QSS=<mode>

Example 1

Enable the unsolicited indication concerning the SIM status change.

AT#QSS=1 ← enable URCs: #QSS:0/1
OK

#QSS: 0,0 ← unsolicited indication: the SIM in slot1 is extracted.

#QSS: 1,0 ← unsolicited indication: the SIM in slot1 is inserted.

Example 2

AT#QSS=2 ← enable URCs: #QSS:0/1/2/3
OK

AT+IPR=19200 ← select the Main Serial Port speed = DTE speed
OK

AT&W0 ← store the setting on profile 0
OK

AT&P0 ← at Power on use profile 0
OK

Now, power off the module:

#QSS: 0,0 ← unsolicited indication: SIM in slot1 is extracted.

Now, power on the module:

#QSS: 1,0 ← unsolicited indication: SIM in slot1 is inserted.

AT+CPIN?
+CPIN: SIM PIN ← SIM is locked
OK

AT+CPIN=<PIN> ← enter PIN
OK

#QSS: 2,0 ← unsolicited indication: SIM in slot1 is unlocked.

#QSS: 3,0 ← unsolicited indication: SMS and Phonebook are accessible

---

The time interval between the two unsolicited indications (#QSS: 2 and #QSS: 3) depends from the number of SMS stored on the module and the Phonebook size.

3.7.5. SIM Detection Mode

Use the following AT command to manage the SIM Detection Mode:

AT#SIMDET=<mode>

Or

Use the following AT command to enable/disable the SIM Status Unsolicited Indication.

AT#QSS=<mode>

Example

AT#SIMDET?
#SIMDET: 0,0
OK

0 = SIM slot1 is activated.

0 = SIM not inserted, If SIMIN pin is not connected, it is always 0.

AT#QSS?
#QSS: 0,1,0
OK

0 = Disable URC

1 = SIM inserted

0 = SIM slot1

Enable the unsolicited indication concerning the SIM status change.

AT#QSS=1
OK

Now, Insert the SIM into SIM slot2.

AT#SIMDET=1 ← switch to SIM slot2
OK
#QSS: 0,0 ← unsolicited indication, SIM not inserted on SIM slot1.
#QSS: 1,1 ← unsolicited indication, SIM inserted on SIM slot2.

AT#SIMDET?
#SIMDET: 1,0 ← 1 = SIM slot2 is activated, 0 = If SIMIN pin is not connected, it is always 0.
OK

AT#SIMDET=0 ← switch to SIM slot1
OK
#QSS: 0,1 ← unsolicited indication, SIM not inserted on SIM slot2
#QSS: 1,0 ← unsolicited indication, SIM inserted on SIM slot1

AT#SIMDET?
#SIMDET: 0,0 ← 0 = SIM slot1 is activated, 0 = If SIMIN pin is not connected, it is always 0.
OK

3.7.6. SIM/USIM Access File

AT+CSIM command is used to read/write SIM/USIM files. The format of the AT+CSIM parameters and the sequence of the AT+CSIM commands must be in accordance with the protocol card. The distinction between SIM and USIM <command> format is needed because the AT+CSIM command works directly on the card.

AT+CSIM=<length>,<command>

Example

AT+CSIM=1 ← Lock SIM interface
OK

••••

To read/write card files refer to “LM940 AT_Command_Reference_Guide.doc”.

••••

AT+CSIM=0 ← Unlock SIM interface
OK

3.7.7. MSISDN

MSISDN is a number uniquely identifying a subscription in a GSM or UMTS mobile network. MSISDN is defined by the ITU-U Recommendation which defines the numbering plan: a number uniquely identifies a public network termination point and typically consists of three fields, CC (Country Code), NDC (National Destination Code), and SN (Subscriber Number), up to 15 digits in total.

Select the "ON" storage:

AT+CPBS="ON"
OK

Write a new record on the selected storage:

AT+CPBW=1,"+393912457",145,"MyNumber"
OK

Read the just entered number:

AT+CPBF="MyNumber"
+CPBF: 1," +393912457",145,"MyNumber"
OK

3.8. Network Information

3.8.1. Network Status

Enter the following AT command to verify if the module is registered on a network.

AT+CREG?

3.8.1.1. CS network registration status in UTRAN/E-UTRAN

Send command **AT+CREG?**

Wait for response:

Response	Reason	Action

+CREG: 0,0 or +CREG: 1,0	SIM not present or damaged or SIM is present and PIN is required to continue operations	Check SIM/UICC or require UICC insertion and repeat from par. 3.7.1 or Repeat par. 3.7.2
+CREG: 0,1 or +CREG: 1,1	Mobile is registered on its home network.	Proceed ahead. Ready to call
+CREG: 0,2 or +CREG: 1,2	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at par. 3.8.1.1 to see if it has found a suitable network to register in
+CREG: 0,3 or +CREG: 1,3	Mobile has found some networks but it is not allowed to register on any of them, no roaming was allowed.	Try in another place, and repeat procedure at par. 3.8.1.1
+CREG: 0,4 or +CREG: 1,4	Mobile is in an unknown network status	Repeat procedure at par. 3.8.1.1 to see if it has found a suitable network to register in
+CREG: 0,5 or +CREG: 1,5	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to call

3.8.1.2. PS network registration status in UTRAN

Send command **AT+CGREG?**

Wait for response:

Response	Reason	Action
+CGREG: 0,0 or +CGREG: 1,0	SIM not present or damaged or SIM is present and PIN is required to continue operations	Check SIM/UICC or require UICC insertion and repeat from par. 3.7.1 or Repeat par. 3.7.2
+CGREG: 0,1 or +CGREG: 1,1	Mobile is registered on its home network.	Proceed ahead. Ready to call
+CGREG: 0,2 or +CGREG: 1,2	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at par. 3.8.1.2 to see if it has found a suitable network to register in

+CGREG: 0,3 or +CGREG: 1,3	Mobile has found some networks but it is not allowed to register on any of them, no roaming was allowed.	Try in another place, and repeat procedure at par. 3.8.1.2
+CGREG: 0,4 or +CGREG: 1,4	Mobile is in an unknown network status	Repeat procedure at par. 3.8.1.2 to see if it has found a suitable network to register in
+CGREG: 0,5 or +CGREG: 1,5	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to call

3.8.1.3. PS network registration status in E-UTRAN

Send command **AT+CEREG?**

Wait for response:

Response	Reason	Action
+CEREG: 0,0 or +CEREG: 1,0	SIM not present or damaged or SIM is present and PIN is required to continue operations	Check SIM/UICC or require UICC insertion and repeat from par. 3.7.1 or Repeat par. 3.7.2
+CEREG: 0,1 or +CEREG: 1,1	Mobile is registered on its home network.	Proceed ahead. Ready to call
+CEREG: 0,2 or +CEREG: 1,2	Mobile is currently not registered on any network but is looking for a suitable one to register.	Repeat procedure at par. 3.8.1.3 to see if it has found a suitable network to register in
+CEREG: 0,3 or +CEREG: 1,3	Mobile has found some networks but it is not allowed to register on any of them, no roaming was allowed.	Try in another place, and repeat procedure at par. 3.8.1.3
+CEREG: 0,4 or +CEREG: 1,4	Mobile is in an unknown network status	Repeat procedure at par. 3.8.1.3 to see if it has found a suitable network to register in
+CEREG: 0,5 or +CEREG: 1,5	Mobile has found some networks and is currently registered in roaming on one of them	Proceed ahead. Ready to call

When a response +CREG/+CGREG/+CEREG: x,1 or + CREG/+CGREG/+CEREG: x,5 is received, then the device is ready to place and receive a call or SMS. It is possible to jump directly to call setup procedures or SMS sending procedures.

3.8.2. Network Operator Identification

Use the following AT command to query the module for Network Operators Identifications Once the mobile has registered on some network (or even if it has returned +CREG/+CGREG/+CEREG:x,3), it is possible to query the mobile for network identifications, codes and names:

- send command **AT+COPS=?**
- wait for response in the format:

+COPS: [list of supported (<stat>,long alphanumeric <oper>,short alphanumeric <oper>,numeric <oper>,< AcT>)s]

[,,(list of supported <mode>s),(list of supported <format>s)]

where:

<stat> operator availability

0 - unknown

1 - Available

2 - current

3 - Forbidden

<AcT> access technology selected

0 GSM

2 UTRAN

7 E-UTRA UTRAN

Since with this command a network scan is done, this command may require some seconds before the output is given.

For example:

AT Command

AT+COPS=?

Answer:

+COPS: (2,"","SKTelecom","45005",7),(3,"KT","KT","45008",7),(3,"KOR LG Uplus","LG U+","45006",7),,(0-4),(0-2)

OK

In this case the mobile is registered on the network **"SKTelecom"** which is a network from Korea, code: 450 and Network ID: 05.

The other network is not available for registration:

This command issues a network request and it may require quite a long time to respond, since the device has to wait the answer from the network (it can be as long as 60 seconds). Do not use this command if not necessary.

3.8.3. Preferred Network Operator List

Use the following AT command to manage the Preferred Operator List stored on SIM.

AT+CPOL=[<index>][,<format>[,<oper>[,<GSM_AcT>,<GSM_Compact_AcT>,<UTRAN_AcT,<EUTRAN_AcT>]]]

Check the supported number of operators in the SIM preferred operator list and the format:

AT+CPOL=?
+CPOL: (1-16),(0-2)←The used SIM supports 16 positions; the supported format (0) is long format alphanumeric, (1) is short format alphanumeric and (2) is numeric
OK

AT+CPOL?
+CPOL: 1,2,"20801",1,0,1,1
+CPOL: 2,2,"21407",1,0,1,1
.
+CPOL: 16,2,"73001",1,0,1,1
OK

LM940 does not support GSM access technology. <GSM_Compact_Act> is not supported but set value is acceptable.

The User controlled PLMN could not be read/wrote/returned values and range on some SIM like AT&T when it set to CPLS 0 because the EF_PLMNwACT field does not exist.

3.8.4. Signal Strength & Quality

Assume that the module is registered on a network that provides 3G technology. The following AT command returns the received signal strength & quality giving an indication about the radio link reliability.

AT+CSQ

Assume that the antenna is not connected to the module or network coverage is not present at all.

AT+CSQ
+CSQ: 99,99
OK

Now, the antenna is connected to the module and network coverage is present. Enter again the previous AT command:

AT+CSQ
+CSQ: 17,0 ← 17 = <rssi> = Received Signal Strength Indication
OK 0 = <ber> = Bit Error Rate

Now, a wrong parameter is entered just to see the result format when Verbose Extended Error result is enabled:

AT+CSQ?
+CME ERROR: operation not supported

3.8.5. Extended Signal Strength & Quality

Assume that the module is registered on a network that provides 3G and 4G technology. The following AT command returns the received signal strength & quality giving an indication about the radio link reliability.

AT+CESQ

Assume that the antenna is not connected to the module or network coverage is not present at all.

AT+CESQ
+CSQ: 99,99,255,255,255,255
OK

Now, the antenna is connected to the module and network coverage is present. Enter again the previous AT command:

AT+CESQ
+CSQ: 99,99,94,97,255,255 ← 94 = <rscp> = Received Signal Code Power
OK 47 = <ecno> = Ratio of the received energy per PN chip to the total received power spectral density.

AT+CESQ
+CSQ: 99,99,255,255,32,95 ← 32 = <rsrq> = Reference Signal Recevied Quality
OK 95 = <rsrp> = Reference Signal Received Power

Now, a wrong parameter is entered just to see the result format when Verbose Extended Error result is enabled:

AT+CESQ?
+CME ERROR: operation not supported

3.8.6. Fast Network Status Check

Once the module is registered on a network, does not matter about the technology (3G or 4G), it is useful to know the received signal strength and the network on which the module is registered. This information is gathered by means of the following standard AT commands: +CREG, +COPS and +CSQ. These commands are not fast in the response due to network response time, especially the +COPS command. If the user objective is to keep his application as general as possible, he can use the standard AT command above mentioned.

Telit's modules provide proprietary AT commands to gather all the information in a faster and simpler way, they are:

- **AT#MONI**
- **AT#SERVINFO**

AT#MONI and AT#SERVINFO commands should be used only to collect network name and signal strength information. To check if the module is registered or it is looking for a suitable network to register on, use +CREG command. In fact, if the network signal is too weak and module loses the registration, until a new network is found the two commands report the last measured valid values and not the real ones. The TA (timing advance parameter) is valid only during a call.

Check network registration with +CREG command. When module is registered, query the module for network operator name and signal strength with AT#MONI command.

3.8.6.1. 3G Network

Suppose that the 3G Technology is present on the air. Use the command AT+WS46=22 to force the module in 3G mode.

Examples

Check if the module is using 3G Technology:

```
AT+COPS?
+COPS: 0,0,"KOR SK Telecom",2
OK
```

Yes, it is using 3G Technology.

Select the Serving Cell:

```
AT#MONI=0
OK
```

Collect information:

```
AT#MONI
#MONI: KOR SK Telecom PSC:14 RSCP:-64 LAC:21E1 Id:3CDA520 EcIo:-2.5
UARFCN:10713 PWR:-59 dbm DRX:64 SCR:224
OK
```

Use the following AT command to collect only the Serving Cell Information:

```
AT#SERVINFO
#SERVINFO: 10713,-61,"KOR SK Telecom","45005",14,21E1,64,3,-66,"I",01
OK
```

Use this command to get the current network status.

AT#RFSTS
#RFSTS: "450 05",10713,14,-5.0,-68,-63,21E1,01,,64,19,0,1,001,3CDA520,
"450050217220238","KOR SK Telecom",3,1
OK

3.8.6.2. 4G Network

Suppose that the 4G Technology is present on the air. Use the command AT+WS46=28 to force the module in 4G mode.

Examples

Check if the module is using 4G Technology:

AT+COPS?
+COPS: 0,0,"KOR SK Telecom",7
OK

Yes, it is using 4G Technology.

Select the Serving Cell:

AT#MONI=0
OK

Collect information:

AT#MONI
#MONI: KOR SK Telecom RSRP:-79 RSRQ:-9 TAC:310C Id: 06FC047 EARFCN:1350 PWR:-53dbm DRX:128
OK

Use the following AT command to collect only the Serving Cell Information:

AT#SERVINFO
#SERVINFO: 1350,-60,"KOR SK Telecom","45005",06FC047,310C,128,3,-94
OK

Use this command to get the current network status.

AT#RFSTS
#RFSTS: "450 05",1350,-94,-59,-13,310C,255,,128,19,0,06FC047,”450050217220238”,”KOR SK Telecom”3,3
OK

3.8.7. Enhanced Network Selection and AT&T functions

Use the following AT command to enable/disable the Enhanced Network Selection and the AT&T features. ENS works if the module and the SIM card are both ENS-capable.

AT#ENS=[<mode>]

AT#ENS?
#ENS: 0 ← factory setting

Enter the following setting. Power OFF/ON the module to make active the new entered setting.

AT#ENS=1
OK

The following chapters describe the features enabled by the AT#ENS command for each module/software version.

3.8.7.1. No AT&T SIM cards

The module supports the following features independently from the #ENS setting:

- +PACSP AT command to display the PLMN Mode Bit read from CPHS file on SIM (refer to AT&T Device Requirement)

3.8.7.2. AT&T SIM cards

Assume that #ENS=1. The module supports the features the following:

- Acting Home PLMN (refer to AT&T Device Requirement)

3.9. Software Shutdown

Enter the following AT command to start the module shutdown.

AT#SHDN
OK

During shutdown, the module executes the following actions:

- Detachment from the network
- Module power off

To have more information about procedure and timing refer to HW user guide in accordance with the module that you are using.

4. ADVANCED AT COMMANDS

4.1. SMS Management

The modules provide the SMS Service to store, send, receive, and delete a SMS, which is a short text message up to 160 characters long. Before using the SMS messages, you must configure the Short Message Service.

4.1.1. Select SMS Format Type

The Telit Module supports two SMS formats:

- PDU mode
- Text mode

The module uses the PDU format to send a message on the air. The PDU mode enables the user to edit the message in PDU format. If the user is familiar with PDU encoding, he can operate with PDU by selecting that mode and use the appropriate commands.

The present document uses the Text mode to explain how to operate with SMS. Here is the AT command to select the mode.

AT+CMGF=<mode>

Examples

Check the supported range of values:

AT+CMGF=?
+CMGF: (0,1)
OK

Set up Text Mode for the SMS:

AT+CMGF=1
OK

This setting is stored and remains active until the module is turned OFF.

4.1.1.1. Set Text Mode Parameters

When SMS format is Text mode, the SMS parameters that usually reside on the header of the PDU must be set apart with the +CSMP command.

AT+CSMP=<fo>,<vp>,<pid>,<dcs>

Example 1

Set the SMS parameters as follow:

- <fo> expressed in binary format, see table below. The binary number expressed in decimal format is 17.

0	0	0	1	0	0	0	1
Module is not requesting a status report	Always 0	Replay Path not requested	Validity period field present in relative format		Always 0	SMS-SUBMIT	

- <vp> validity period (in relative format) = 24 hours is coded into 167 decimal format.
- <pid> protocol identifier.
- <dcs> data coding scheme, default value 0.

AT+CSMP= 17,167,0,0
OK

Example 2

Set the SMS parameters as follow:

- <fo> expressed in binary format, see table below. The binary number expressed in decimal format is 25.

0	0	0	1	1	0	0	1
Module is not requesting a status report	Always 0	Replay Path not requested	Validity period field present in absolute format		Always 0	SMS-SUBMIT	

- <vp> validity period in absolute format represents the expiration date of the message, for example:
  date: 29/06/02; time: 02:20; in the time zone of Italy (+1) is formatted as follows:
  “29/06/02,02:20:00+1”
- <pid> protocol identifier.
- <dcs> data coding scheme:
  - Default Alphabet
  - Class 0 (immediate display SMS)

Data coding scheme is coded in the following binary format: 11110000, corresponding to 240 in decimal format.

AT+CSMP=25,"29/06/02,02:20:00+1",0,240
OK

Use dcs=0 if no particular data coding scheme is needed. Not all dcs combinations described in the 3GPP TS 23.038 are jointly supported by Networks and Telit Modules: some features may be not implemented on Networks or on Telit Modules. This no matching is resulting in a ERROR result code, use different dcs.

4.1.1.2. Character Sets

Use the following AT command to select the character set:

AT+CSCS=<chset>

Here are the supported character sets:

- “GSM” default alphabet
- “IRA” – ITU-T.50
- ”8859-1” – ISO 8859 Latin 1
- ”PCCP437” – PC character set Code Page 437.
- “UCS2” – 16-bit universal multiple-octet coded character set (ISO/IEC10646)

Examples

Check the supported character sets:

AT+CSCS=?
+CSCS: (“GSM”,”IRA”,”8859-1”,”PCCP437”,”UCS2”)
OK

Check the current character set:

AT+CSCS?
+CSCS: “IRA”
OK

Select a non-existent character set, merely to see the response format:

AT+CSCS=”GSA”
ERROR

Enabling the Error report in verbose format:

AT+CMEE=2
OK

Select again a non-existent character set:

AT+CSCS=”GSA”
+CME ERROR: operation not supported

4.1.1.2.1. IRA Character Set

The IRA character set is used in Text mode. IRA set defines each character as a 7-bit value: from 0x00 to 0x7F. The table below lists all the supported characters and their hexadecimal code.

		Most Significant Nibble							
		0x	**1x**	**2x**	**3x**	**4x**	**5x**	**6x**	**7x**
Least Significant Nibble	**x0**			SP[1]	0	@	P		p
	x1			!	1	A	Q	a	q
	x2			“	2	B	R	b	r
	x3			#	3	C	S	c	s
	x4			$	4	D	T	d	t
	x5			%	5	E	U	e	u
	x6			&	6	F	V	f	v
	x7			‘	7	G	W	g	w
	x8			(	8	H	X	h	x
	x9			)	9	I	Y	i	y
	xA	LF[2]		*	:	J	Z	j	z
	xB			+	;	K		k	
	xC			,	<	L		l	
	xD	CR[3]		-	=	M		m	
	xE			.	>	N		n	
	xF			/	?	O	£	o	

[1] – SP stands for space character

[2] – LF stands for Line Feed character

[3] – CR stands for Carriage Return character

The following examples show how to use the IRA table:

- Get the IRA code of the character ‘&’: the most significant nibble is 2, the least significant nibble is 6, so the IRA code for the ‘&’ character is the hexadecimal value: 0x26.
- Translate IRA code 0x6B into the corresponding character: the most significant nibble is 6, the least significant nibble is B, the cell at the crossing of column 6 and row B holds the character: "k".

4.1.1.2.2. UCS2 Character Set

The UCS2 Character Set is used in Text mode.

- Phone number 329 05 69 6... converted into "UCS2" format: 3=0033, 2=0032, 9=0039, 0=0030, 5=0035, 6=0036, 9=0039, 6=0036 ...
- Text HELLO converted into UCS2 format: H=0048, E=0045, L=004C, O=004F

4.1.2. Read SMSC Number

The module sends the SMS to the SMSC where the message is dispatched towards its final destination or is kept until the delivery is possible. To ensure the correct operation of this service the number of the SMSC needs to be configured on the module in accordance with the network operator used.

To know the SMSC number stored on the module, use the following AT command.

AT+CSCA?

Check the stored SMSC number:

AT+CSCA?
+CSCA: "+39X20XX58XX0",145
OK

SMSC number is compliant with the international numbering scheme.

4.1.3. Set SMSC Number

Use the following AT command to store a new SMSC number. The old number is overwritten.

AT+CSCA=<number>,<type>

Set up the desired SMSC number in international format:

AT+CSCA=+39X20XX58XX0,145
OK

Enable extended result code in verbose format:

AT+CMEE=2
OK

Enter the command with no parameters:

AT+CSCA=
+CME ERROR: operation not supported

4.1.4. Send a SMS

Use the following AT command to send a SMS.

AT+CMGS

To read and set the SMSC number see § 4.1.2 and 4.1.3.

Example 1

Send a SMS to the module itself and do not store it. Use the UCS2 character set.

Select Text Mode.

AT+CMGF=1
OK

Select the UCS2 character set.

AT+CSCS="UCS2"
OK

Set SMS parameters:

AT+CSMP=17,168,0,26
OK

Select how the new received message event is notified by the DCE to the DTE.

AT+CNMI=1,1,0,0,0
OK

Send the message to the module itself. The UCS2 character set is used:

- Phone number 329 05 69 628 is converted into "UCS2" format: 3=0033, 2=0032, 9=0039, 0=0030, 5=0035, 6=0036, 9=0039, 6=0036, 2=0032, 8=0038
- Text CIAO is converted into UCS2 format: C=0043, I=0049, A=0041, O=004F

AT+CMGS=003300320039003000350036003900360032003 8
> 004300490041004F (close the message with Ctrl Z)
+CMGS: 81
OK

The module itself receives the SMS, the following unsolicited indication is shown on DTE:

+CMTI: "SM",3

The SMS was successfully sent to the SMSC and its network reference number is 81. Do not confuse message reference with message index position: the first one indicates the network reference for identifying the sent message, the second one – reported by the unsolicited indication – indicates that the module receives the message and it is stored on the position 3 of the "SM" storage.

Select the "SM" storage as indicated by the unsolicited indication.

AT+CPMS="SM"
+CPMS: 3,50,3,50,3,50
OK

Read the message from the storage position indicated by the unsolicited indication.

AT+CMGR=3
+CMGR: "REC UNREAD","002B0033003900330032003900300003500360039003600320038",
"00570049004E004400200053004900 4D","08/05/13,12:22:08+08"
004300490041004F
OK

Example 2

Send a SMS to the module itself and do not store it.

Select Text Mode

AT+CMGF=1
OK

Select how the new received message event is notified by the DCE to the DTE.

AT+CNMI=1,1,0,0,0
OK

Send the message to the module itself.

AT+CMGS="+39329X569YYY"
> SEND THE SMS #1 TO ITSELF (close the message with Ctrl Z)
+CMGS: 76
OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: "SM",1

The SMS was successfully sent to the SMSC and its network reference number is 76. Do not confuse message reference with message index position: the first one indicates the network reference for identifying the sent message, the second one – reported by the unsolicited indication – indicates that the module has received the message and it is stored on the position 1 of the "SM" storage.

Use unsolicited indication parameter to read the SMS #1 for the first time.

AT+CMGR=1
+CMGR: "REC UNREAD","+39329X569YYY","WIND SIM","08/04/18,13:58:04+08"
SEND THE SMS #1 TO THE MODULE ITSELF
OK

4.1.5. Select/Check SMS Storage Type

Telit Modules can provide two type of SMS storage, in agreement with the family of belonging:

- “SM” – SIM Card Memory
- “ME” – Mobile Equipment Memory
- “SR” – Status Report Message Memory.

Use the following AT command to select memory storage:

AT+CPMS=<memr>,<memw>,<mems>

The SMS are usually stored (this is true for both the originated and the received SMS) in the SM/ME storage.

The LM940 family allows the user to select a different storage for the read-delete, write-send, and reception-saving SMS operations.

Examples

AT+CPMS=? ← Check the supported SMS storage types
+CPMS: (“ME”,“SM”,“SR”),(“SM”,“ME”),(“SM”,“ME”)
OK

AT+CPMS? ← Check the current active storage type
+CPMS: “SM”,1,50,”SM”,1,50,”SM”,1,50
OK

AT+CPMS=”ME” ← Select “ME” storage type
+CPMS: 0,50,1,50,1,50
OK

AT+CPMS? ← Check the current active storage types
+CPMS: “ME”,0,50,”SM”,1,50,”SM”,1,50 ← Two SMS storage types are active: “ME” and “SM”
OK

4.1.6. Store a SMS

Use the following AT command to store a SMS.

AT+CMGW="<da>"

Example

Store a SMS in the "SM" storage, send it to the module itself and read the message in the receiving storage.

AT+CMGF=1 ← Select Text Mode
OK

AT+CSMP=17,168,0,240 ← Assume to send a SMS of Class 0
OK

Select how the new received message event is notified by the DCE to the DTE

AT+CNMI=1,1,0,0,0
OK

Store into "SM" the SMS message to be sent to the module itself.

AT+CMGW="+39329X569YYY"
> SEND THE STORED SMS #1 TO THE MODULE ITSELF (close with Ctrl Z or ESC to abort)
+CMGW: 5
OK

Use index 5 to read SMS #1 from "SM" storage type.

AT+CMGR=5
+CMGR: "STO SENT","+39329X569YYY","WIND SIM"
SEND THE STORED SMS # 1 TO MODULE ITSELF
OK

Send the stored SMS #1using the storage position 5 returned by the previous command.

AT+CMSS=5
+CMSS: 78
OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: "SM",6

Check the current SMS storage type.

AT+CPMS?
+CPMS: "SM",6,30,"SM",6,30,"SM",6,30
OK

Use index 6 to read received SMS #1 from "SM" storage memory.

AT+CMGR=6
+CMGR: "REC UNREAD","+39329X569YYY","WIND SIM","08/04/21,09:56:38+08"
SEND THE STORED SMS # 1 TO THE MODULE ITSELF
OK

Use index 6 to read again received SMS #1 from "SM" storage memory.

AT+CMGR=6
+CMGR: "**REC READ**","+39329X569YYY","WIND SIM","08/04/21,09:56:38+08"
SEND THE STORED SMS # 1 TO THE MODULE ITSELF
OK

4.1.7. Send a Stored SMS

A SMS stored in the "SM" storage type is sent using the following AT command. Its storage location index is needed.

AT+CMSS=<index>

Example

Send the stored SMS to the module itself:

Select Text Mode

AT+CMGF=1
OK

Select “SM” storage to read SMS

AT+CPMS=”SM”
+CPMS: 1,50,1,50,1,50
OK

Read the SMS stored on position 1.

AT+CMGR=1
+CMGR: “STO SENT”,”+39329X569YYY”,”WIND SIM”
SEND THE STORED SMS # 1 TO MODULE ITSELF
OK

Select how the new received message event is indicated by the DCE to the DTE.

AT+CNMI=1,1,0,0,0
OK

Send the stored SMS # 1 message to module itself.

AT+CMSS=1
+CMSS: 79
OK

The module itself receives the SMS #1, the following unsolicited indication is shown on DTE:

+CMTI: “SM”,2

4.1.8. Delete an SMS

Use the following AT command to delete an SMS stored on the “SM” storage type.

AT+CMGD=<index>

Example

Deleting an SMS stored in “SM” storage type:

AT+CPMS=”SM” ← Select memory storage
+CPMS: 13,50,13,50,13,50
OK

AT+CMGD=? ← Check the SMS
+CMGD: (1,2,3,4,5,6,7,8,9,10,11,12,13),(0-4)
OK

Delete SMS in memory position 1.

AT+CMGD=1
OK

Check if the SMS is deleted:

AT+CMGD=?
+CMGD: (2,3,4,5,6,7,8,9,10,11,12,13),(0-4)
OK

Delete all SMS. Disregard the first parameter of the +CMGD.

AT+CMGD=1,4
OK

AT+CMGD=?
+CMGD: (),(0-4)
OK

4.1.9. Read an SMS

An SMS is read with the following command:

AT+CMGR=<index>

Example

AT+CPMS?
+CPMS: “SM”,1,50,”SM”,1,50,”SM”,1,50
OK

Read the SMS #1, for the first time, in storage memory “SM”, position 1:

AT+CMGR=1
+CMGR: “STO SENT”,”+39329X569YYY”,”WIND SIM”
SEND THE STORED SMS # 1 TO MODULE ITSELT
OK

4.1.10. SMS Status

SMSs can be gathered into 5 different groups depending on their Status:

- REC UNREAD: received messages still not read
- REC READ: received messages already read
- STO UNSENT: written messages not yet sent

- STO SENT: written messages already sent
- ALL: all types of messages

Use the following AT command to query the SMS status:

AT+CMGL=<stat>

Check if Text Mode is active

AT+CMGF?
+CMGF: 1 ← Text Mode is active
OK

Check the supported SMS status

AT+CMGL=?
+CMGL: (“REC UNREAD”,”REC READ”,”STO UNSENT”,”STO SENT”,”ALL”)
OK

Check the available SMS storage type

AT+CPMS?
+CPMS: “SM”,6,30,”SM”,6,30,”SM”,6,30
OK

List all the SMSs stored on “SM” storage with their Status.

AT+CMGL=”ALL”
+CMGL: 1,”REC READ”, •••• SMS body ••••
+CMGL: 2,”REC READ”, •••• SMS body ••••
+CMGL: 3,”REC READ”, •••• SMS body ••••
+CMGL: 4,”STO SENT”, •••• SMS body ••••
+CMGL: 5,”STO SENT”, •••• SMS body ••••
+CMGL: 6,”REC READ”, •••• SMS body ••••
OK

List the SMSs stored on “SM” storage with their Status=STO SENT

AT+CMGL=”STO SENT”
+CMGL: 4,”STO SENT”, •••• SMS body ••••
+CMGL: 5,”STO SENT”, •••• SMS body ••••
OK

4.1.11. Cell Broadcast Service

GSM Standard specifies two different types of SMS:

- SMS Point to Point (SMS/PP),
- SMS Cell Broadcast (SMS/CB).

The first type can send a text message long up to 160 characters from a module to the another (as stated on the previous paragraphs), the second type allows the Network to send, at the same time, a message to all modules contained in the defined area including one or more radio cells. The availability and the implementation of the Cell Broadcast Service are strictly connected with the Network Operator of the subscriber.

Use the following AT command to enable the Cell Broadcast Service:

AT+CSCB=[<mode>[,<mids>[,<dcss>]]]

Select Text Mode.

AT+CMGF=1
OK

Select the District service.

AT+CSCB=0,50,0
OK

Select how the new received message event is indicated by the DCE to the DTE.

AT+CNMI=2,0,2,0,0
OK

After a while the “District” broadcast message is displayed on the DTE.

+CBM: 24,50,1,1,1
TRIESTE

+CBM: 4120,50,2,1,1
TRIESTE

+CBM: 8216,50,1,1,1
TRIESTE

+CBM: 12312,50,2,1,1
TRIESTE

The network operator can provide the following list of Services, it is not mandatory:

<mids>	**Service name**
000	Index
010	Flashes
020	Hospitals
022	Doctors
024	Pharmacy
030	Long Distant Road Reports
032	Local Road Reports
034	Taxis
040	Weather
050	District
052	Network Information
054	Operator Services
056	Directory Inquiries (national)
057	Directory Inquiries (international)
058	Customer Care (national)

059	Customer Care (international)

4.2. Phonebooks

The user can access the different Phonebook types, stored on the SIM card or on the NVM memory, by means of the dedicated AT commands. The modules support the Phonebooks described in the following sub-chapters.

4.2.1. Phonebook types

The choice of the Phonebook type must be the first Phonebook operation. Once storage is selected, it is no longer needed to select it again until the desired storage remains the same, and the module is not turned off.

<storage>

- **"SM" - SIM Phonebook:** is used to store and recall phone numbers.
- **"FD" - SIM Fixed Dialing-Phonebook:** It is accessible by means of the PIN2 code. E.g.: if the "FD" storage holds the following string numbers 0432, 040, the module can call only phone numbers starting with one of the two string numbers.
- **"LD" - SIM Last-Dialing-Phonebook:** is the list of the last dialed phone numbers; it is updated automatically in SIM. +CPBW command can be only used to delete phone numbers.
- **"MC" - NVM Missed-Calls-Phonebook:** is the list of the received calls not answered. It is updated automatically. +CPBW command can be only used to delete phone numbers.
- **"RC" - NVM Received-Calls-List:** is the list of the received and answered calls. It is updated automatically. +CPBW command can be only used to delete phone numbers.
- **"DC" - NVM Last-Dialing-Phonebook:** is the list of the last dialed phone numbers stored on the module (NVM); it is updated automatically. +CPBW command can be only used to delete phone numbers.
- **"MB" - SIM Mail-Box-List:** is a read only list of the phone mailbox numbers. The MB must be supported by SIM.
- **"ME" - NVM Module Phonebook:** is used to store and recall phone numbers.
- **"EN" - SIM Emergency List:** is a read only list of the emergency phone numbers stored on SIM.
- **"ON" - SIM Own Number:** is the list of the SIM numbers, e.g.: SIM number for voice call and SIM number for data call.
- **"SD" - SIM Service Dialling Numbers:** (SDN) phonebook. +CPBW is not applicable for this storage.

4.2.2. Select Phonebook Memory Storage

Use the following AT command to select the Phonebook Memory Storage:

AT+CPBS=<storage>

Examples

AT+CPBS=? ← Read the supported range of Phonebook Storages
+CPBS: ("SM","FD","LD","MC","RC","DC","ME","EN","ON","MB","SD")

OK

AT+CPBS? ← Read the current phonebook storage
+CPBS: “SM”,19,250

OK

4.2.3. Search Phonebook Entries

Use the following AT command to search a Phonebook entry.

AT+CPBF=<findtext>

Examples

Read the current Phonebook storage and select “SM” storage:

AT+CPBS?
+CPBS: “MC”,0,20
OK

AT+CPBS=”SM”
OK

AT+CPBS?
+CPBS: “SM”,10,250
OK

Look for entries having name starting with “FA” on the selected storage:

AT+CPBF=”FA”
+CPBF: 7,"+39404192",145,"Fabio",0,"","",129,"","”
+CPBF: 9,"040492",129,"Fabrizio",0,"","",129,"","”

OK

Look for an entry not present on the selected storage. Before doing that verify if the Extended Error result code is enabled.

AT+CMEE?
+CMEE: 2

OK

AT+CPBF=”FAUSTO”
+CME ERROR: not found

The search for <name> string is not case sensitive and the string may or may not be included in double brackets.

4.2.4. Read Phonebook Entries

Use the following AT command to read a Phonebook entry:

AT+CPBR=<index1>[,<index2>]

Select “SM” storage:

AT+CPBS=”SM”
OK

Look for the entry at the position index = 7:

AT+CPBR=7
+CPBR: 7,"+39404192",145,"Fabio",0,"","",129,"","",""

OK

Look for the entries from position 7 up to position 9:

AT+CPBR=7,9
+CPBR: 7,"+39404192",145,"Fabio",0,"","",129,"","",""
+CPBR: 9,"040492",129,"Fabrizio",0,"","",129,"","",""

OK

The position 8 is empty.

4.2.5. Write Phonebook Entry

Use the following AT command to write a Phonebook entry:

AT+CPBW=[<index>][,<number>[,<type>[,<text>[,<group>[,<adnumber>[,<adtype>[,<secondtext>[,<email>[,<hidden>]]]]]]]]]

Examples

Select the “SM” phonebook:

AT+CPBS=”SM”
OK

Write a new record on the first free position of the selected “SM” phonebook:

AT+CPBW=,”0404192”,129,”NewRecord”
OK

Check where the new record has been written:

AT+CPBF=”NEW”
+CPBF: 8,"0404192",129,"NewRecord",0,"","",129,"","""

OK

4.2.6. Delete Phonebook Entry

Use the following AT command with only <index> parameter to delete a Phonebook entry:

AT+CPBW=<index>

Examples

Select the “SM” phonebook:

AT+CPBS=”SM”
OK

Delete record 7 on the “SM” phonebook:

AT+CPBW= 7
OK

Try to delete a non-existent record on the “SM” phonebook, just to see the format response:

AT+CPBR=7
OK

The delete command overwrites the <index> record number with an empty record.

4.3. GPIO Pins

Telit Modules provide various GPIO pins, which can be configured, by means of the AT commands, as showed hereafter:

- Inputs,
- Outputs,

User applications, through GPIO AT commands, can control external user equipment connected to GPIO pins. Simple or no circuitries are needed to perform the required hardware interface.

4.3.1. Set GPIO Pin as OUTPUT

Use the following AT command to set a GPIO as output with Low or High status value.

AT#GPIO=<pin>,<value>,1

Set GPIO3 pin as Output with Low status:

AT#GPIO=3,0,1
OK ← GPIO3 pin is set in output; its status is Low

Set GPIO4 pin as Output with High status:

AT#GPIO=4,1,1
OK ← GPIO4 pin is set in output; its status is High

4.3.2. Set GPIO Pin as INPUT

Use the following AT command to set a GPIO as input. A dummy value must be specified for pin status value.

AT#GPIO=<pin>,<dummy_value>,0

Example

Set GPIO3 pin as Input:

AT#GPIO=3,0,0
OK ← GPIO3 pin is set in input

4.3.3. GPIO Pin Status

Use the following AT command to check the pin status.

AT#GPIO=<pin>,2

Set GPIO3 pin as output with Low status.

AT#GPIO=3,0,1
OK

Set GPIO4 pin as input.

AT#GPIO=4,0,0
OK

Now, physically connect GPIO3 with GPIO4, and check the GPIO4 status.

AT#GPIO=4,2
#GPIO: 0,0 ← GPIO4 pin status is Low, as commanded by GPIO3.

Set GPIO3 pin as output with High status.

AT#GPIO=3,1,1
OK

Check the GPIO4 status.

AT#GPIO=4,2
#GPIO: 0,1 ← GPIO4 pin status is High, as commanded by GPIO3.

Check the GPIO3 status.

AT#GPIO=3,2
#GPIO: 1,1

GPIO3 pin is set in Output direction and its status is High.

The AT command response is function of the pin direction:

- input: the command response indicates the current input status
- output: the command response indicates the last setting of the pin status

4.4. Clock

4.4.1. Set Module Clock

Use the following AT command to update the module clock.

AT+CCLK="<time>"

Set up the clock to 7 November 2002 at 12h 24m 30s for the time zone +01h central Europe:

AT+CCLK="02/11/07,12:24:30+04"
OK

The time is successfully set.

The updated time starts immediately after the time setting command.

4.4.2. Read the Current Date and Time

Use the following AT command to display the current module time.

AT+CCLK?

Read the current time:

AT+CCLK?
+CCLK="02/11/07,12:26:47"
OK

Current date/time is: 7 November 2002 12h 26m 47s

Enter the current time: year/month/day,hour:minute:seconds±time zone:

AT+CCLK="08/05/16,09:20:30+00"
OK

Read the current time:

AT+CCLK?
+CCLK: "08/05/16,09:20:52"
OK

The three last characters of <time> are not returned by the command because the used module does not support time zone information.

4.4.3. Automatic Data/Time updating

Use the following AT command to enables or disables the data/time updating. Not all Operators support this feature.

AT#NITZ=<val>,<mode>

Examples

AT#NITZ?
#NITZ: 7,0
OK

AT#NITZ=15,1 enable full data/time updating
OK

AT&W0
OK

AT&P0
OK

Power the module OFF/ON. After GSM registration or GPRS attach, depending on the Network Provider configuration, on the DTE appears the following unsolicited indication:

#NITZ: 10/11/30,14:36:37+04,0 ← date/time and time zone + daylight saving time

Now, type in the following commands just to make a comparison between the commands responses formats.

AT+CCLK?
+CCLK: “10/11/30, 14:36:42+04” ← date/time and time zone
OK

4.5. TCP/IP Protocol

4.5.1. 3G Dialup Connection

The following two sub-chapters describe how to establish a dialup connection. The connection uses the following protocols:

- PPP running on the PC (or Application Equipment), and on the module
- TCP/IP running only on the PC (or Application Equipment)

Check the current network operator.

AT+COPS?
+COPS: 1,0,"network operator",2 ← 2 = UTRAN
OK

Check the current module attachment state.

AT+CGATT?
+CGATT: 1
OK

Use <cid>=1 to configure the PDP context.

AT+CGDCONT=1,"IP","APN"
OK

Type in the dialup command to enter the ONLINE Mode. By default, the command uses the <cid>=1.

ATD*99#
CONNECT

Now, your application should start the PPP protocol, which triggers the PDP context activation.

4.5.2. Default/Dedicated EPS Bearers

In GPRS and 3G networks, the data session is established by means of the Packet Data Protocol (PDP) Context procedure. Before the PDP context can be established, the module must do an Attach procedure, which communicates to the SGSN (Serving GPRS Support Node) that the module has powered up. After the Attach procedure is completed, the module can do the first PDP Context procedure that will establish the data session, and allocate an IP address to the module. This PDP Context will have a QoS associated with it based on the current needs. If the module needs to have multiple data sessions, it will do a second PDP Context activation, and so on.

In LTE (4G) modules there are two types of data session setups.

- **Default Evolved Packet System (EPS) Bearer.**
  When UE attaches to the network for the first time, it will be assigned default bearer that remains as long as UE is attached. UE can have additional default bearers as well. Each default bearer comes with a separate IP address. Default bearer does not have specific QoS (non-GBR bearer).
- **Dedicated Evolved Packet System (EPS) Bearer.**
  It is created when the requested service cannot be fulfilled through default bearer. Some services require a high level of QoS like VoIP, video etc. Therefore, network creates a

dedicated bearer with required QoS (can be GBR or non-GBR). Dedicated bearer does not require separate IP address, only additional default bearer needs an IP address and therefore dedicated bearer is always linked to one of the default bearer established previously.

To have information on AT commands syntax and related parameters refer to document [1].

4.5.2.1. Default EPS Bearer at UE Power on

Example

Power on a LM940 module (4G).

By default, the <p_cid>=1 context identifier is assigned to a not defined APN.

```
AT+CGDCONT?
+CGDCONT: 1,"IPV4V6","","",0,0
OK
```

When the network recognizes the attach request with a not defined APN, the network assigns to <p_cid>=1 its Default EPS Bearer. The UE is 4G attached.

```
AT+CGATT?
+CGATT: 1
OK
```

After the Attach procedure, the <p_cid>=1

identifies the PDP context assigned by the network.

```
AT+CGACT?
+CGACT: 1,1
OK
```

List the parameters regarding the Default PDP Context assigned by the network, and associated to <p_cid>=1 context identifier.

```
AT+CGCONTRDP=1
+CGCONTRDP:
1,                                  p_cid
5,                                  bearer_id
"lte.tim.it.mnc001.mcc222.gprs",    apn
"10.178.43.36",                     ip_addr
,                                   gw_addr
"213.230.129.10",                   DNS_prim_addr
"168.126.63.1",                     DNS_sec_addr
OK
```

The functionalities (Data, IMS) of the Default PDP context assigned by the network, depend on the Network Operator.

When the <p_cid>=1 is associated to a user APN, i.e. the APN is not empty, that APN is used by the module during the 4G registration and data connection procedures. Some Network Operators could not allow the 4G registration when the user APN is used, and they could force a detach. If this happens, it is recommended to set the user APN on a <p_cid> different from 1 and keep on <p_cid> 1 the empty APN.

4.5.2.1.1. Change a Default EPS Bearer at UE Power on

Following these steps, you can substitute the Default EPS Bearer with a user PDP Context.

Set up the new PDP Context associated to <p_cid>=1.

```
AT+CGDCONT=1,"IP","ibox.tim.it"
OK
```

Check the setting of the new PDP Context.

```
AT+CGDCONT?
+CGDCONT: 1,"IP","ibox.tim.it","",0,0
OK
```

Detach the UE from the network.

```
AT+CGATT=0
OK
```

Attach the UE. In a 4G network, the new PDP Context associated to <p_cid>=1 is automatically activated.

```
AT+CGATT=1
OK
```

List the parameters regarding the new Default EPS Bearer set and activated by the user.

```
AT+CGCONTRDP=1
+CGCONTRDP:
1,                                  p_cid
5,                                  bearer_id
"ibox.tim.it.mnc001.mcc222.gprs",   apn
"2.192.4.65",                       ip_addr
,                                   gw_addr
"10.207.43.46",                     DNS_prim_addr
"10.205.56.223",                    DNS_sec_addr
OK
```

The UE saves the Default EPS Bearer parameters in NVM. At each reboot, the Protocol Stack uses them.

Now, reboot the module and verify the PDP Context.

```
AT+CGDCONT?
+CGDCONT: 1,"IP","ibox.tim.it","",0,0
OK
```

4.5.2.2. Establish a Default EPS Bearer

The following AT commands can establish a Default EPS Bearer:

- **AT+CGACT**
  Establishes a Default EPS Bearer. If the module (UE) is not attached, it does the Attached procedure and then activates the PDP Context.
- **ATD**
  Establishes a Default EPS Bearer. It provides a dialup connection: PPP protocol is used to exchange data between the PC (or Application Equipment) and the module (UE), the TCP/IP stack is running on the module.

The AT commands shown in this chapter cannot use together the same <cid>.

4.5.2.2.1. IP Easy Connection

Example 1

Assume that the Default EPS Bearer associated to the <p_cid>=1 is "IP","ibox.tim.it".

```
AT+CGDCONT?
+CGDCONT: 1,"IP","ibox.tim.it","",0,0
OK
```

Check if the UE is registered on a 4G network.

```
AT+COPS?
+COPS: 0,0,"I TIM",7            ← 7 = E-UTRAN
OK
```

Check if the Default EPS Bearer is active

```
AT+CGCONTRDP=?
+CGCONTRDP: (1)
OK
```

Check the IP address

```
AT+CGPADDR=
+CGPADDR: 1,"2.192.16.194"
OK
```

4.5.2.2.2. Dialup Connection

It is legacy method to access internet service using public switched telephone network. The DTE uses an attached modem to send and receive internet protocol packets. So, it is limited to support high speed data rate over LTE technology. Not recommend to use this method for internet access.

Example

Use COM1 port to enter the next commands, and assume that the Default EPS Bearer associated to the <p_cid>=1 is "IP","ibox.tim.it".

AT+CGDCONT?
+CGDCONT: 1,"IP","ibox.tim.it","",0,0
OK

Check if the UE is registered on a 4G network.

AT+COPS?
+COPS: 0,0,"I TIM",7 ← 7 = E-UTRAN
OK

Check if the Default EPS Bearer is active

AT+CGCONTRDP=?
+CGCONTRDP: (1)
OK

Enter the following command to force the UE in the ONLINE Mode. The command uses the <cid>=1.

ATD*99*1#**
CONNECT

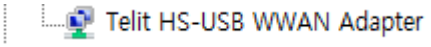
Now, your application should start the PPP protocol.

4.5.2.2.3. Mobile Broadband Networking(RmNet)

RmNet is a proprietary USB virtual Ethernet framework developed by Qualcomm for its mobile phone platforms. RmNet provides for improved throughput via the Thin Layer Protocol(TLP) and allows for Quality of Service flow control.

To support LTE high speed data rate, this product provides mobile broadband USB interface where DTE can be experienced high quality data service over LTE technology without any limitation.

This network interface is configured on Device Manager of Windows once USB driver is installed, followed by this product being connected to DTE using USB cable



Connecting to mobile broadband networking is possible through “Control” ->”Network and Internet” ->”Network Connection” over Windows

It is strongly recommended that application supports RmNet technology to experience LTE high speed date rate.

4.6. GNSS operation

4.6.1. Introduction

The LM940 module is equipped with gpsOne that is controllable by the modem using a set of AT commands or dedicated NMEA sentences.

4.6.2. LM940 Serial Ports

4 serial ports are available on the module:

- MODEM #1 USB SERIAL PORT
- MODEM #2 USB SERIAL PORT
- AUX USB SERIAL PORT
- NMEA USB SERIAL PORT

4.6.3. WGS 84

GPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. For LM940 the default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map dates. (Local map dates are a best fit to the local shape of the earth and not valid worldwide)

4.6.4. NMEA 0183

The NMEA 0183 is a specification created by the National Marine Electronics Association (NMEA) that defines the interface between other marine electronic equipment. The standard permits marine electronics to send information to computers and to other marine equipment. GPS receiver communication is defined within this specification. The actually supported version is 4.10.
The provided NMEA sentences are:
GGA GPS Fix Data. Time, position and fix type data.
GLL Geographic Position - Latitude/Longitude
GSA GPS receiver operating mode, satellites used in the position solution and DOP values.
GSV The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC Time, date, position, course and speed data.
VTG Course and speed information relative to the ground

The NMEA USB port provides the following sentences with $GPSNMUN command: GGA, GLL, GSA, GSV, RMC, VTG.

4.6.4.1. GGA – Global Position System Fixed Data

This sentence provides time, position, and fixes related data for a GPS Receiver. Table A contains the values for the following example:
$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18

Table A: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table B
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Units	M	meters	
Geoid Separation		meters	
Units	M	meters	

Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

Table B : Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid
4	Real Time Kinematic
5	Float RTK
6	Estimated (dead reckoning) Mode
7	Manual Input Mode
8	Simulator Mode

4.6.4.2. GLL - Geographic Position - Latitude/Longitude

This sentence provides latitude and longitude of vessel position, time of position fix and status. Table C contains the values for the following example:

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41

Table C: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=Autonomous mode D= Differential mode E=Estimated (dead reckoning) mode M=Manual input mode S=Simulator mode N=Data not valid (Only present in NMEA version 3.00)
Checksum	*41		
<CR> <LF>			End of message termination

4.6.4.3. GSA - GNSS DOP and Active Satellites

This sentence reports the GPS receiver's operating mode, satellites used in the navigation solution reported by the GGA sentence and DOP values. Table D contains the values for the following example:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33

Table D: GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table E
Mode 2	3		See Table F
Satellite Used1. Satellite used in solution.1	07		Sv on Channel 1
Satellite Used1	02		Sv on Channel 2
....			
Satellite Used1			
PDOP	1.8		
HDOP	1.0		
VDOP	1.5		
Checksum	*33		
<CR> <LF>			End of message termination

Table E: Mode 1

Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Table F: Mode 2

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

4.6.4.4. GSV - GNSS Satellites in View

This sentence reports the number of satellites (SV) in view, satellite ID numbers, elevation, azimuth and SNR value. There could be four satellites information per transmission so; if the number of satellites in view is bigger, separated GSV sentences will be generated. The number of sentence in transmission and the total to be transmitted is shown in the first 2 fields of the sentence. Table G contains the values for the following example:

$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71
$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41

Table G: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	2		Range 1 to 3
Message Number1	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)

Elevation	79	degrees	
Azimuth	048	degrees	
SNR (C/No)	42	dBHz	
....	....	....	
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR> <LF>			End of message termination

4.6.4.5. RMC - Recommended Minimum Specific GNSS Data

This sentence reports Time, date, position, and course and speed data. Table H contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10

Table H: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	120598		ddmmyy
Magnetic Variation		degrees	E=east or W=west
Mode	A		A=Autonomous, D=DGPS, E=DR
Checksum	*10		
<CR> <LF>			End of message termination

4.6.4.6. VTG - Course over Ground and Ground Speed

This sentence reports the actual course and speed relative to the ground.
Table I contains the values for the following example:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K,A*23

Table I: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62		Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	knots	Measured horizontal speed
Units	N	Knots	
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour

Mode	*A*		*A=Autonomous, D=DGPS, E=DR*
Checksum	*23		
<CR> <LF>			End of message termination

4.6.5. Checking GNSS Device Functionality

After a proper power on, the device is ready to receive AT commands on the MODEM serial port.
When the **$GPSP** command is issued, The GNSS receiver also will be powered on and it will start the scan of the available GNSS signals.
On the NMEA USB port (default 115200 bps, 8, n, 1) there must be presence of the NMEA sentences when the **$GPSNMUN** command is issued.

4.6.6. Controlling GNSS Receiver

The LM940 module is provided by a set of AT commands that permits to configure and use it through the MODEM serial port.

4.6.6.1. Power Control of GNSS Receiver

The GNSS receiver is by default switched off at the first power on. If is necessary to switch it on or off is possible to use the AT$GPSP command. The GNSS receiver is usable if the module is switched on (or at least in power saving). This command also switches off the GNSS antenna supply.
Syntax of the command **AT$GPSP=<status>**
Where:
<status> - 0 GPS controller is powered down(default), 1 GPS controller is powered up, ? Returns the range of values accepted

AT$GPSP? will return the current status.
Example 1: (to switch on the GNSS)
AT$GPSP=1<CR>
OK

Example 2: (to know the status)
AT$GPSP?<CR>

The answer will be:
$GPSP: 0
OK

4.6.6.2. GNSS Reset

With the command **AT$GPSR=<reset_type>** is possible to reset the GNSS module.
Parameter:
<reset_type>

0 - Factory reset: This option clears all GPS memory including clock drift. It is available in controlled mode only.

1 - Coldstart (No Almanac, No Ephemeris): this option clears all data that is currently stored in the internal memory of the GPS receiver including position, almanac, ephemeris, and time. The stored clock drift however, is retained. It is available in controlled mode only.

2 - Warmstart (No ephemeris): this option clears all initialization data in the GPS receiver and subsequently reloads the data that is currently displayed in the Receiver Initialization Setup screen. The almanac is retained but the ephemeris is cleared. It is available in controlled mode only.

3 - Hotstart (with stored Almanac and Ephemeris): the GPS receiver restarts by using the values stored in the internal memory of the GPS receiver; validated ephemeris and almanac. It is

available in controlled mode only.

Example:
It is available in controlled mode only.
AT$GPSP=1<CR>
OK

Let's suppose to perform a cold start of the GNSS receiver.
AT$GPSR=1<cr>
OK

The Receiver will clear all the parameters in its memory and it will start a new scanning of the available satellites.

4.6.6.3. GNSS Antenna Management

The GNSS receiver needs an active antenna. This antenna could be supplied by the module. 3.1V DC power is supplied to the GNSS antenna port. By default the antenna supply is set to OFF.
Refer to the following **$GPSANTPORT** command to configure the port and type of GNSS antenna.
The syntax is AT$ GPSANTPORT=<type>
Parameter:

<type> : Enabled Port type

0 – Disable GNSS on AUX Port and GNSS Port. (*GNSS Off*)
1 – Enable GNSS son AUX Port and disable GNSS on GNSS Port. (*Passive antenna on Aux Port*)
2 – Enable GNSS on GNSS Port and disable GNSS on AUX Port; DC-Bias Off. (*Passive antenna on GNSS Port*) (**Default**)
3 – Enable GNSS on GNSS Port and disable GNSS on AUX Port; DC-Bias On. (*Active antenna on GNSS Port*)
4 – Enable GNSS on GNSS Port, disable GNSS on AUX Port; High Gain Mode, DC-Bias On. (*Active antenna on GNSS Port, High Gain*)

4.6.6.4. GNSS Parameters Save

This command allows saving the set parameters in the module's memory
Syntax of the command
AT$GPSSAV

4.6.6.5. Restore GNSS Parameters

This command allows restoring the factory default parameters for the GNSS module
Syntax of the command:
AT$GPSRST

After this command should restart the module to update the modifications.

If the GPS controller is powered up (see $GPSP), the GPS controller is powered down because the GPS parameters should be reset with factory default.

4.6.6.6. Read Acquired GNSS position

This command allows reading the acquired position of the GNSS receiver
Syntax of the command

AT$GPSACP

The response syntax is:

$GPSACP:<UTC>,<latitude>,<longitude>,<hdop>,<altitude>,<fix>,<cog>,<spkm>,<spkn>,<date>,<nsat>

The fields contain the following information:

<UTC>: (referred to GGA sentence)
hhmmss UTC of Position
Values:
hh (hour) 00 to 23
mm (minutes) 00 to 59
ss (seconds) 00 to 59
<latitude>: (referred to GGA sentence)
ddmm.mmmm N/S
Values:
dd (degrees) 00 to 90
mm.mmmm (minutes) 00,0000 to 59.9999
N/S: North / South
<longitude>: (referred to GGA sentence)
dddmm.mmmm E/W
Values:
ddd (degrees) 00 to 180
mm.mmmm (minutes) 00,0000 to 59.9999
E/W: East / West
<hdop>: (referred to GGA sentence)
x.x Horizontal Diluition of Precision
<altitude>: (referred to GGA sentence)
xxxx.x Altitude - mean-sea-level (geoid) (meters)
<fix>:
0 - Invalid Fix
2 - 2D fix
3 - 3D fix
<cog>: (referred to VTG sentence)
ddd.mm Course over Ground (degrees, True)
Values:
ddd: 000 to 360 degrees
mm 00 to 59 minutes
<spkm>: (referred to VTG sentence)
xxxx.x Speed over ground (Km/hr)
<spkn>: (referred to VTG sentence)
xxxx.x Speed over ground (knots)
<date>: (referred to RMC sentence)
ddmmyy Date of Fix
Values:
dd (day) 01 to 31
mm (month) 01 to 12
yy (year) 00 to 99 (2000 to 2099)
<nsat>: (referred to GSV sentence)
nn Total number of satellites in use
Example:

$GPSACP:080220,4542.82691N,01344.26820E,259.07,3,2.1,0.1,0.0,0.0,270705,09
OK

5. QMI COMMAND

This chapter describes the QUALCOMM® MSM™ Interface (QMI) architecture and framework. The QMI allows applications on attached Terminal Equipment (TE) devices to access various Services provided by devices based on QUALCOMM's MSM chipsets and AMSS software.

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5.1. QMI Framework

QMI framework defines an interface between the TE and a processor running AMSS, enabling applications on the tethered processor to make use of functionality on the AMSS processor.

The QMI framework is composed of:

- Properties of the interconnection between an MSM chipset and the TE, including orthogonal control and data channels
- An enumeration of logical devices emulated by the MSM device over the interconnection
- A messaging protocol for messaging on the control channels of each logic device that allows applications running on the TE to access MSM-based Services

Figure 5.1 illustrates the layering of the QMI between the applications executing on a TE device and the MSM device.

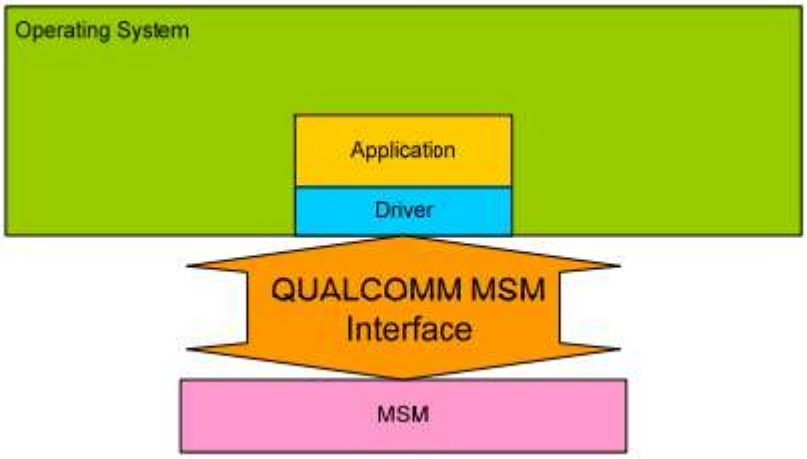


Fig. 5.1: QUALCOMM MSM interface

5.1.1. MSM-TE interconnection

QMI connects an MSM device to the TE (see Figure 5.2). The term TE is inclusive of all form factors, including devices such as PCs, notebooks, PDAs, and smartphones. The TE consists of an application environment (and possibly an operating system) executing on a separate processor, which is connected to the MSM processor via some form of interconnect.

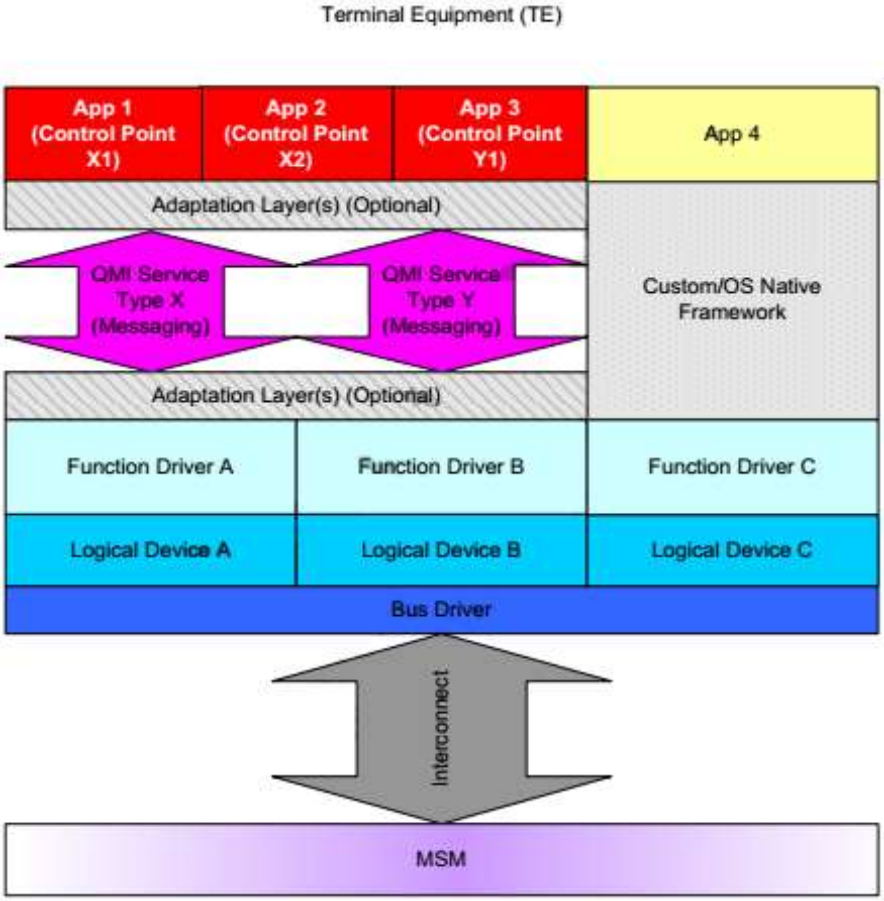


Fig. 5.2: QMI architecture

The TE can be attached to the MSM over various bus interconnects, e.g., serial buses like USB, RS-232, PCI, or PCMCIA; wireless links like Bluetooth® or 802.11; shared memory interfaces, etc.

Regardless of which interconnect is used, QMI enumerates a number of logical devices. The interconnection must provide a mechanism for multiplexing multiple logical devices over a single physical connection.

Each logical device consists of at least one communication channel, and the underlying interconnect must provide for independent data and control communication channels for each logical device. Channel independence implies that each channel must act as if there were no physical coupling between the communication channels, including (but not limited to) separate Tx and Rx path queuing, independent flow control mechanisms, and independent data transmission scheduling.

A logical device uses at least one communication channel but need not have both (see Figure 5.3). For example, the existing MSM diagnostic interface consists of a data channel only.

For both QMI control and data channels, the interconnection must provide for framing of messages exchanged, i.e., delineating packet boundaries to the transport protocol (e.g., 802.3).

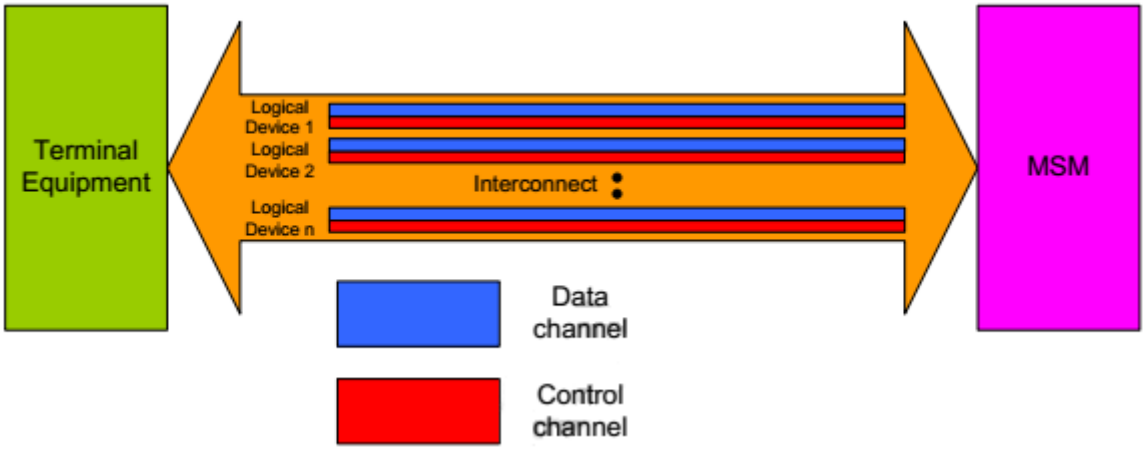


Fig. 5.3: QMI MSM-TE interconnection

5.1.2. Logical device enumeration

Logical devices include both those that leverage QMI messaging protocols, such as an Rm network (RmNet) device.

Existing non-QMI devices are enumerated as well, such as:

- Legacy modem device
- Diagnostic interface
- NMEA device

Each logical device that is capable of exchanging QMI messages must provide orthogonal data and control channels. QMI messages are exchanged on the control channel.

The RmNet device presents an IP network interface to the TE provided by the wireless data-enabled QMI device.

5.1.3. Control channel messaging protocol

The QMI defines the protocol for communication over the control channel of a QMI logical device, consisting of:

- The QMUX transport protocol, which carries all control channel messages
- A communication reference model defining communication endpoints known as Control Points and Services, described below message definition; all QMI Service interfaces, including Services that conform to this generalized Service protocol and also custom QMI Services, are outside the scope of this document and are described in detail in their own specification document

- A special QMI_CTL Service that is used by the QMI drivers on both the TE and MSM devices to negotiate client IDs and special control Services; QMI_CTL conforms to general

Each logical device that is capable of exchanging QMI messages must provide orthogonal data and control channels. QMI messages are exchanged on the control channel.

5.1.3.1. Endpoint model

Applications and device drivers on the TE communicate with a QMI-enabled MSM device by exchanging QMI Service messages over the QMUX transport protocol. These control messages are sent on the control channel of a QMI logical device (see Figure 5.4).

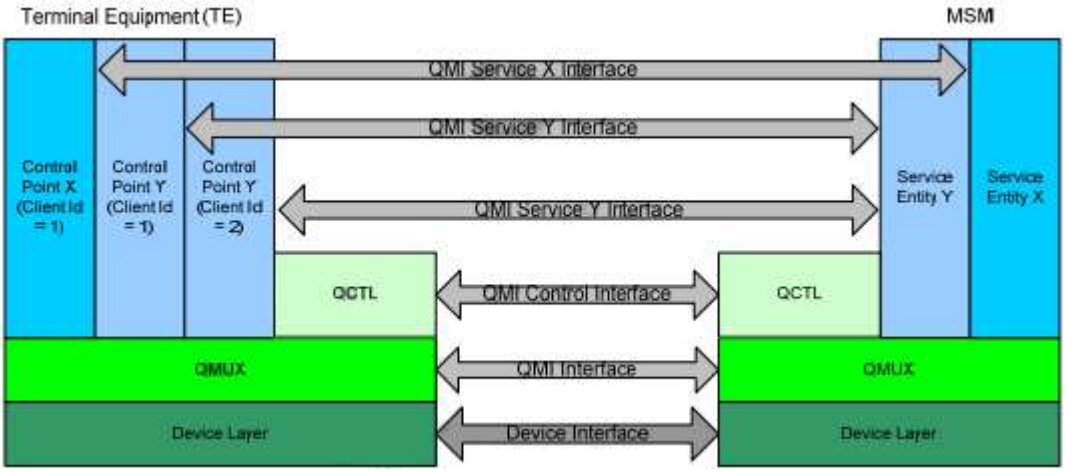


Fig. 5.4: QMI control channel messaging endpoint model

All controlling applications are referred to as Control Points. A Control Point is a client of a particular QMI Service.

The software module that receives the QMI Service message and performs the function is referred to as a QMI Service.

A Control Point is to the Service as a client is to a server in the standard software engineering client/server model.

If an application makes use of several QMI Services, it will comprise a Control Point for each of the utilized Services.

5.1.4. Usage

Connection manager applications and device drivers on the TE are expected to interface to the QMI-enabled MSM device using QMI Service protocols.

Other applications on the TE may also be capable of using QMI Services.

5.2. QMI Generalized Service Message Protocol

This chapter describes the generalized message format and procedures that QMI Services should follow to ease implementation.

If a particular QMI Service diverges from this protocol, the corresponding QMI Service specification will document the superseding message format and/or procedures for that particular Service.

5.2.1. Service message format

5.2.1.1. QMI message structure

A single QMI Service message is formatted as described in Figure 5.5.

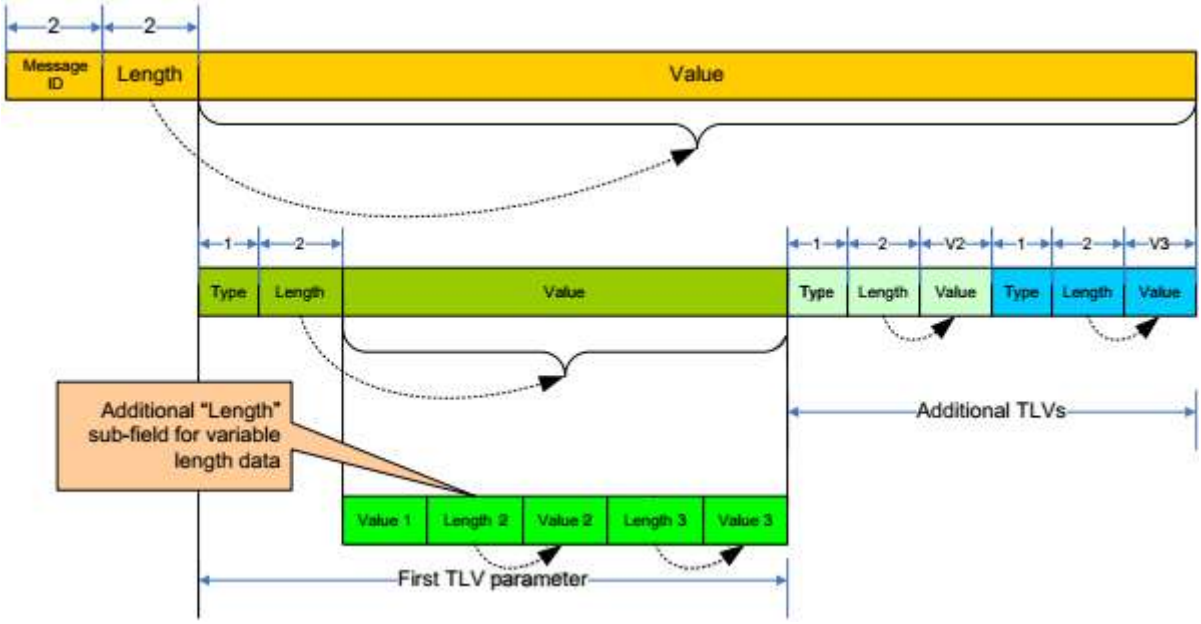


Fig. 5.5: Generalized QMI Service message and parameter formats

The QMI Service messages are distinguished by QMI message ID.

Each QMI Service type has its own set of QMI messages, defined in the QMI Service specification document.

The same message ID value is used in corresponding request and response messages. If an indication message is defined corresponding to the request and response, it will share the same message ID value.

The length field following the message ID indicates the total number of bytes in the message following the length field, i.e., the total length of all parameters included in the message.

The value portion of the message consists of zero or more parameters associated with the message. The value typically contains the information required to execute the requested action or results of the action.

5.2.1.2. QMI message parameter structure

Figure 5.5 illustrates parameters within the value portion of the QMI message.

Message parameters are defined separately for each request, response, or indication message. Message parameters are formatted with three sections, type, length, and value. Because of this, message parameters are sometimes referred to as TLVs.

5.2.1.2.1. Parameter types

The parameter type field indicates which parameter is being specified.

A unique TLV parameter type is defined for each parameter that may be specified within a given message type. The same parameter type may have a different meaning in the context of other messages.

5.2.1.2.2. Parameter length

The parameter length indicates the length in bytes of the following value field.

The expected length will be documented per parameter in the QMI Service specification. This will be a fixed value when the value field is a fixed structure. If the parameter contains a string or other variable-length data, this will be defined as a calculated value. For example, if the value section includes a variable length string, the length field will tell the receiver how many bytes are in that string.

5.2.1.2.3. Parameter value

The value of a parameter contains the actual information communicated by including the parameter in the message.

The entire parameter, as defined in the Service specification, must be present. Any flexibility in format of the value portion of the parameter will be described in the parameter value description. All numeric data are positive (unsigned) binary values unless stated otherwise in the parameter description.

5.2.2. QMI message types

The generalized QMI Service transaction format defines three basic message types. All three message types follow the generalized QMI Service message format described in Section 5.2.1.1.

5.2.2.1. Request

A request message may be used to set parameters, query parameter values, or configure the generation of indications.

The request message is issued by the Control Point.

A valid request always generates a response from the Service.

5.2.2.2. Response

A response message is issued by the Service, in response to a received request.

Each response contains at least the result parameter indicating that the request succeeded or failed, and the error status, indicating the result of the operation requested. Additional parameters may be present to communicate data associated with the operation.

5.2.2.3. Indication

An indication is sent by a QMI Service to inform Control Point(s) of changes in state.

The indication message is issued by the Service without any solicitation by a Control Point.

5.2.2.3.1. Unicast vs. broadcast indications

Indications from the Service are either broadcast to all Control Points or unicast to a specific Control Point. Indication type is indicated by the value of the client ID field in the QMUX header.

The definition of the indication message (in the associated QMI Service specification document) specifies whether it shall be unicast or broadcast.

5.2.3. State variables

QMI Services may keep track of state related to the internal functionality accessed through that Service in Service global state variables. The Service may also keep track of Control Point settings and state in Control Point state variables.

When a Control Point is allocated a new client ID, and when that client ID is released, that client ID's state variables are set to the default settings.

Upon powerup, and when the QMI link is disconnected, Service global state variables are reset to their default settings.

The handling of state variables and their impact on the system is described in the QMI Service specification document.

5.2.4. Control Point arbitration

It is possible to have multiple Control Points interact with a single Service on the QMI device.

In cases where multiple Control Points issue messages related to a common resource, the default policy is that the actions will be executed in the order received; hence, the “last request wins.”

In some cases, more careful arbitration of a common resource is managed by keeping track of Control Point requests via state variables. In such cases, the message definition may describe any the arbitration policy for the common resource.

5.2.5. QMI Service versioning

QMI Control Points and QMI Services are written to a particular version of a QMI Service specification document. Since the Service specifications are compiled to over time, Control Points may want to know the Service version implemented on a device, to know whether specific functionality within the Service is supported.

5.2.5.1. Version format

Each QMI Service has its own version number that is independent of other QMI Services. A QMI Service version is represented as M.n where:

- M = major version, 2 bytes
- n = minor version, 2 bytes

5.2.5.2. Learning QMI Service versions

The QMI driver on the TE provides an API to learn the Service version.

5.2.5.3. Service versioning rules

5.2.5.3.1. Major versions

As the major version of the Service is incremented, the Service specification is changed in a way that breaks backward compatibility with the previous version.

Control Points should not assume interoperability with a Service that has a different major version.

A QMI Service is required only to support one major version of a QMI Service. A QMI Service may implement multiple major versions of a QMI Service.

5.2.5.3.2. Miner versions

The minor version of the Service is incremented when the Service specification is modified without breaking backward compatibility with previous versions sharing the same major revision number.

Control Points may assume interoperability with a Service that has a different minor version.

5.2.5.4. Message and parameter updates

Each message definition will indicate the QMI Service version in which it was first defined. The Control Point should consider this the minimum required Service version to carry out the operation associated with that request.

Each parameter definition will indicate the QMI Service version in which it was last modified. Since the backward compatibility requirement implicit to QMI ensures that parameters will not be changed in a way that renders an older minor revision incompatible, it is not critical for the application to take action based on the last modified version. This is provided as a quick means for the application writer to identify updated fields in a newer Service specification that might be handled by the application; however, the application will work without implementing any of these changes.

5.3. Common Constant Definitions (QMI_COMMON)

QMI_COMMON enumerates the global constant definitions used by all QMI services. The definitions include enumerated values for QMI service types, result codes, and error codes.

5.3.1. QMI service type values

Table 5.1 lists QMI service type values that are currently defined. These values are used to specify to which QMI service the messages are routed.

Table. 5.1: QMI service and values

QMI service	QMI service type value
QMI_CTL (Control Service)	0x00
QMI_WDS (Wireless Data Service)	0x01
QMI_DMS (Device Management Service)	0x02
QMI_NAS (Network Access Service)	0x03
QMI_WMS (Wireless Messaging Service)	0x05
QMI_UIM (User Identity Module Service)	0x0B
QMI_LOC (Location Service)	0x10
QMI_PDC (Persistent Device Configuration Service)	0x24
QMI_FOTA(Firmware Over The Air Service)	0xE6
QMI_GMS (Telit General Modem Service)	0xE7
QMI_GAS (Telit General Application Service)	0xE8

5.3.2. QMI result codes

For QMI services that conform to the generalized QMI service message protocol, the result Type-Length-Value (TLV) is present in all response messages. The Result Code TLV consists of two parameters: qmi_result and qmi_error.

5.3.2.1. qmi_result code

The qmi_result parameter contains one of the values in Table 5.2.

Table. 5.2: qmi_result parameter values

Result code	Hex value
QMI_RESULT_SUCCESS	0x0000
QMI_RESULT_FAILURE	0x0001

All other values are reserved for future assignment.

5.3.2.2. qmi_error codes

The qmi_result parameter contains one of the values in Table 5.3.

Table. 5.3: qmi_error parameter values

Error code	Hex value

QMI_ERR_NONE	0x0000
QMI_ERR_MALFORMED_MSG	0x0001
QMI_ERR_NO_MEMORY	0x0002
QMI_ERR_INTERNAL	0x0003
QMI_ERR_ABORTED	0x0004
QMI_ERR_CLIENT_IDS_EXHAUSTED	0x0005
QMI_ERR_UNABORTABLE_TRANSACTION	0x0006
QMI_ERR_INVALID_CLIENT_ID	0x0007
QMI_ERR_NO_THRESHOLDS	0x0008
QMI_ERR_INVALID_HANDLE	0x0009
QMI_ERR_INVALID_PROFILE	0x000A
QMI_ERR_INVALID_PINID	0x000B
QMI_ERR_INCORRECT_PIN	0x000C
QMI_ERR_NO_NETWORK_FOUND	0x000D
QMI_ERR_CALL_FAILED	0x000E
QMI_ERR_OUT_OF_CALL	0x000F
QMI_ERR_NOT_PROVISIONED	0x0010
QMI_ERR_MISSING_ARG	0x0011
QMI_ERR_ARG_TOO_LONG	0x0013
QMI_ERR_INVALID_TX_ID	0x0016
QMI_ERR_DEVICE_IN_USE	0x0017
QMI_ERR_OP_NETWORK_UNSUPPORTED	0x0018
QMI_ERR_OP_DEVICE_UNSUPPORTED	0x0019
QMI_ERR_NO_EFFECT	0x001A
QMI_ERR_NO_FREE_PROFILE	0x001B
QMI_ERR_INVALID_PDP_TYPE	0x001C
QMI_ERR_INVALID_TECH_PREF	0x001D
QMI_ERR_INVALID_PROFILE_TYPE	0x001E
QMI_ERR_INVALID_SERVICE_TYPE	0x001F
QMI_ERR_INVALID_REGISTER_ACTION	0x0020
QMI_ERR_INVALID_PS_ATTACH_ACTION	0x0021
QMI_ERR_AUTHENTICATION_FAILED	0x0022
QMI_ERR_PIN_BLOCKED	0x0023
QMI_ERR_PIN_PERM_BLOCKED	0x0024
QMI_ERR_SIM_NOT_INITIALIZED	0x0025
QMI_ERR_MAX_QOS_REQUESTS_IN_USE	0x0026
QMI_ERR_INCORRECT_FLOW_FILTER	0x0027
QMI_ERR_NETWORK_QOS_UNAWARE	0x0028
QMI_ERR_INVALID_QOS_ID/QMI_ERR_INVALID_ID	0x0029
QMI_ERR_REQUESTED_NUM_UNSUPPORTED	0x002A
QMI_ERR_INTERFACE_NOT_FOUND	0x002B
QMI_ERR_FLOW_SUSPENDED	0x002C
QMI_ERR_INVALID_DATA_FORMAT	0x002D
QMI_ERR_GENERAL	0x002E
QMI_ERR_UNKNOWN	0x002F
QMI_ERR_INVALID_ARG	0x0030
QMI_ERR_INVALID_INDEX	0x0031
QMI_ERR_NO_ENTRY	0x0032
QMI_ERR_DEVICE_STORAGE_FULL	0x0033
QMI_ERR_DEVICE_NOT_READY	0x0034
QMI_ERR_NETWORK_NOT_READY	0x0035
QMI_ERR_CAUSE_CODE	0x0036
QMI_ERR_MESSAGE_NOT_SENT	0x0037

QMI_ERR_MESSAGE_DELIVERY_FAILURE	0x0038
QMI_ERR_INVALID_MESSAGE_ID	0x0039
QMI_ERR_ENCODING	0x003A
QMI_ERR_AUTHENTICATION_LOCK	0x003B
QMI_ERR_INVALID_TRANSITION	0x003C
QMI_ERR_NOT_A_MCAST_IFACE	0x003D
QMI_ERR_MAX_MCAST_REQUESTS_IN_USE	0x003E
QMI_ERR_INVALID_MCAST_HANDLE	0x003F
QMI_ERR_INVALID_IP_FAMILY_PREF	0x0040
QMI_ERR_SESSION_INACTIVE	0x0041
QMI_ERR_SESSION_INVALID	0x0042
QMI_ERR_SESSION_OWNERSHIP	0x0043
QMI_ERR_INSUFFICIENT_RESOURCES	0x0044
QMI_ERR_DISABLED	0x0045
QMI_ERR_INVALID_OPERATION	0x0046
QMI_ERR_INVALID_QMI_CMD	0x0047
QMI_ERR_TPDU_TYPE	0x0048
QMI_ERR_SMSC_ADDR	0x0049
QMI_ERR_INFO_UNAVAILABLE	0x004A
QMI_ERR_SEGMENT_TOO_LONG	0x004B
QMI_ERR_SEGMENT_ORDER	0x004C
QMI_ERR_BUNDLING_NOT_SUPPORTED	0x004D
QMI_ERR_OP_PARTIAL_FAILURE	0x004E
QMI_ERR_POLICY_MISMATCH	0x004F
QMI_ERR_SIM_FILE_NOT_FOUND	0x0050
QMI_ERR_EXTENDED_INTERNAL	0x0051
QMI_ERR_ACCESS_DENIED	0x0052
QMI_ERR_HARDWARE_RESTRICTED	0x0053
QMI_ERR_ACK_NOT_SENT	0x0054
QMI_ERR_INJECT_TIMEOUT	0x0055
QMI_ERR_INCOMPATIBLE_STATE	0x005A
QMI_ERR_FDN_RESTRICT	0x005B
QMI_ERR_SUPS_FAILURE_CAUSE	0x005C
QMI_ERR_NO_RADIO	0x005D
QMI_ERR_NOT_SUPPORTED	0x005E
QMI_ERR_NO_SUBSCRIPTION	0x005F
QMI_ERR_CARD_CALL_CONTROL_FAILED	0x0060
QMI_ERR_NETWORK_ABORTED	0x0061
QMI_ERR_MSG_BLOCKED	0x0062
QMI_ERR_INVALID_SESSION_TYPE	0x0064
QMI_ERR_INVALID_PB_TYPE	0x0065
QMI_ERR_NO_SIM	0x0066
QMI_ERR_PB_NOT_READY	0x0067
QMI_ERR_PIN_RESTRICTION	0x0068
QMI_ERR_PIN2_RESTRICTION	0x0069
QMI_ERR_PUK_RESTRICTION	0x006A
QMI_ERR_PUK2_RESTRICTION	0x006B
QMI_ERR_PB_ACCESS_RESTRICTED	0x006C
QMI_ERR_PB_DELETE_IN_PROG	0x006D
QMI_ERR_PB_TEXT_TOO_LONG	0x006E
QMI_ERR_PB_NUMBER_TOO_LONG	0x006F
QMI_ERR_PB_HIDDEN_KEY_RESTRICTION	0x0070
QMI_ERR_PB_NOT_AVAILABLE	0x0071

QMI_ERR_DEVICE_MEMORY_ERROR	0x0072
QMI_ERR_NO_PERMISSION	0x0073
QMI_ERR_TOO_SOON	0x0074
QMI_ERR_TIME_NOT_ACQUIRED	0x0075
QMI_ERR_OP_IN_PROGRESS	0x0076
QMI_ERR_FW_WRITE_FAILED	0x0184
QMI_ERR_FW_INFO_READ_FAILED	0x0185
QMI_ERR_FW_FILE_NOT_FOUND	0x0186
QMI_ERR_FW_DIR_NOT_FOUND	0x0187
QMI_ERR_FW_ALREADY_ACTIVATED	0x0188
QMI_ERR_FW_CANNOT_GENERIC_IMAGE	0x0189
QMI_ERR_FW_FILE_OPEN_FAILED	0x0190
QMI_ERR_FW_UPDATE_DISCONTINOUS_FRAME	0x0191
QMI_ERR_FW_UPDATE_FAILED	0x0192

0xF000 to 0xFFFE – Vendor-defined error codes

All codes in the range 0x0000 to 0xEFFF, except those that were previously mentioned in this section, are reserved for future assignment.

Refer to the individual service specification documents for the meanings of the error codes.

5.4. QMI Use Cases and Flows

5.4.1. QMI_WDS (Wireless Data Service)

The QMI WDS provides a command set to interface to a wireless mobile station, providing IP connectivity and related value-added services.

- Data call setup and teardown
- Network registration and attach
- Packet transmission statistics
- Data bearer rate
- Data session profile management

5.4.1.1. Scenario 1 – Data connection/disconnection

This scenario is an example of data connection/disconnection using QMI_WDS_START_NETWORK_INTERFACE_REQ and QMI_WDS_STOP_NETWORK_INTERFACE_REQ.

Figure 5.6 illustrates the data connection/disconnection flow for the scenario.

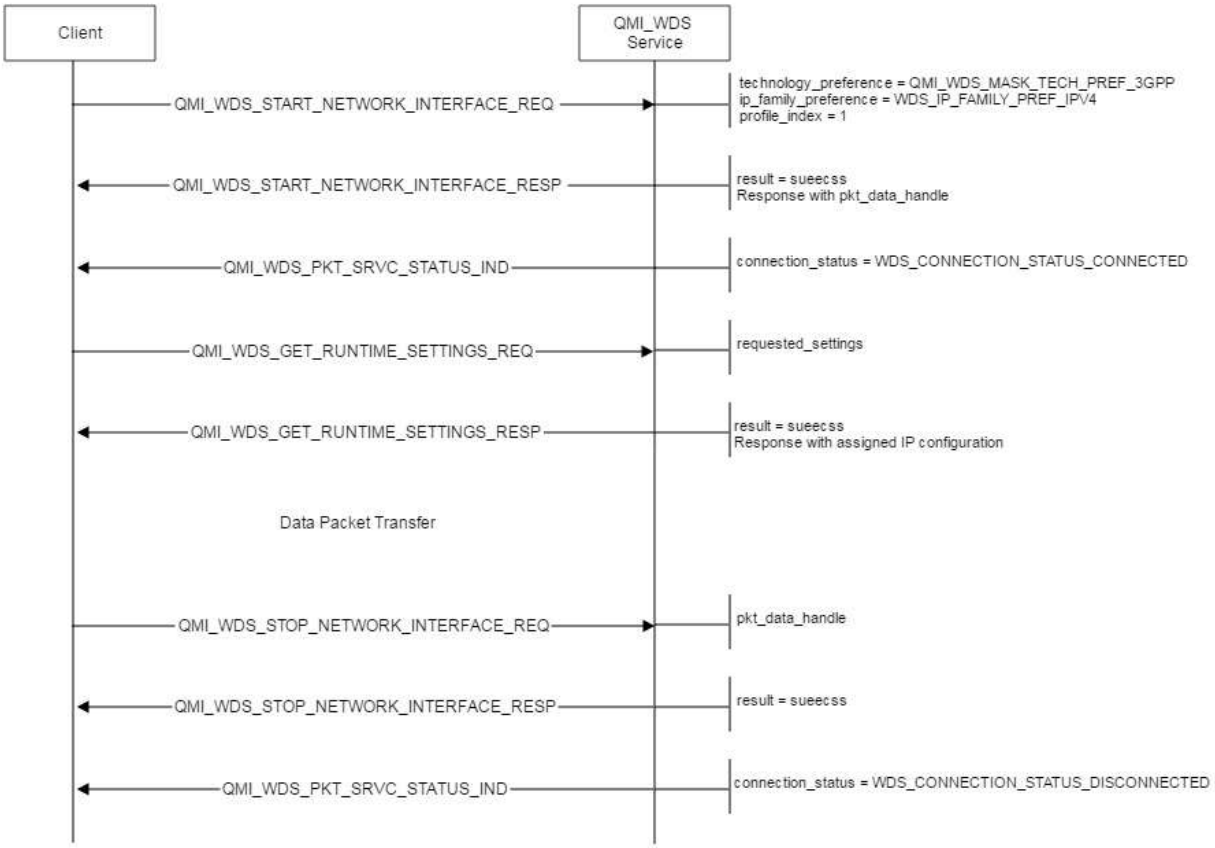


Fig. 5.6: Data connection/disconnection

5.4.1.2. Scenario 2 – WDS Event Report

The QMI_WDS_SET_EVENT_REPORT_IND command is sent by the service to relevant control points.

This command is unsolicited and report the various information that is about packet data. The following table shows all information that is sent through QMI_WDS_SET_EVENT_REPORT_IND command.

Name	Description
Tx Packets OK	Number of packets transmitted without error.
Rx Packets OK	Number of packets received without error.
Tx Packet Errors	Number of outgoing packets with framing errors.
Rx Packet Errors	Number of incoming packets with framing errors.
Tx Overflows	Number of packets dropped because Tx buffer overflowed (out of memory).
Rx Overflows	Number of packets dropped because Rx buffer overflowed (out of memory).
Channel Rate	Max channel Tx rate in bits per second. Max channel Rx rate in bits per second.
Data Bearer Technology	Data bearer technology.
Dormancy Status	Traffic channel dormant or active.
Tx Bytes OK	Number of bytes transmitted without error.
Rx Bytes OK	Number of bytes received without error.
MIP Status	Status of the last MIP call.
Current Data Bearer Technology	Current network type of data bearer. RAT mask to indicate the type of technology. SO mask to indicate the service option or type of application.
Data Call Status Change	Data call unknown or activated or terminatred.
Current Preferred Data System	Unknown, CDMA 1X, EVDO, GPRS, WCDMA, LTE or TD-SCDMA.
Data Call Type	None, Embedded call, Tethered call or Modem embedded call. Non-tethered call, RmNet call or DUN call.
EV-DO Page Monitor Period Change	EVDO slot cycle and long sleep info.
Data System Status	Information of preferred network, network, RAT and SO.
Tx Packets Dropped	Number of outgoing packets dropped.
Rx Packets Dropped	Number of incoming packets dropped.
Uplink Flow Control	Uplink flow control status.
Data Call Address Family	Data call address family – Unknown, IPv4, IPv6.
Additional PDN Filters Removed	Removed filter handles.
Data Bearer Technology Extended	Technology type.
Uplink Flow Control Sequence Number	Sequence number of each flow enable and disable event.
Delay Dormancy Result Indicator	Status and failure reason.

To receive the information, previously registering the wireless data state reporting conditions using QMI_WDS_SET_EVENT_REPORT command.

The following table shows all items that could be registered.

If the registered state is changed, the relevant information is sent via the QMI_WDS_EVENT_REPORT_IND indication.

Name	Description
Current Channel Rate	Reporting current channel rate or not.
Transfer Statistics	Period between transfer statistics reports. Requested statistics bitmask.
Data Bearer Technology	Reporting data bearer technology or not.
Dormancy Status	Reporting dormancy status or not
MIP Status	Reporting MIP status or not
Current Data Bearer Technology	Reporting current data bearer or not
Data Call Status Change	Reporting data call status or not
Current Preferred Data System	Reporting current preferred data system or not
EVDO Page Monitor Period Change	Reporting EVDO page monitor period change or not
Data System Status Change	Reporting data system status change or not
Uplink Flow Control	Reporting uplink flow control or not
Limitted Data System Status Change	Reporting limited data system status or not
Additional PDN Filters Removal	Reporting additional PDN filters removal or not
Data Bearer Technology Extended	Reporting data bearer technology extended or not
Delay Dormancy Result	Reporting delay dormancy result or not

The result of registering the each value of indicators is sent with QMI_WDS_SET_EVENT_REPORT_RESP message.

The following figure shows the WDS event report flow:

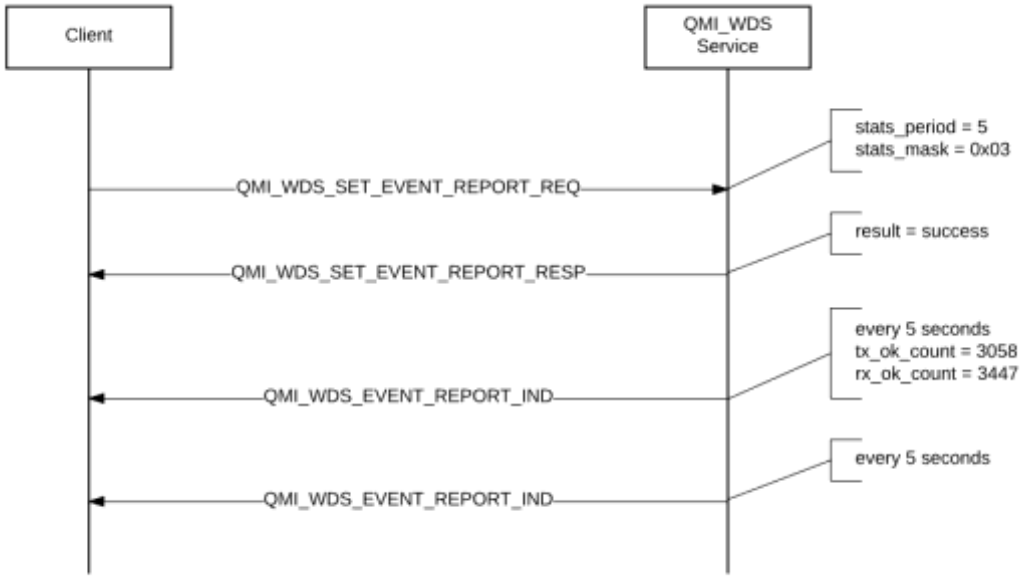


Fig. 5.7: Event report flow

5.4.2. QMI_NAS (Network Access Service)

5.4.2.1. Scenario 1 – Switching Mode Preference to Connect to a Network

This scenario is an example of using QMI_NAS_SET_SYSTEM_SELECTION_PREFERENCE to switch the mode preference from GSM to WCDMA and connect to the available WCDMA network. The client must use QMI_NAS_INDICATION_REGISTER to register for SYSTEM_SELECTION_PREFERENCE_IND, SYS_INFO_IND, and SIG_INFO_IND. The client then sends QMI_NAS_SET_SYSTEM_SELECTION_PREFERENCE with the desired mode preference. SYSTEM_SELECTION_PREFERENCE_IND is sent when the mode preference changes. QMI_NAS_GET_SYSTEM_SELECTION_PREFERENCE can be used to see the current system selection preferences. Figure 5.8 illustrates the call flow for switching the mode preference to connect to a network.

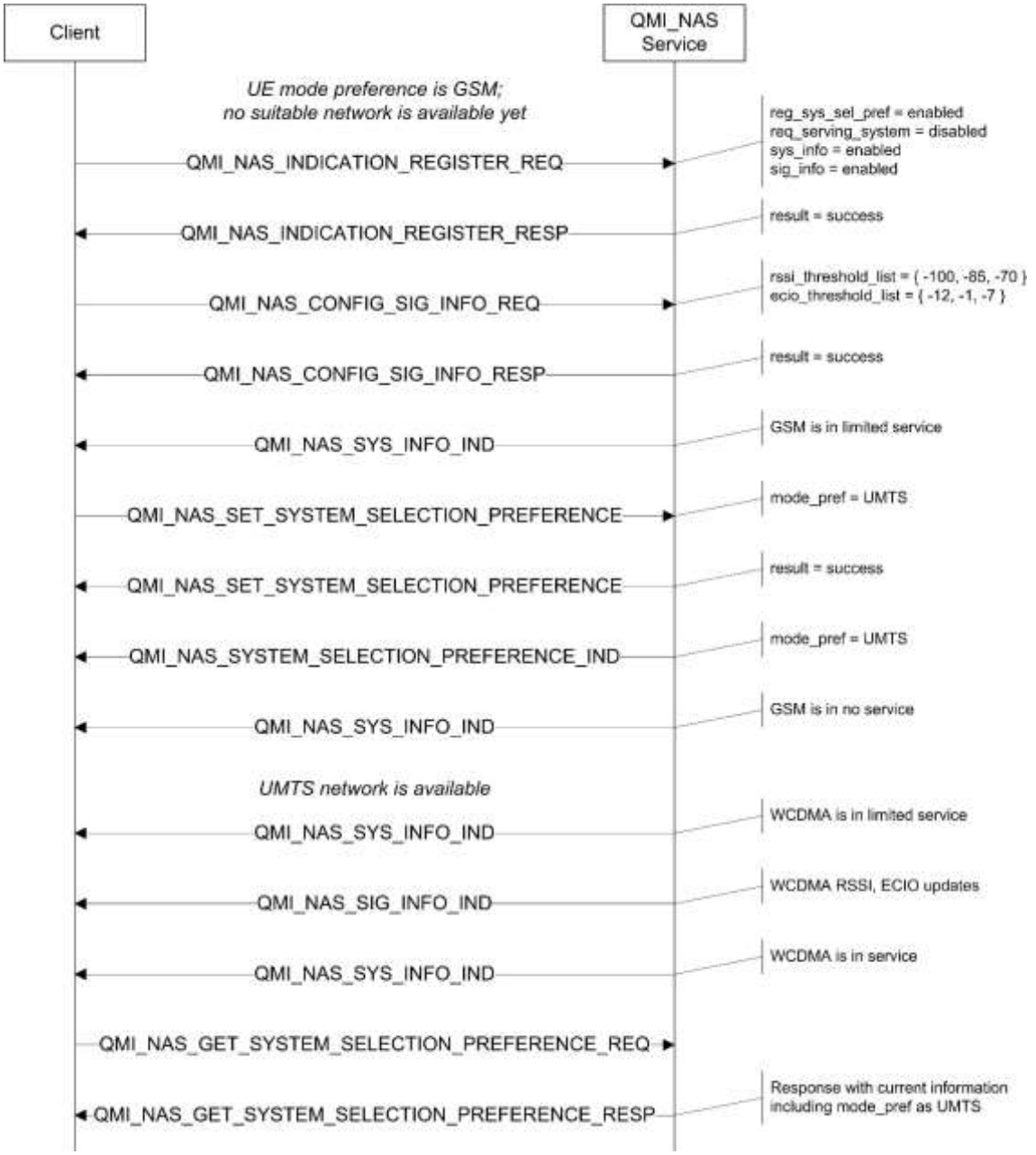


Fig. 5.8: Switching mode preference to connect to a network

5.4.2.2. Scenario 2 – System Information and Signal Information

This scenario is an example of using QMI_NAS_GET_SYS_INFO, QMI_NAS_SYS_INFO_IND, QMI_NAS_SIG_INFO_IND, and QMI_NAS_GET_SIG_INFO to get phone system and signal information. Figure 5.9 illustrates the call flow for the scenario.

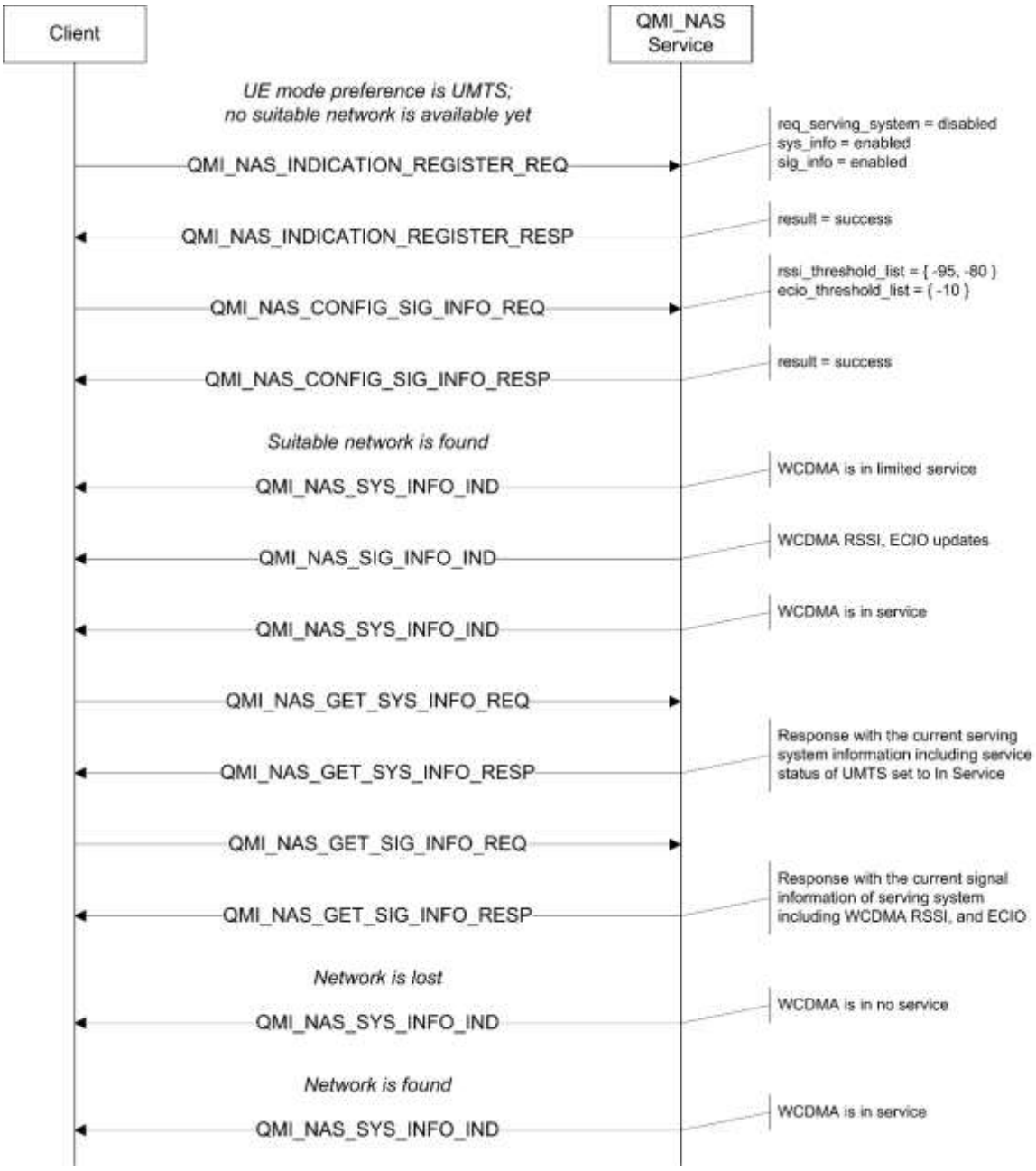


Fig. 5.9: System information and signal information

5.4.2.3. Scenario 3 – Perform Network Scan

This scenario is an example of using QMI_NAS_PERFORM_NETWORK_SCAN to scan for available networks. It also shows an example of aborting a network scan by using QMI_NAS_ABORT. Figure 5.10 illustrates the call flow for the scenario.

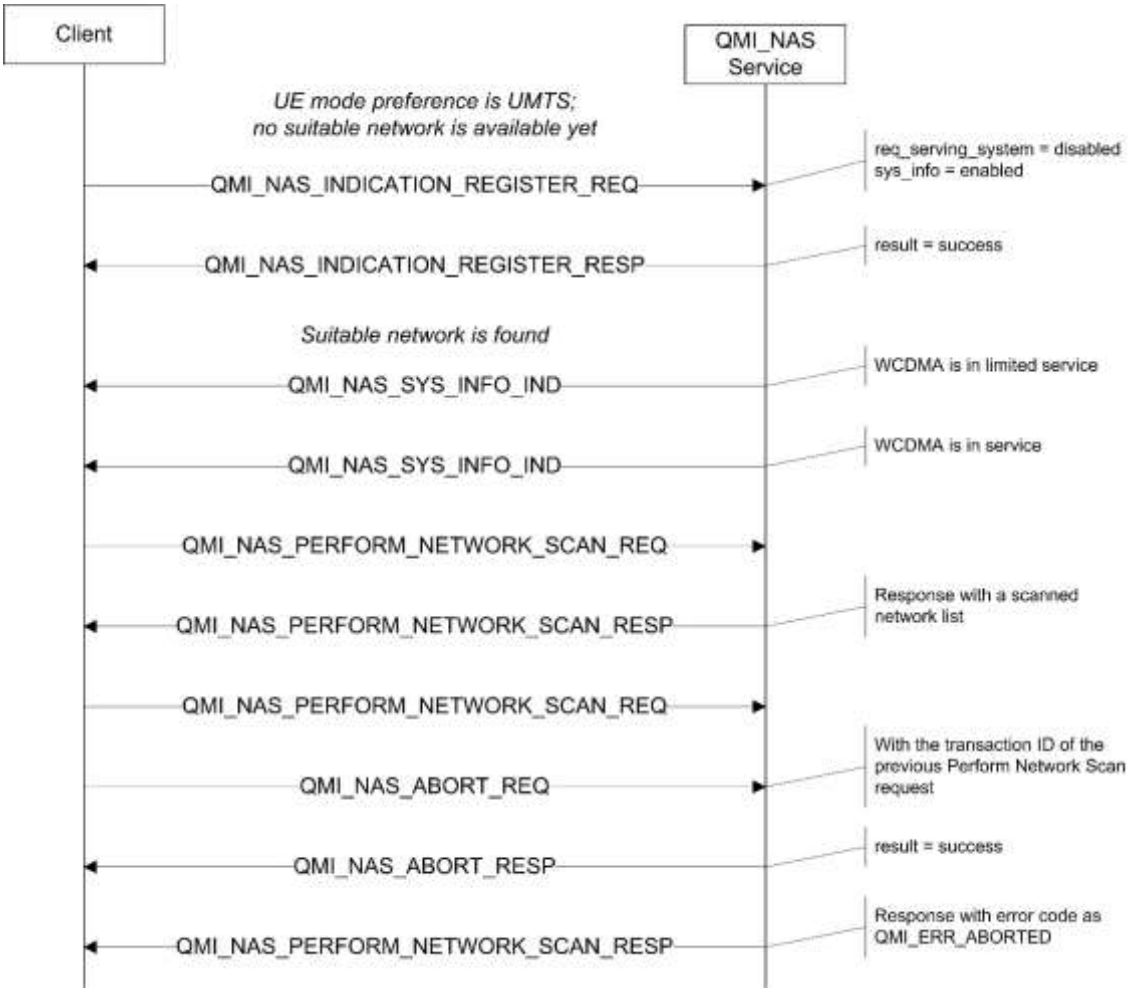


Fig. 5.10: Perform a network scan

5.4.2.4. Scenario 4 – Initiate Attach

This scenario is an example of using QMI_NAS_SET_SYSTEM_SELECTION_PREFERENCE to modify the CS/PS attach state for phone. Figure 5.11 illustrates the call flow for the scenario.

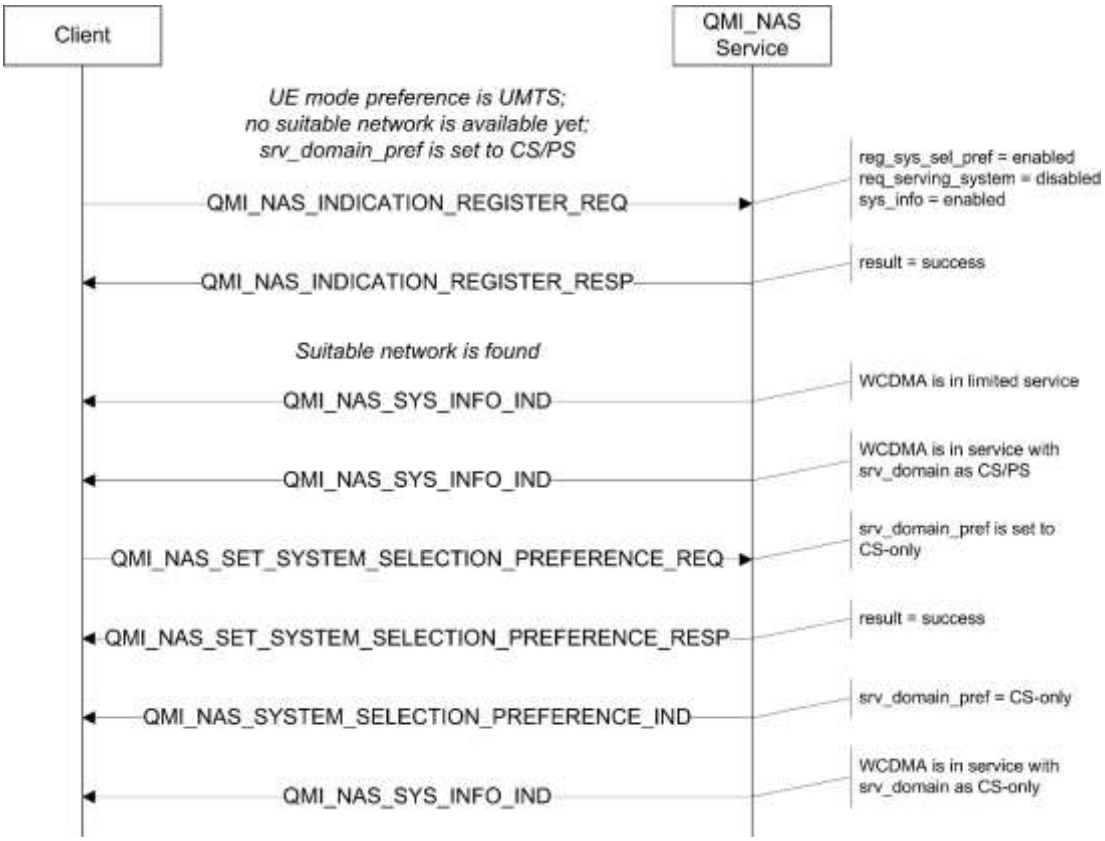


Fig. 5.11: Initiate attach

5.4.2.5. Scenario 5 – Initiate Network Registration

This scenario is an example of manual network registration using QMI_NAS_SET_SYSTEM_SELECTION_PREFERENCE. It shows an attempt at manual network registration on a network that is not available, which is followed by registration on the available network.

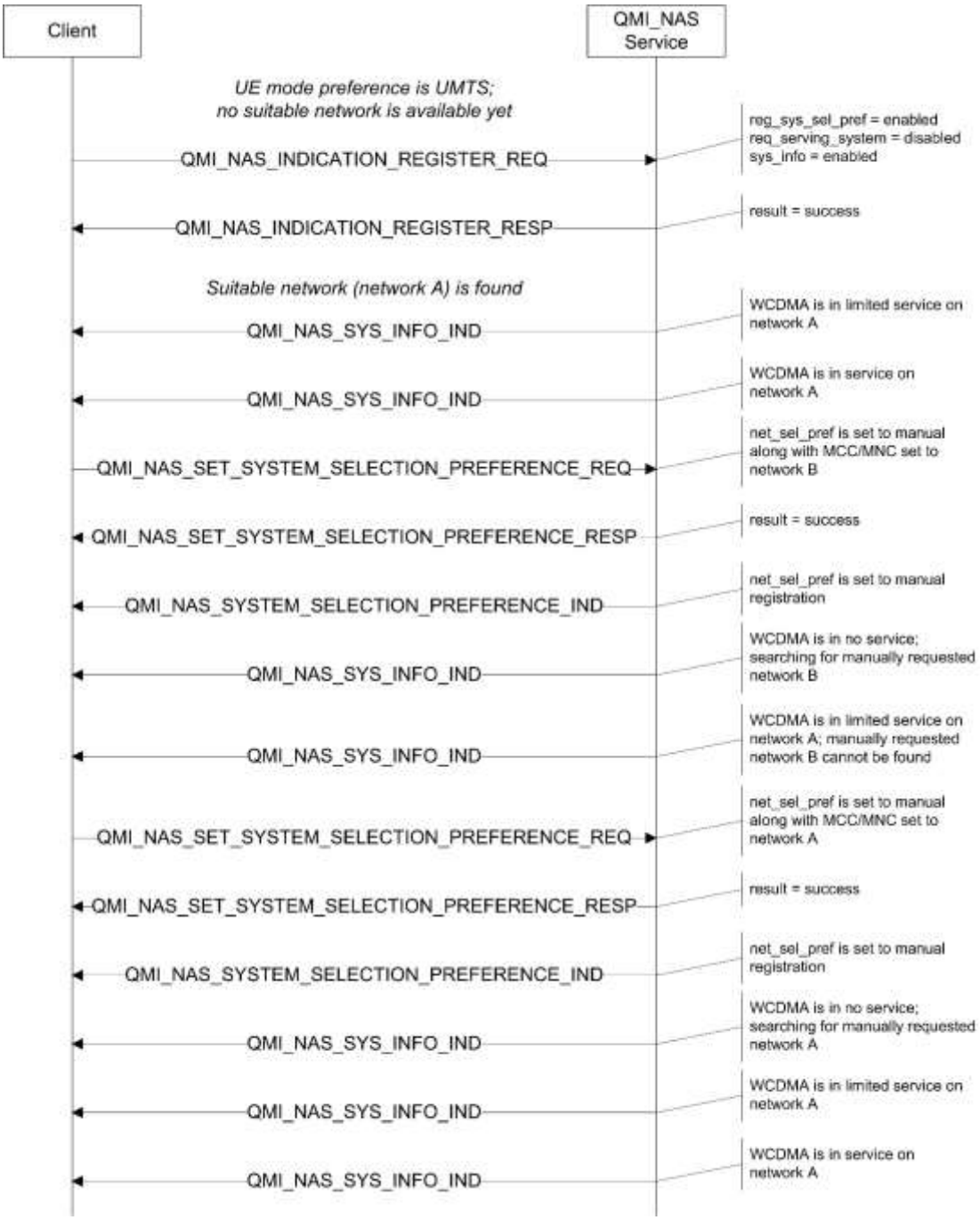


Fig. 5.12: Initiate network registration

5.4.2.6. Scenario 6 – Get PLMN Name

This scenario is an example of retrieving a PLMN name for a network. Any network information can be retrieved by providing the MCC/MNC. Figure 5.13 illustrates the call flow for the scenario.

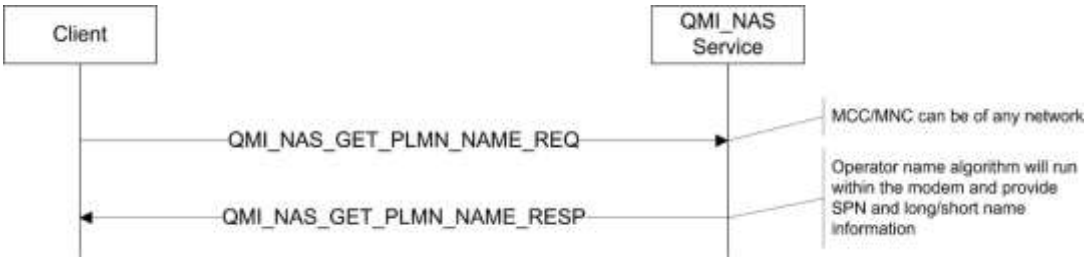


Fig. 5.13: Get PLMN name

5.4.3. QMI_WMS (Wireless Messaging Service)

5.4.3.1. Scenario 1 – Send a New Message

This scenario is an example of using QMI_WMS_GET_MESSAGE_PROTOCOL to query the message protocol currently in use for the WMS client, and sending a new message by using QMI_WMS_RAW_SEND. Figure 5.14 illustrates the call flow for the scenario.

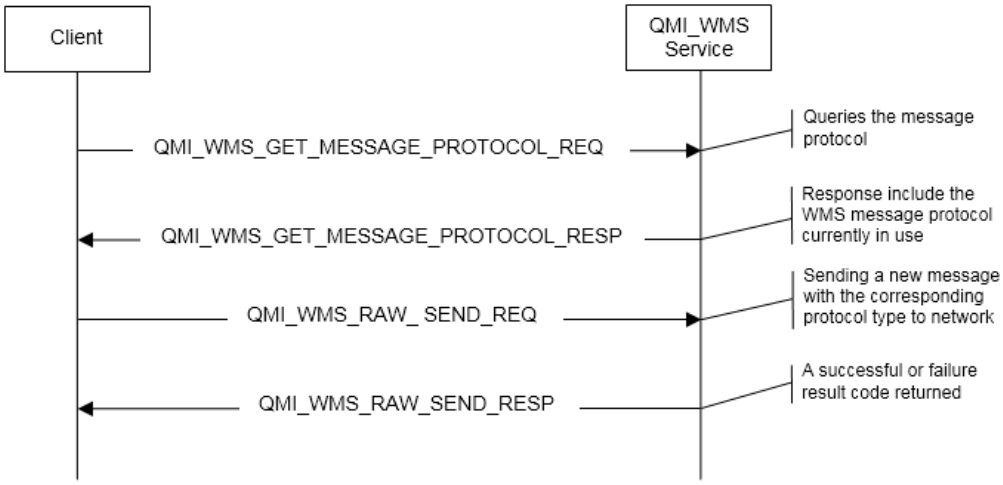


Fig. 5.14: Send a New Message

5.4.3.2. Scenario 2 – Read and Delete Message

This scenario is an example of using QMI_WMS_RAW_READ, QMI_WMS_MODIFY_TAG, QMI_WMS_DELETE, QMI_WMS_LIST_MESSAGES to read, modify tag, delete and list message. Figure 5.15 illustrates the call flow for the scenario.

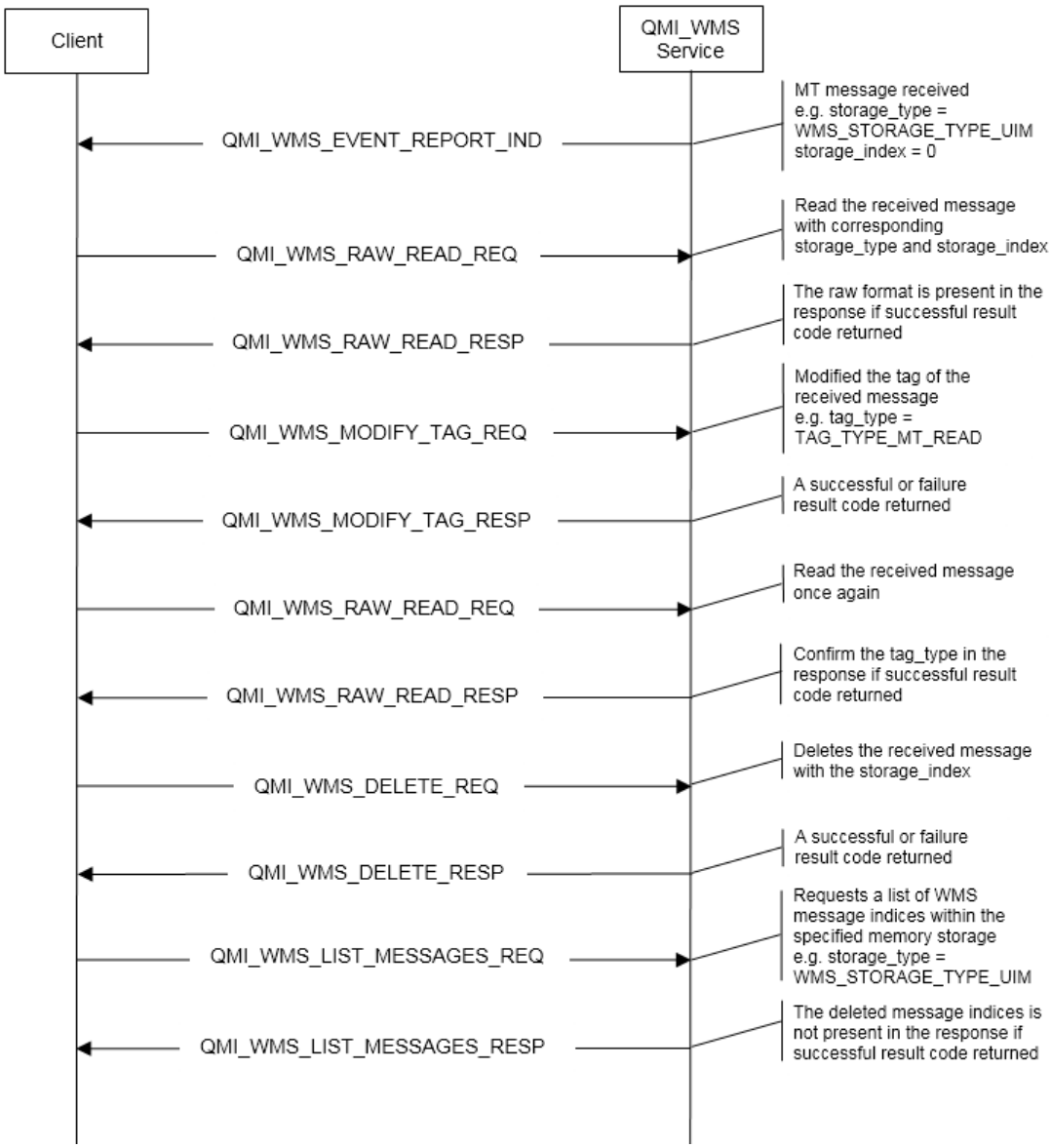


Fig. 5.15: Read and Delete Message

5.4.4. QMI_UIM (User Identity Module Service)

5.4.4.1. Scenario 1 – File Access

This scenario is an example of using QMI_UIM_GET_CARD_STATUS to query the current status of SIM card in use for the UIM client, and reading any transparent file in SIM card by using QMI_UIM_READ_TRNASPARENT. Figure 5.16 illustrates the call flow for the scenario.

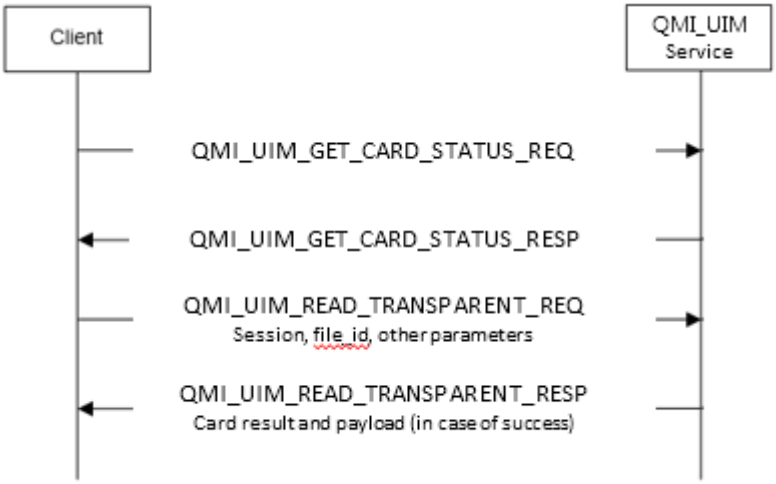


Fig. 5.16: File Access

5.4.5. QMI_GAS (Telit General Application Service)

5.4.5.1. Scenario 1 – Modem firmware switch

This scenario is an example of using QMI_GAS_DMS_ACTIVE_FW_REQ to switch modem f/w image from stored in device. Figure 5.17 illustrates the switching flow for the scenario.

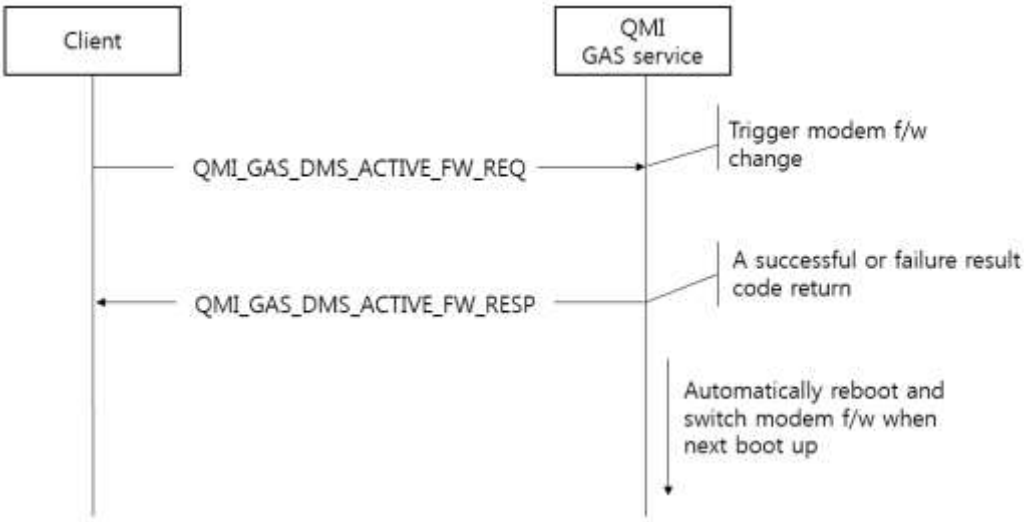


Fig. 5.17: Modem f/w switch

6. FIRMWARE UPDATE TOOL

The Telit Modules firmware is updated through the USB Interface normally used for the AT Commands.
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.

GT terminals are complete encased modems. They do not need the Telit Evaluation Kit (Telit EVK) to perform testing, evaluation and Firmware Update.

6.1. TFI Tool

The firmware update can be done with a specific software tool provided by Telit that runs on Windows based PCs.

First the program will erase the content of flash memory, and then the program will write on the flash memory.

LM940_xxx_TFI.exe includes binary image

Tool title is :

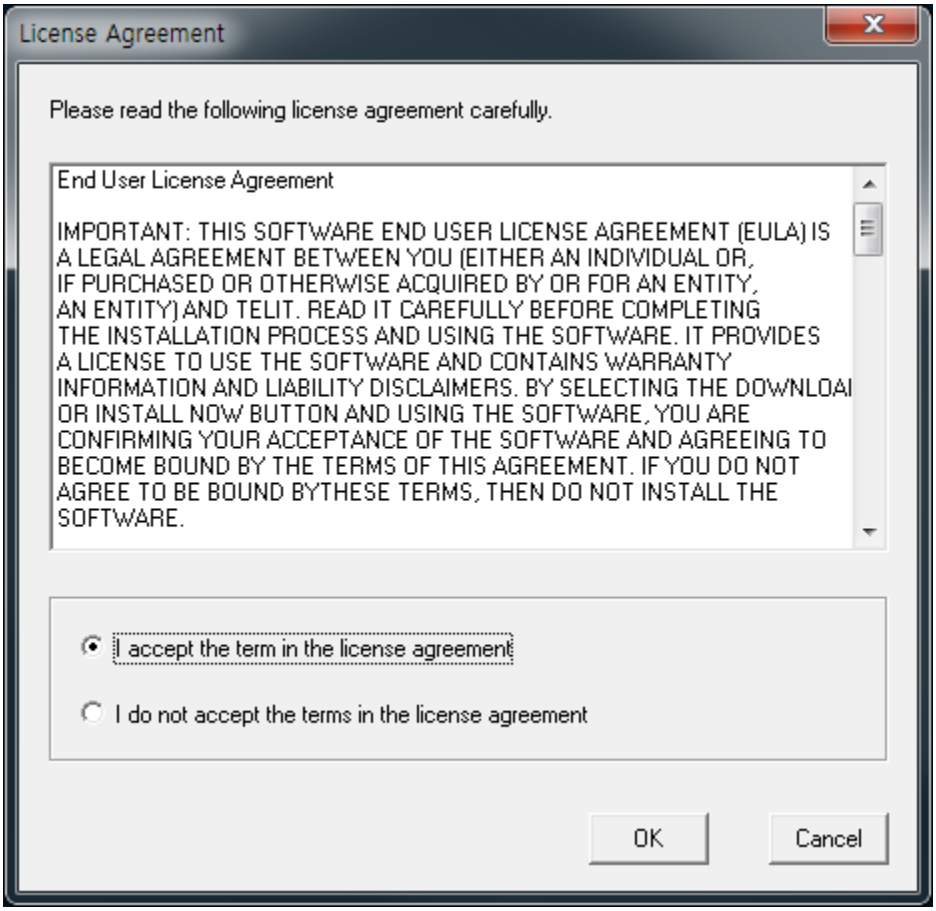
ex): TFI V2.xx – LM940_xxx / xxx

6.1.1. Update Procedure

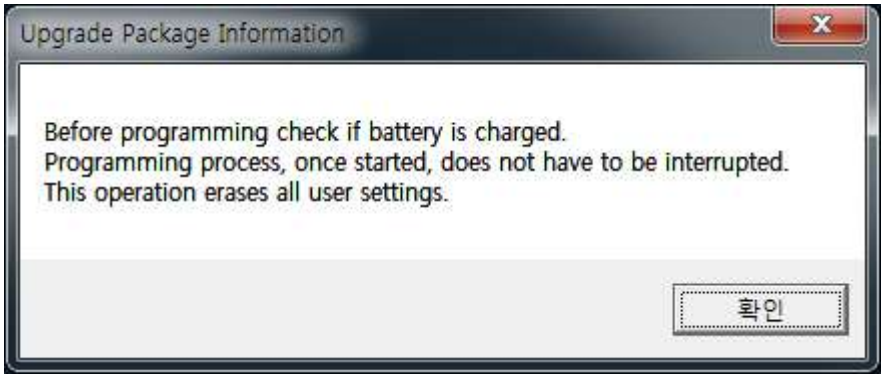
To update the firmware of the module, we suggest the following procedure:

1) Run the file ***LM940_xxx_TFI.exe***. The following window must be displayed, select the language preferred by pressing the correspondent button.

2) The End User License Agreement will appear. Please, read it and accept the terms if you are going to proceed.



3) Press OK to the initial message.

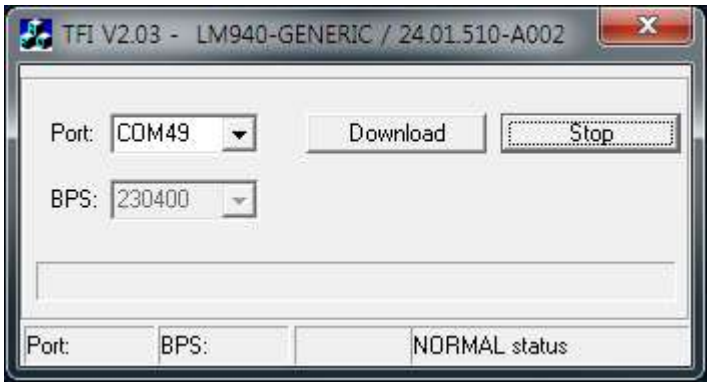


In connection with the LM940 modules, charged battery has to be understood that the power supply must not be disconnected during the firmware update.

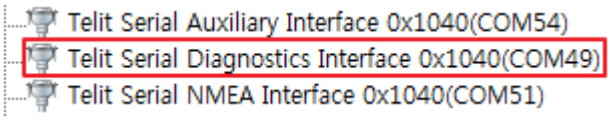
4) Download ready screen – If “Diagnostic” COM Port is automatically detected then the baudrate is fixed to 230400. But automatic port detection is depending on Windows OS. If COM Port is not detected then you must recheck that connecting status of USB cable of modem to PC , USB driver installation and Modem is powered on.

NOTE : TFI program’s usable Serial Port Number is limited to COM999. You must re-enumerate port number to under 999 if “Telit Serial Diagnostics Interface” port is enumerated over 999 on your PC. (The Serial Port Number is limited to COM255 if you use TFI version under V2.03)

5) Firmware Version displayed on Title bar is new firmware version and this version will be updated to the module.

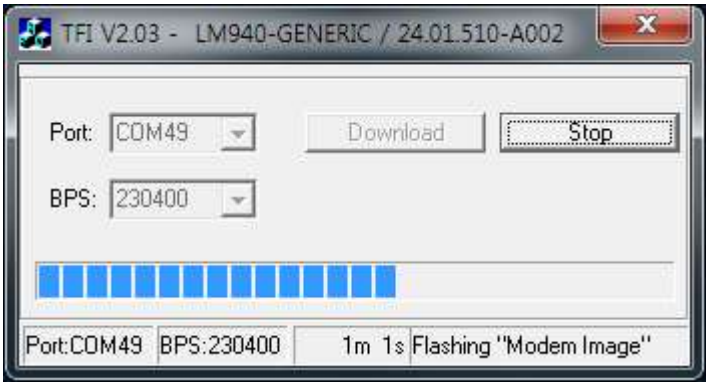


6) If port is not detected automatically, you will choose the port manually. Click the port combo box, and select one (“Telit Diagnostics Interface”)

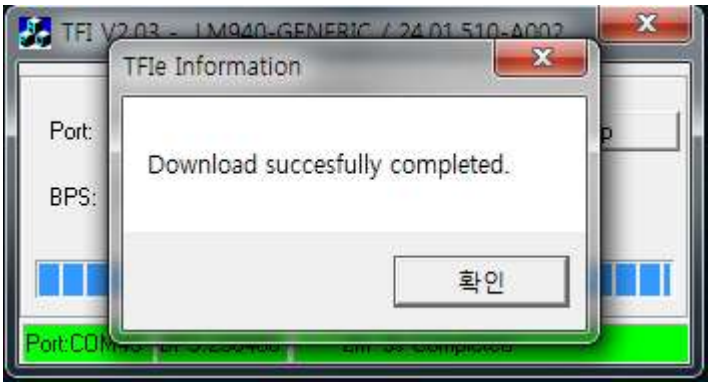


7) Select the right COM port. Then Press the Download button.

8) Modem will reset automatically several times for upgrade process after click download button. You can use modem again after TFI notice upgrade finished.



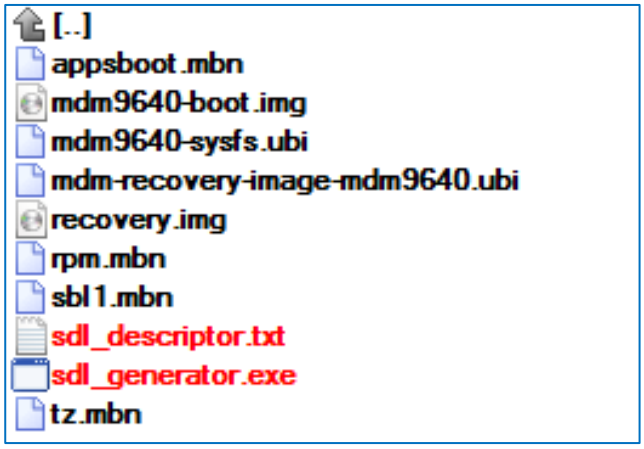
9) Wait for the end of programming completed message.



10) The Telit LM940 module is now programmed with the new firmware.

6.2. XFP Generatoion Tool

XFP generation tool provides a way to generate XFP stream binary by customer. This tool is in compressed LM940-HOST_24.01.50x-XXXX_BIN.zip file with other firmware files.



Telit delivers modem firmware files by grouping into some ZIP files like below.

LM940-HOST_24.01.50x-XXXX_BIN.zip : Other Firmware & Generation Tool

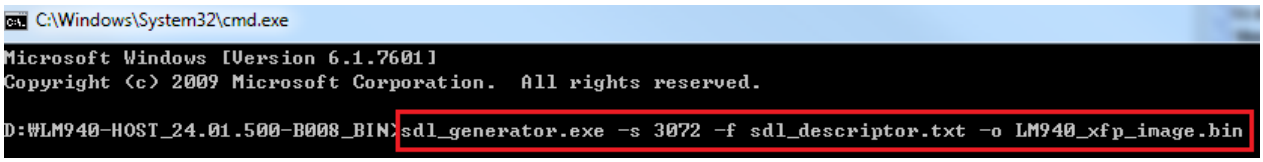
LM940-GENERIC_24.01.51x-XXXX_BIN.zip: Generic Carrier Modem Firmware

LM940-VERIZON_24.01.52X-XXXX_BIN.zip : Verizon Carrier Modem Firmware

LM940-ATT_24.01.54x-XXXX_BIN.zip : AT&T Carrier Modem Firmware

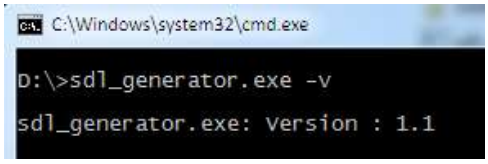
Usage of this tool is :*sdl_generator.ext -s <Max Block Size> -f <Input Description File> -o <Output Binary File>*

ex> sdl_generator.exe -s 3000 -f ./sdl_scriptor.txt -o XFP_generated_image.bin



Max Block Size (byte)	The size of one block. (maximum up to 65536 byte) It is important that the size of one packet transferred to module should be the same with this Max Block Size.
Input Descriptor File	Text file describing the contents of XFP binary file.
Output Binary File	Output binary file.

Use '-v' option to get version of generation tool.



6.2.1. Description File

This text description file is divided into two phase *<BASIC INFORMATION>* and *<INPUT FILES>*. *<BASIC INFORMATION>* has basic information included in header of output binary file, such as product name, S/W version and so on. *<INPUT FILES>* has information of binary files included into output binary file. The delimiter of each configuration line is ':' like below.

CONFIGURATION NAME : VALUE

A line started with '#' is a comment.

Below table shows each configuration name and description..

<BASIC INFORMATION>		
Name	**Description**	**Version**
PRODUCT NAME	Product Name. *e.g. LM940*	From 1.0
SW VERSION	Version of released S/W. e.g. 24.01.5X0-SAMPLE This version information will be included in header of XFP generated binary.	From 1.0
PRINT LEVEL	Level of debugging message. (default is CRITICAL) Value should be one of below list. *CRITICAL, INFO, SPEW* *(*This is an option for trobleshooting. if set it to spew, there is a performance degradation. therefore, we recommend that you don't change level.*)* This version information will be included in header of XFP generated binary.	From 1.0
ACTIVE CARRIER	Change active carrier after downloading generated binary. Value should be one of below list. *Generic, Verizon, ATT, Sprint* It is important that the carrier image to be activated should be included in the generated binary if this configuration is enabled. This configuration is optional.	From 1.1
<INPUT FILES>		
ROOTDIR	Root directory which has all firmware images. This directory path is relative path from current directory. If the value of this configuration is empty, this tool tries to find images in current directory.	From 1.1
RECOVERYFS	This image will be included into XFP binary if select "1". Note : In case of 1, "mdm-recovery-image-mdm9640.ubi" file shoud be in the ROOTDIR	From 1.1

RECOVERY	This image will be included into XFP binary if select “1”. Note : In case of 1, “recovery.img” file shoud be in the ROOTDIR	From 1.1
BOOT	This image will be included into XFP binary if select “1”. Note : In case of 1, “mdm9640-boot.img” file shoud be in the ROOTDIR	From 1.1
SYSTEM	This image will be included into XFP binary if select “1”. Note : In case of 1, “mdm9640-sysfs.ubi” file shoud be in the ROOTDIR	From 1.1
RPM	This image will be included into XFP binary if select “1”. Note : In case of 1, “rpm.mbn” file shoud be in the ROOTDIR	From 1.1
TZ	This image will be included into XFP binary if select “1”. Note : In case of 1, “tz.mbn” file shoud be in the ROOTDIR	From 1.1
ABOOT	This image will be included into XFP binary if select “1”. Note : In case of 1, “appsboot.mbn” file shoud be in the ROOTDIR	From 1.1
SBL	This image will be included into XFP binary if select “1”. Note : In case of 1, “sbl1.mbn” file shoud be in the ROOTDIR	From 1.1
GENERIC	This image will be included into XFP binary if select “1”. Note : In case of 1, “NON-HLOS-Generic.ubi” file shoud be in the ROOTDIR	From 1.1
VERIZON	This image will be included into XFP binary if select “1”. Note : In case of 1, “NON-HLOS-Verizon.ubi” file shoud be in the ROOTDIR	From 1.1
ATT	This image will be included into XFP binary if select “1”. Note : In case of 1, “NON-HLOS-ATT.ubi” file shoud be in the ROOTDIR	From 1.1
SPRINT	This image will be included into XFP binary if select “1”. Note : In case of 1, “NON-HLOS-Sprint.ubi” file shoud be in the ROOTDIR	From 1.1

The packing order of images follows the description file and is also same sequence during downloading.

Customer could find the order in tool's output text as shown below.

```
Model Type = MDM9X
Max Packet Size = 65536
Input File Name = sdl_descriptor.txt

Image Packing Order : {SYSTEM,GENERIC,VERIZON,ATT,SPRINT,}
```

Below is the sample of description file.

This sample description file is also delivered with tool.

<BASIC INFORMATION>

PRODUCT NAME : LM940

SW VERSION : 24.01.50x

PRINT LEVEL : CRITICAL

ACTIVE CARRIER : GENERIC

<INPUT FILES>

ROOTDIR :

RECOVERYFS : 0

RECOVERY : 0

SYSTEM : 0

BOOT : 0

RPM : 0

TZ : 0

ABOOT : 0

SBL : 0

GENERIC : 1

VERIZON : 1

ATT : 1

SPRINT : 1

EU : 0

AU : 0

NOTE: LM940 can include maximum 4 carrier images. So, please be careful not to exceed the maximum count when generate XFP binary.

6.3. XFP Tool

The firmware update of the module can be performed with the XFP Tool provided by Telit. It runs on Windows based PCs. It erases the flash memory content, and then it downloads the new firmware on the flash memory.

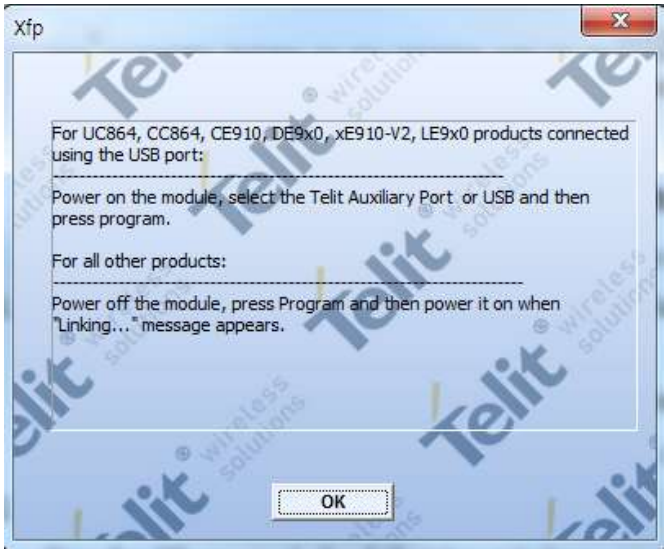
6.3.1. Update Procedure

To update the Telit Module firmware, follow the procedure:

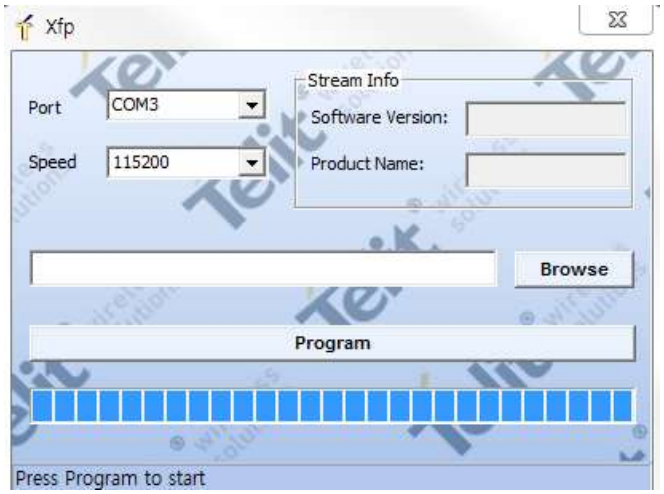
1) collect information about the Telit Module and Software version using the following AT commands:

- **AT+CGMR<cr>**, returns the Software version information;
- **AT+CGMM<cr>**, returns the Telit Module identification.

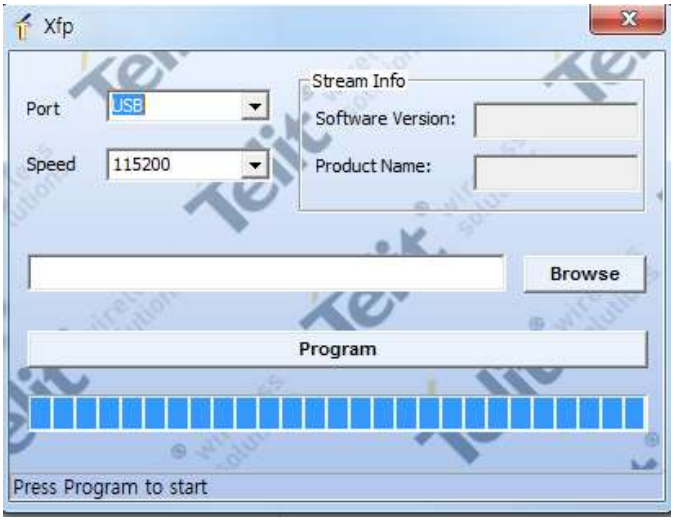
2) Run the ‘Xfp.exe’, the following windows are displayed.



3) After pressing OK button on the screen is displayed only the following windows.

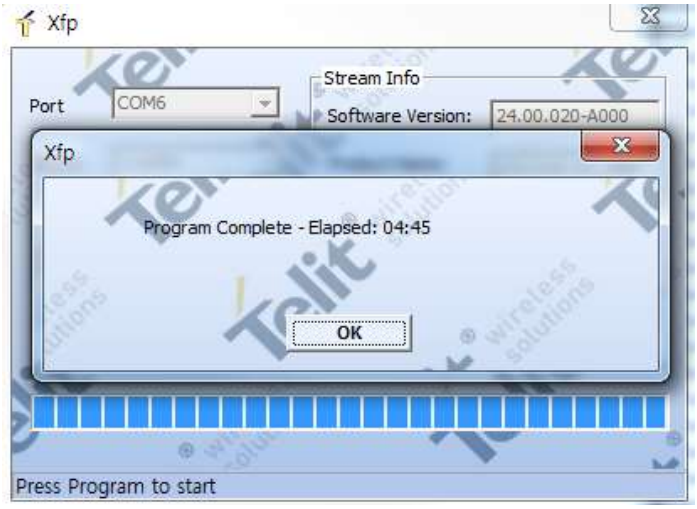


4) If you want to upgrade over the usb, please select “USB” in port combobox.



5) After press Program button, a flashing blue bar will be increased during upgrade. The following window is displayed on the screen.

6) The following window is displayed on the screen when the module is successfully programmed.


Xfp
Port
COM6
Stream Info
Software Version:
24.00.020-A000
Xfp
Program Complete - Elapsed: 04:45
OK
Press Program to start

7. 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
DRX	Discontinuous Reception
DTE	Data Terminal Equipment
DTMF	Dual Tone Multiple Frequency
DTR	Data Terminal Ready
GBR	Guaranteed Bit Rate
GERAN	GSM EDGE Radio Access Network
GNSS	Global Navigation Satellite Sservices
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
PDN	Public Data Network
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PIN	Personal Identification Number
PPP	Point to Point Protocol
QMI	Qualcomm MSM interface, Qualcomm modem interface

QMUX	QMI Multiplexing 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

8. DOCUMENT HISTORY

Revision	Date	Changes
0	2017-04-21	Initial version
1	2017-10-20	New: 2.2. Modem Configuration and PRI revision 6.2 XFP Generation Tool Update: 2.1. Multi-modem Image Support 3.1 Serial Ports Arrangements 3.6. Band Configuration 3.7.4 SIM Status 3.7.5 SIM Detection Mode 3.8.3. Preferred Netowk Operator List 4.4.3 Automatic Data/Time updating Removed: 5.4.5.2. Scenario 2 – Modem firmware update

SUPPORT INQUIRIES

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

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