

# EC2x&EG9x&EG2x-G&EM05 Series

## IMS Application Note

**LTE Standard Module Series**

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# About the Document

## Revision History

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-	2021-01-25	Wythe WANG/ Yosef ZHANG	Creation of the document
1.0	2021-09-23	Wythe WANG/ Yosef ZHANG	First official release

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# 1 Introduction

This document introduces application of the IMS feature from the following aspects.

- Instruction of MBN (Modem Configuration Binary)
- Instruction of IMS (IP Multimedia Subsystem)
- AT commands and examples related to MBN and IMS

## 1.1. Applicable Modules

Table 1: Applicable Modules

Module Series	Module
EC2x	EC21 Series
	EC25 Series
	EC20-CE
EG9x	EG91 Series
	EG95 Series
EG2x-G	EG21-G
	EG25-G
EM05	EM05 Series

## 1.2. Introduction of MBN

### 1.2.1. MBN File

MBN (Modem Configuration Binary) files are a set of configurations that the system will read during module initialization to assign values for state variables to meet the operational requirements of carriers' network, so as to configure IMS functions.



MBN contains NV Item list with preset default values, EFS file list, MBN version information, and MBN-matching phone card information (ICCID, IMSI). And it is divided into three parts: *NV Items Configuration Area*, *EFS File Configuration Area*, and *Trailer Record Configuration Area*.

*NV Items Configuration Area* contains the following parameters: MBN version, MBN version date, MBN-matching phone card information (ICCID, IMSI), etc., which are to be set based on operator requirements.

When the MBN to be activated is selected (automatically or manually), the module reads all the NVM/EFS item lists from the MBN, and write these default values into the configuration. After that, the module will operate based on these configurations.

In the same way, when the MBN is deactivated, the module will delete all the NV/EFS item lists that have been read from the MBN.

If an NV item of the MBN files is changed through AT command, when the MBN is activated or deactivated, the previously configured NV item will recover to default.

The purpose of MBN file is to maintain different NV item lists and EFS file lists for operators based on IMSI and ICCID. Therefore, it is very convenient to support certification and VoLTE service.

**NOTE**

Please contact Quectel Technical Supports ([support@quectel.com](mailto:support@quectel.com)) for the latest MBN list.

### 1.2.2. MBN Type

In most cases, there is one ROW MBN and many operator MBNs in the module.

The operator MBN files are used for certification or VoLTE requirements. Usually, it is named after abbreviations of operators' names. However, not all operator MBN files enable IMS by default.

The ROW MBN file contains general NV settings. For example, the attached APN from ROW MBN file is null since ROW MBN file indicates to a non-specific operator. When the ROW MBN file activated, you should write the list of mandatory NV items for network registration or service request by AT command manually.

ROW MBN file is usually used when the operator MBNs based on the inserted (U)SIM card cannot be activated. If no MBN file of a specific operator matches the inserted (U)SIM card, ROW MBN file will be activated automatically.

### 1.2.3. MBN Selection

You can check whether the automatic MBN selection is enabled by **AT+QMBNCFG="AutoSel"**, which can be referred to in **Chapter 2.3.2.4**. When MBN Auto Selection is enabled, the MBN file is activated based on the IMSI of the inserted (U)SIM card. In case of no MBN file including the IMSI of the inserted (U)SIM card, ROW MBN file will be activated.

## 1.3. Introduction of IMS

IMS (IP Multimedia Subsystem) includes all CN elements for providing IP multimedia services comprising audio, video, text, etc. and a combination of them delivered over the PS domain.

VoLTE (Voice over LTE) is a new voice solution utilizing IMS technology. IMS is more like the voice service bearer. In addition to voice, IMS network also supports SMS, emergency calls, DTMF, etc.

### 1.3.1. IMS Registration Process

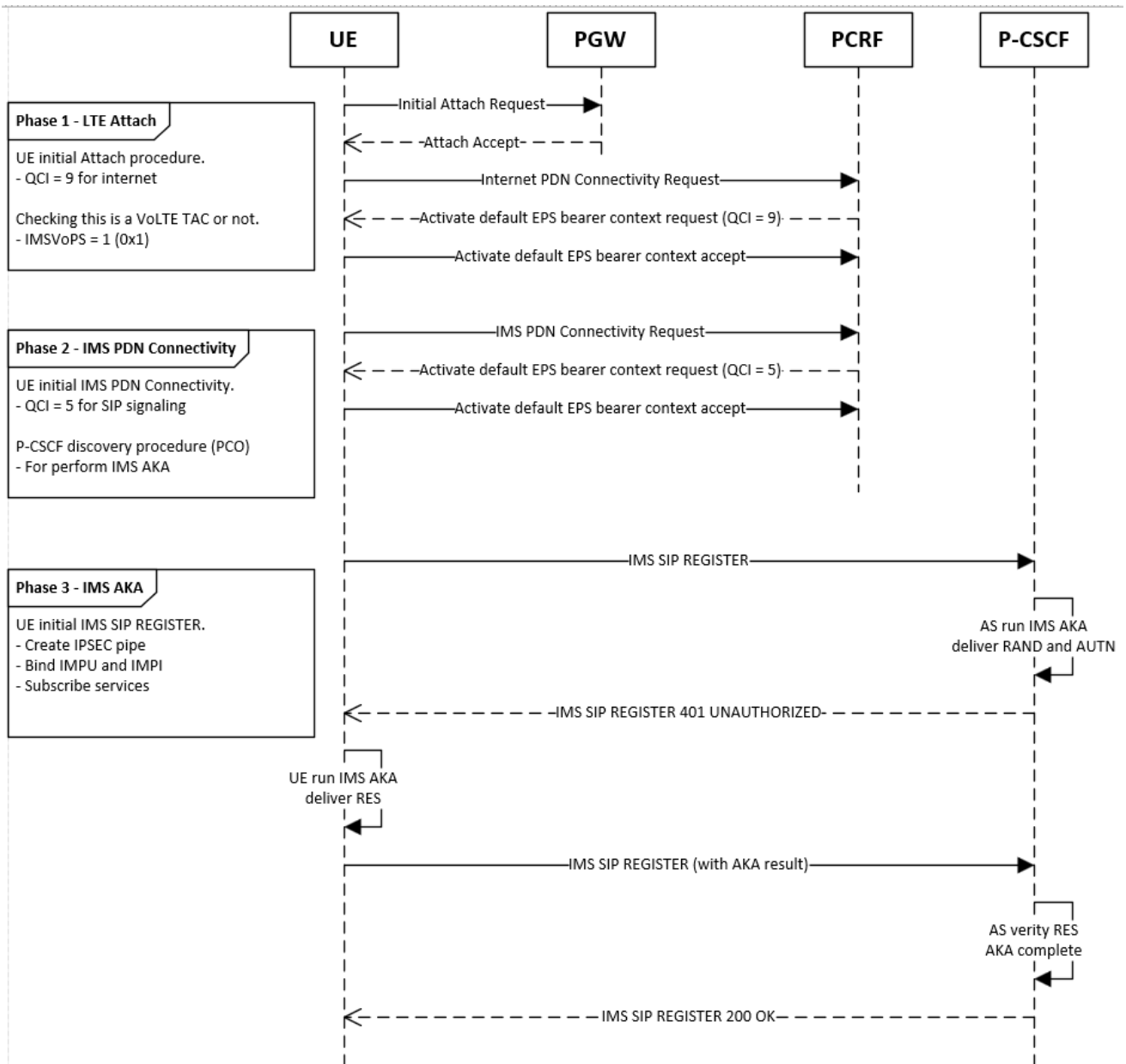


Figure 1: IMS Registration Procedure

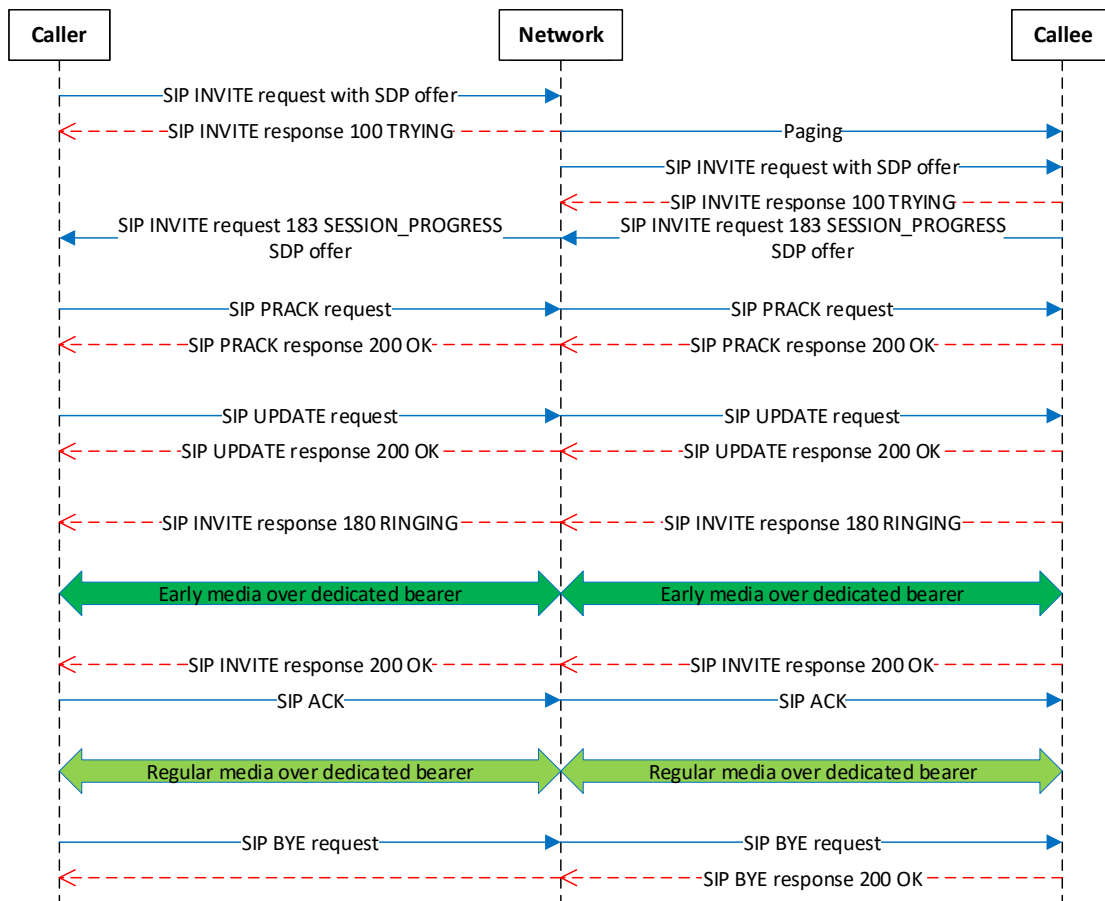
IMS registration is the mandatory procedure for all services over IMS and the registration should be successful before triggering any service. You can check the IMS registration status by **AT+QCFG="ims"**, which can be referred to in **Chapter 2.3.1**.

### 1.3.2. Processes of Services over IMS

These services procedures based on the IMS network listed below are introduced by the following sections.

- VoLTE over IMS
- SMS over IMS
- Emergency call over IMS
- DTMF over IMS
- SRVCC over IMS

#### 1.3.2.1. VoLTE



**Figure 2: VoLTE Call Procedure**

**NOTE**

In case of any error occurring in VoLTE roaming scenario, please provide the logs to Quectel Technical Supports (support@quectel.com) for further analysis.

1.3.2.2. SMS

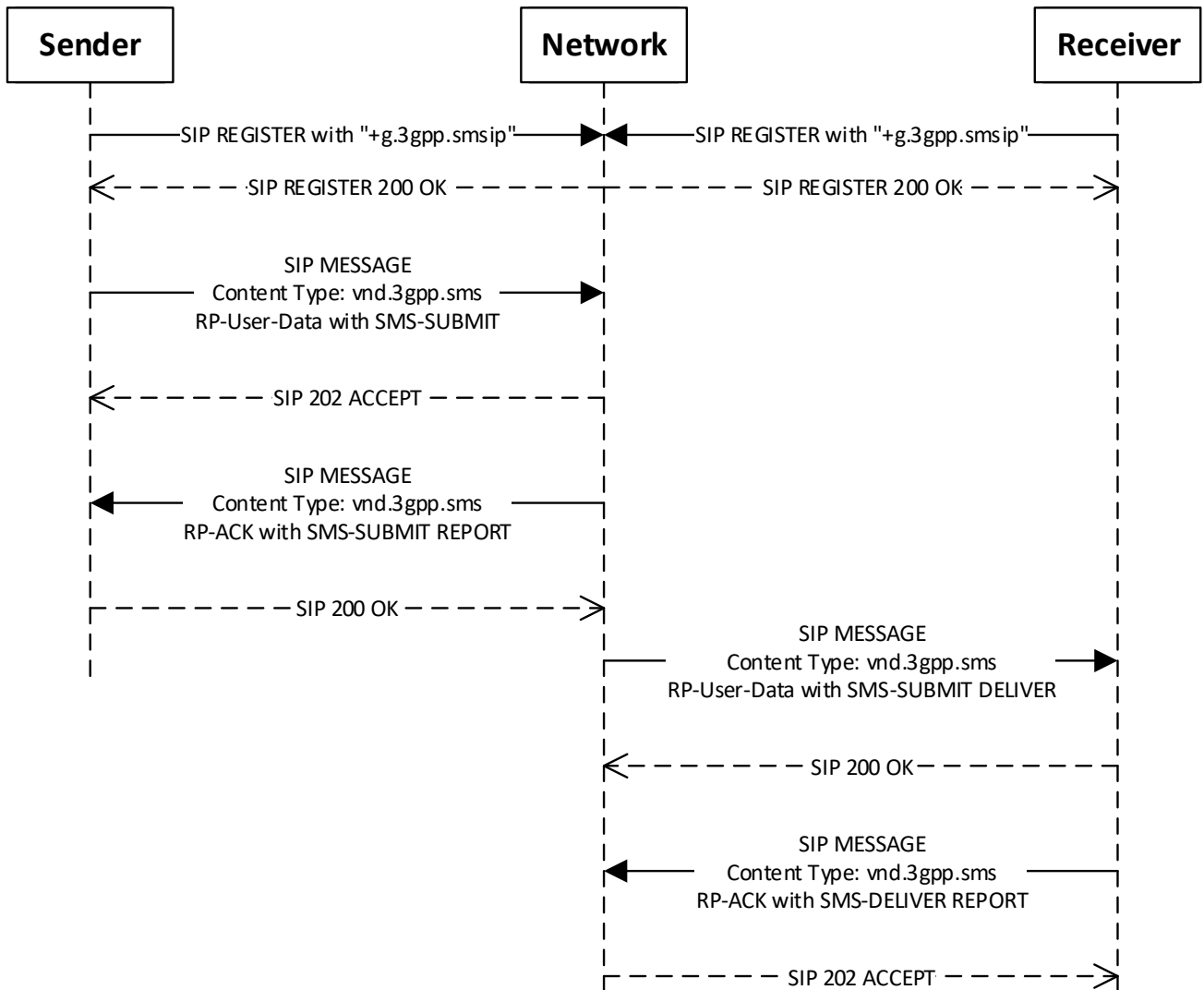


Figure 3: SMS over IMS Procedure

1.3.2.3. Emergency Call

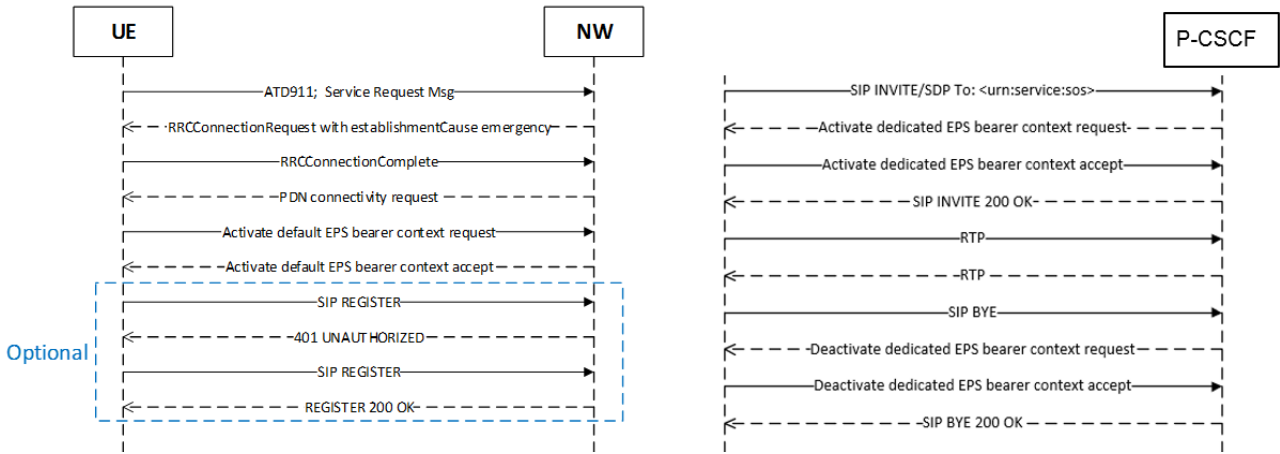


Figure 4: Emergency Call over IMS Procedure

Generally, the emergency call number is gathered from the (U)SIM card, UE setting and network-assigned attach accept message. Quectel modules support reading all emergency call number types. In addition, you can usually add an emergency call numbers with **AT+QECCNUM**, and then take effect immediately and be saved automatically. Please refer to **document [1]** for details of the command.

1.3.2.4. DTMF

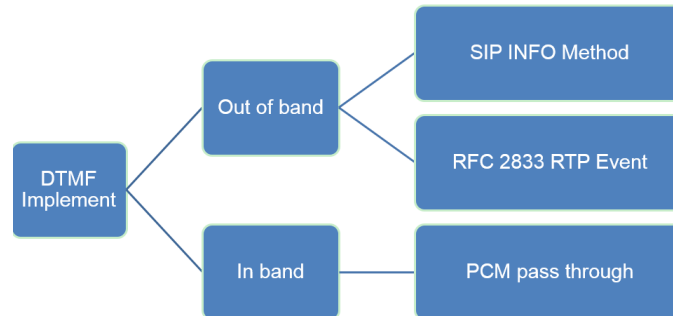


Figure 5: DTMF over IMS Procedure

RFC 2833 RTP event is a popular solution for DTMF over IMS. When it is received and detected correctly, DTMF tone is played simultaneously with DTMF URC.

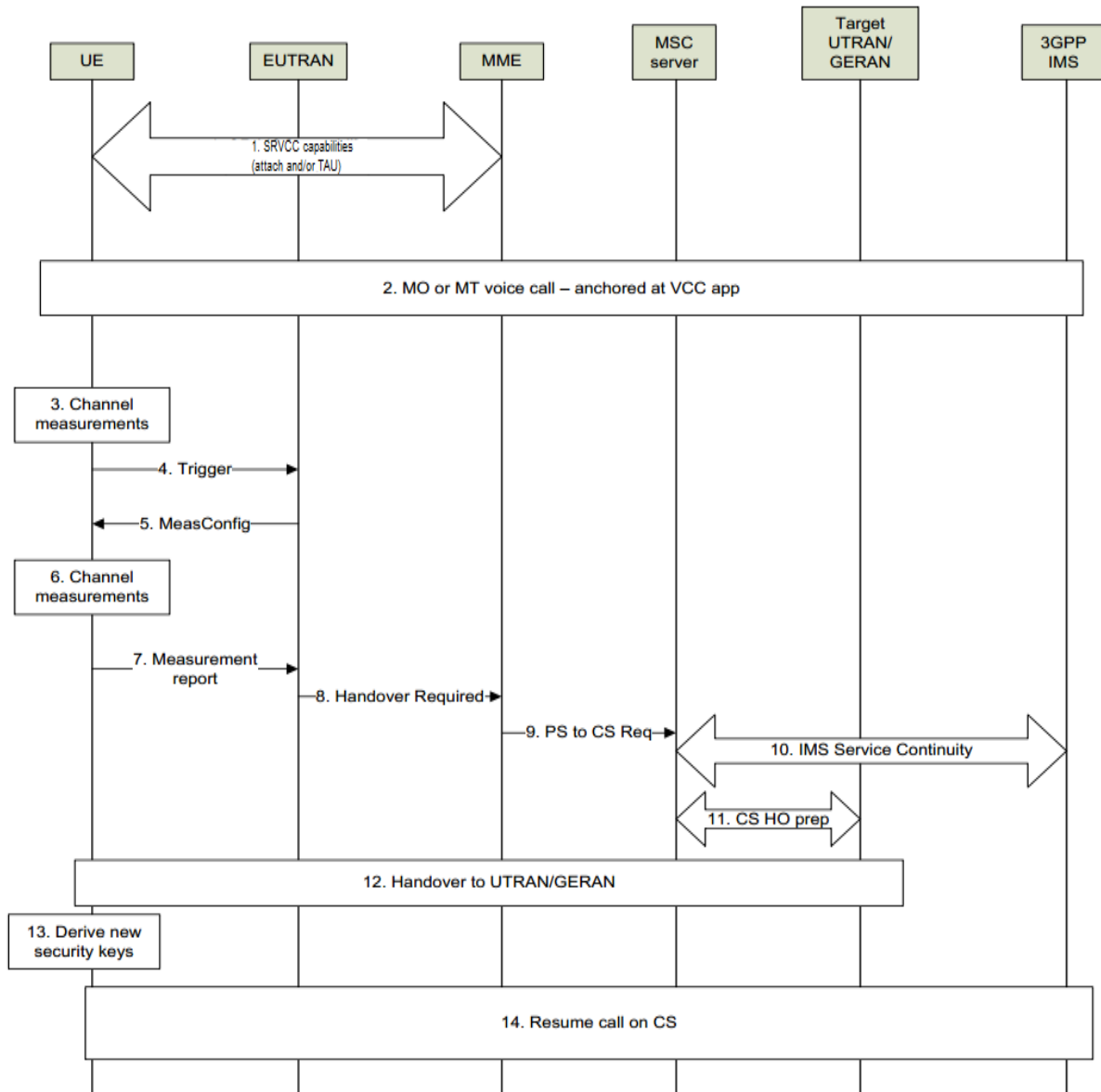
**NOTE**

Currently the applicable modules of this document support RFC 2833 RTP event only.

**1.3.2.5. SRVCC**

SRVCC (Single Radio Voice Call Continuity) provides the ability to transit a voice call from a VoIP/IMS domain to the legacy circuit switch domain.

The high-level call flow is illustrated by the following figure.



**Figure 6: SRVCC over IMS Procedure**

From a UE perspective, the SRVCC process involves:

1. SRVCC capability negotiation – UE and MME should agree on the capabilities and whether SRVCC should be supported. This negotiation is performed in different stages using RRC and NAS signaling.
2. Initiating a voice call – For SRVCC purposes, the voice call will be anchored at VCC task.
3. Channel measurements and reporting – On LTE network, UE shall perform the normal channel measurements on E-UTRAN.
4. If the channel quality with the current eNodeB falls below a certain level, UE will notify eNodeB of it.
5. UE reports the measurements based on the triggers specified by eNodeB. The desired target could be EUTRAN or UTRAN/GERAN.
6. Handover to UMTS/GERAN and derivation of keys upon SRVCC HO.
7. UE uses the CS path to continue the voice call.

Generally, SRVCC is enable by default. You can check it from attach request and UE capability information message.



# 2 IMS Related AT Commands

## 2.1. AT Command Introduction

### 2.1.1. Definitions

- **<CR>** Carriage return character.
- **<LF>** Line feed character.
- **<...>** Parameter name. Angle brackets do not appear on the command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on the command line. When an optional parameter is not given in a command, the new value equals to its previous value or the default settings, unless otherwise specified.
- **Underline** Default setting of a parameter.

### 2.1.2. AT Command Syntax

All command lines must start with **AT** or **at** and end with **<CR>**. Information responses and result codes always start and end with a carriage return character and a line feed character: **<CR><LF><response><CR><LF>**. In tables presenting commands and responses throughout this document, only the commands and responses are presented, and **<CR>** and **<LF>** are deliberately omitted.

**Table 1: Types of AT Commands**

Command Type	Syntax	Description
Test Command	<b>AT+&lt;cmd&gt;=?</b>	Test the existence of corresponding Write Command and return information about the type, value, or range of its parameter.
Read Command	<b>AT+&lt;cmd&gt;?</b>	Check the current parameter value of a corresponding Write Command.
Write Command	<b>AT+&lt;cmd&gt;=&lt;p1&gt;[,&lt;p2&gt;[,&lt;p3&gt;[...]]]</b>	Set user-definable parameter value.
Execution Command	<b>AT+&lt;cmd&gt;</b>	Return a specific information parameter or perform a specific action.

## 2.2. Declaration of AT Command Examples

The AT command examples in this document are provided to help you familiarize with AT commands and learn how to use them. The examples, however, should not be taken as Quectel’s recommendation or suggestions about how you should design a program flow or what status you should set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there exists a correlation among these examples and that they should be executed in a given sequence.

## 2.3. Description of AT Commands

### 2.3.1. AT+QCFG="ims" Configure IMS

AT+QCFG="ims" Configure IMS	
Write Command <b>AT+QCFG="ims"[,&lt;IMS_conf&gt;]</b>	Response If the optional parameter is omitted, query the current setting: <b>+QCFG: "ims",&lt;IMS_conf&gt;,&lt;VoLTE_cap&gt;</b>  <b>OK</b>  If the optional parameter is specified, configure IMS: <b>OK</b> Or <b>ERROR</b>  If error is related to ME functionality: <b>+CME ERROR: &lt;err&gt;</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after rebooting. The configuration will be saved automatically.

#### Parameter

<b>&lt;IMS_conf&gt;</b>	Integer type. Whether to enable/disable IMS function. <u>0</u> Whether to enable/disable IMS function is determined by the default setting in MBN file 1 Enable IMS function compulsorily 2 Disable IMS function compulsorily
<b>&lt;VoLTE_cap&gt;</b>	Integer type. Indicates the capability of VoLTE. 0 VoLTE is disabled

1 VoLTE is enabled

<err> Error codes. Please refer to **document [2]** for details.

**Example**

```

AT+QCFG="ims" //Query the current configuration
+QCFG: "ims",0,0

OK
AT+QCFG="ims",1 //Enable IMS function compulsorily
OK
AT+QCFG="ims" //Query current settings
+QCFG: "ims",1,1 //VoLTE is enabled, and VoLTE session is available

OK
    
```

**2.3.2. AT+QMBNCFG Extended MBN Configuration**

**AT+QMBNCFG Extended MBN Configuration**

Test Command	Response
AT+QMBNCFG=?	+QMBNCFG: "List" +QMBNCFG: "Select",<MBN_name> +QMBNCFG: "Deactivate" +QMBNCFG: "AutoSel",[(list of supported <enable>s)] +QMBNCFG: "Delete", "<MBN_name>" +QMBNCFG: "Add", "<filename>" +QMBNCFG: "List_all"  OK
Maximum Response Time	300 ms
Characteristics	/

**2.3.2.1. AT+QMBNCFG="List" List All MBN Files**

This command queries all the MBN files available in the module.

**AT+QMBNCFG="List" List All MBN Files**

Write Command	Response
AT+QMBNCFG="List"	[+QMBNCFG: "List",<index>,<selected>,<activated>,<MBN_name>,<version>,<release_date>

	[+QMBNCFG: "List",<index>,<selected>,<activated>,<MBN_name>,<version>,<release_date> [...]]
	OK
Maximum Response Time	30 s
Characteristics	/

**Parameter**

<index>	Integer type. Current MBN index number.
<selected>	Integer type. Indicates whether the MBN file is selected. The MBN file that is selected but not activated will be activated in the next reboot. 0 The current MBN file is not selected 1 The current MBN file is selected
<activated>	Integer type. Indicate whether the MBN file is activated. 0 The current MBN file is not activated 1 The current MBN file is activated
<MBN_name>	String type. MBN file name.
<version>	The current MBN version.
<release_date>	The release date of the current MBN file.

**NOTE**

Maximum 25 MBN files are currently supported.

**2.3.2.2. AT+QMBNCFG="Select" Select a Specific MBN File**

This command selects a specific MBN file loaded in the module.

<b>AT+QMBNCFG="Select" Select a Specific MBN File</b>	
Write Command <b>AT+QMBNCFG="Select",&lt;MBN_name&gt;</b>	Response <b>OK</b>  If there is any error: <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after rebooting. The configuration will be saved automatically.

**Parameter**

<MBN\_name> String type. MBN file name.

**2.3.2.3. AT+QMBNCFG="Deactivate" Deactivate MBN Files**

This command deactivates the MBN files that is running on the module.

**AT+QMBNCFG="Deactivate" Deactivate MBN Files**

Write command <b>AT+QMBNCFG="Deactivate"</b>	Response <b>OK</b>  If there is any error: <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after rebooting. The configuration will be saved automatically.

**Example**

```

AT+QMBNCFG="List"
+QMBNCFG: "List",0,1,1,"ROW_Commercial",0x05010800,201801051
OK
AT+QMBNCFG="Deactivate"
OK
AT+QMBNCFG="List"
+QMBNCFG: "List",0,0,0,"ROW_Commercial",0x05010800,201801051
OK
    
```

**2.3.2.4. AT+QMBNCFG="AutoSel" Configure MBN Automatic Selection**

This command configures automatic selection of MBN file.

**AT+QMBNCFG="AutoSel" Configure MBN Automatic Selection**

Write Command <b>AT+QMBNCFG="AutoSel" [&lt;enable&gt;]</b>	Response If the optional parameter is omitted, query the current setting: <b>+QMBNCFG: "AutoSel",&lt;enable&gt;</b>  <b>OK</b>
---	--

	If the optional parameter is specified, configure automatic selection of MBN file: <b>OK</b>  If there is any error: <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after rebooting. The configuration will be saved automatically.

**Parameter**

<b>&lt;enable&gt;</b>	Integer type. Enable or disable the automatic selection of MBN file.
0	Disable
1	Enable

**NOTE**

1. When this function is enabled, the MBN file will be automatically selected based on the IMSI of (U)SIM card by default.
2. When the function is enabled but no appropriate MBN file is activated, the module will reboot automatically to select and activate a suitable MBN file.

**2.3.2.5. AT+QMBNCFG="Delete" Delete a Specified MBN File**

The command deletes a specified MBN file from EFS.

**AT+QMBNCFG="Delete" Delete a Specified MBN File**

Write Command	Response
<b>AT+QMBNCFG="Delete",&lt;MBN_name&gt;</b>	<b>OK</b> Or <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after rebooting. The configuration will be saved automatically.

**Parameter**

<b>&lt;MBN_name&gt;</b>	String type. MBN file name, e.g., "ROW_Commercial".
-------------------------	---

**2.3.2.6. AT+QMBNCFG="Add" Add a New MBN File**

The command adds a new MBN file that needs to be uploaded to the UFS in advance.

**AT+QMBNCFG="Add" Add a New MBN File**

Write Command <b>AT+QMBNCFG="Add",&lt;filename&gt;</b>	Response <b>OK</b> Or <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	/

**Parameter**

**<filename>** String type. File name. Maximum length: 63 characters, e.g., "test.mbn".

**Example**

```

AT+QFUPL="test.mbn",9436
CONNECT
//Input an MBN file whose size is 9436 bytes
+QFUPL: 9436,657c

OK
AT+QMBNCFG="Add","test.mbn"
OK
    
```

**2.3.2.7. AT+QMBNCFG="List\_all" Query PLMN Contained in MBN**

This command queries the PLMNs contained in every MBN.

**AT+QMBNCFG="List\_all" Query PLMN Contained in MBN**

Write Command <b>AT+QMBNCFG="List_all"</b>	Response <b>[+QMBNCFG: "List_all",&lt;index&gt;,&lt;selected&gt;,&lt;activated&gt;,&lt;MBN name&gt;,&lt;version&gt;,&lt;release_date&gt;,&lt;PLMN_list&gt; [...]]</b>  <b>OK</b>
Maximum Response Time	300 s
Characteristics	/

**Parameter**

<index>	Integer type. Current MBN sequence number.
<selected>	Integer type. Indicates whether the MBN is selected. Selected but not activated MBN file will be activated in the next reboot. 0 The current MBN file is not selected 1 The current MBN file is selected
<activate>	Integer type. Indicates whether the MBN list is activated. 0 The current MBN file is not activated 1 The current MBN file is activated
<MBN name>	String type. MBN file name.
<version>	Current MBN version.
<release_date>	The release date of the current MBN.
<PLMN_list>	List of supported PLMNs contained in the imported MBN.

**Example**

```

AT+QMBNCFG=?
...
+QMBNCFG: "List_all"
...

OK
AT+QMBNCFG="List_all" //Query PLMNs contained in MBN
+QMBNCFG: "List_all",0,0,0,"ROW_Generic_3GPP",0x05010824,201806201,""
+QMBNCFG: "List_all",1,1,1,"OpenMkt-Commercial-CU",0x05011510,201911151,"460-01"
+QMBNCFG: "List_all",2,0,0,"OpenMkt-Commercial-CT",0x0501131C,201911141,"455-07"
+QMBNCFG: "List_all",3,0,0,"Volte_OpenMkt-Commercial-CMCC",0x05012011,201904261,"460-00"
"

OK
    
```

**2.4. Examples**

**2.4.1. Upload MBN File Manually**

```

AT+QMBNCFG="List" //List all MBN files
OK //Only OK is responded, indicating no MBN file

AT+QFLST="" //List all files in the UFS
OK //Only OK is responded, indicating no file in the UFS
AT+QFUPL="test.mbn",9436 //Upload file test.mbn whose size should be 9436 bytes
CONNECT
    
```



```
//Input an MBN file whose size is 9436 bytes.
+QFUPL: 9436,657c

OK
AT+QFLST="" //List all files in the UFS
+QFLST: "test.mbn",9436 //The uploaded file test.mbn is listed

OK
AT+QMBNCFG="Add","test.mbn" //Add test.mbn as MBN file
OK
AT+QMBNCFG="List" //List all MBN files
+QMBNCFG: "List",0,0,0,"ROW_Commercial",0x05010800,201801051 //ROW MBN is listed, with
state being neither selected
nor activated

OK
AT+QMBNCFG="Select","ROW_Commercial" //Select ROW MBN
OK
AT+QMBNCFG="List" //List all MBN files
+QMBNCFG: "List",0,1,0,"ROW_Commercial",0x05010800,201801051 //ROW MBN is listed, with
state being selected but not
activated

OK
//Restart the module
AT+QMBNCFG="List" //List all MBN files
+QMBNCFG: "List",0,1,1,"ROW_Commercial",0x05010800,201801051 //ROW MBN is listed, with
state being selected and
activated

OK
```

### 2.4.2. Automatic Selection Feature

```
AT+QMBNCFG="List" //List all MBN files
+QMBNCFG: "List",0,0,0,"ROW_Commercial",0x05010800,201801051 //ROW MBN is listed, with
state being neither selected
nor activated

OK
AT+QMBNCFG="Autosel" //Query the configuration of MBN automatic selection
+QMBNCFG: "Autosel",0 //Automatic selection of MBN file is disabled

OK
```

```

AT+QMBNCFG="Autosel",1 //Enable automatic selection of MBN file
OK
//Restart the module manually
RDY
POWERED DOWN //The module reboots automatically to activate a suitable MBN file
RDY

+CPIN: READY

+QUSIM: 1
+QIND: SMS DONE
AT+QMBNCFG="List"
+QMBNCFG: "List",0,1,1,"ROW_Commercial",0x05010800,201801051 //ROW MBN is listed, with
state being selected and
activated

OK
//Restart the module manually
RDY
+CPIN: READY

+QUSIM: 1 //The module does not reboot if a suitable MBN file has been activated
//The MBN file is activated.
+QIND: SMS DONE
AT+QMBNCFG="List"
+QMBNCFG: "List",0,1,1,"ROW_Commercial",0x05010800,201801051

OK

```

# 3 Appendix References

**Table 2: Related Documents**

Document Name
[1] Quectel_EC2x&EG9x&EG2x-G_Series_AT_Commands_Manual
[2] Quectel_EC2x&EG9x&EG2x-G_Series_QCFG_AT_Commands_Manual

**Table 3: Terms and Abbreviations**

Abbreviation	Description
AKA	Authentication and Key Agreement
AS	Access Stratum
CN	Core Network
CS	Circuit Switched
DTMF	Dual Tone Multi Frequency
EFS	Embedded File System
eNodeB	Evolved Node B
EPS	Evolved Packet System
EUTRAN	Evolved Universal Terrestrial Radio Access Network
GERAN	GSM EDGE Radio Access Network
HO	Hand Over
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identification Number
IP	Internet Protocol

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LTE	(Long-Term Evolution) a 4G mobile communications standard.
MBN	Modem Configuration Binary
MME	Mobility Management Entity
NAS	Non-Access-Stratum
NV	Non-Volatile
NW	Network
PCM	Pulse Code Modulation
PCRF	Policy and Charging Rules Function
PCSCF	Proxy-Call Session Control Function
PDN	Public Data Networks
PDP	Packet Data Protocol
PGW	PDN (Packet Data Network) Gateway
PLMN	Public Land Mobile Network
PS	Packet Switch
QCI	QoS Class Identifier
RES	Response
RFC	Request For Comments
RRC	Radio Resource Control
RTP	Real-time Transport Protocol
SDP	Session Description Protocol
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SMS	Short Message Service
SRVCC	Single Radio Voice Call Continuity
TA	Terminal Adapter
UE	User Equipment

---

UFS	User File System
(U)SIM	(Universal) Subscriber Identity Module
UTRAN	UMTS Terrestrial Radio Access Network
VCC	Voice Call Continuity
VoIP	Voice over Internet Protocol
VoLTE	Voice (voice calls) over LTE

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