GSM eCall
Application Note

GSM Module Series

Rev. GSM_eCall_Application_Note_V1.3

Date: 2015-04-07

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About the Document

History

Revision	Date	Author	Description
1.0	2012-02-22	Laguna XU	Initial
1.1	2012-03-28	Thomas ZHANG	1. Restructured the document. 2. Added eCall introduction and eCall test steps. 3. Added AT commands for PSAP simulation.
1.2	2013-01-29	Thomas ZHANG	1. Modified format and names of AT commands and URC. 2. Modified the call flow.
1.3	2015-04-07	Thomas ZHANG	Added applicable modules

Contents

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1 Introduction

This document mainly introduces how to use the eCall function of Quectel standard module. The aim of this document is not to explain the mechanism of eCall service, which can be looked up in the standard specifications, but the usage of eCall function in Quectel modules.

This document is applicable to Quectel M10, M66, M85 and M95 modules.

2 eCall Overview

eCall is defined as a manually or automatically initiated emergency call from a vehicle, supplemented with a minimum set of emergency related data (MSD), as defined under the EU Commission's eSafety initiative.

It can be depicted by the figure below.
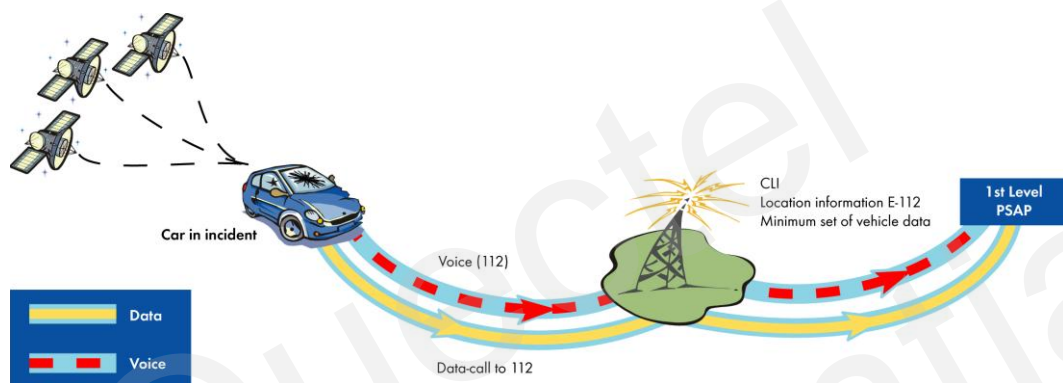
Figure 1: eCall System Overview

The architecture of eCall system is described in Figure 2. In Quectel test system, the module has the ability to act as IVS and also to simulate the PSAP. Thus, eCall testing can be easily performed by preparing two Quectel modules in the circumstance without access to a real PSAP. It will be described in the following chapters. Of course, if a real PSAP can be accessed, testing in the real environment is preferred.
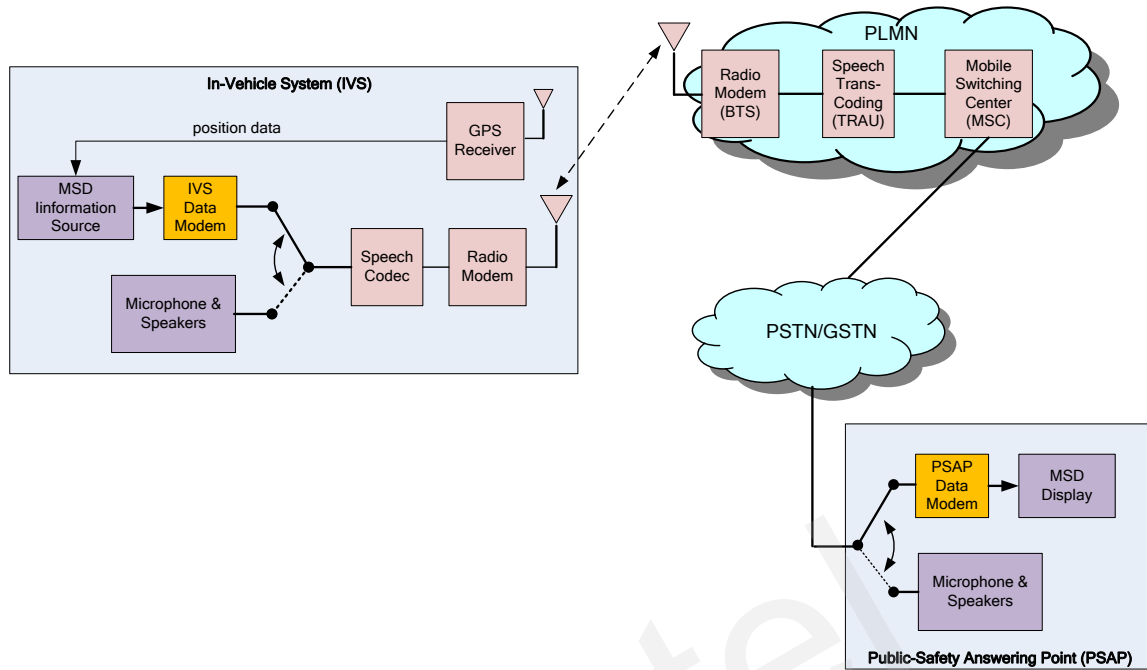
Figure 2: eCall System Architecture

3 eCall Flows

After an emergency voice call has been (automatically or manually) established, the IVS modem receiver constantly monitors the incoming signal from the speech decoder output. When prompted by a request from the PSAP operator for MSD, the IVS connects the IVS data modem transmitter to the input of the speech coder and mutes any speech from the motorist for the duration of MSD transmission to prevent it from interfering with the eCall data transmission. Alternatively, it can be the IVS that may trigger the MSD transmission. In this case, the IVS asks the PSAP to request an MSD transmission.

The first operation mode shall be referred to as the *pull* mode whereas the latter one is the *push* mode. Essentially, push mode is realized by a request from the IVS to the PSAP to *pull* the MSD.

The following figures show the detailed procedure of each mode.

3.1. Push Mode

Figure 3: Push Flow Chart
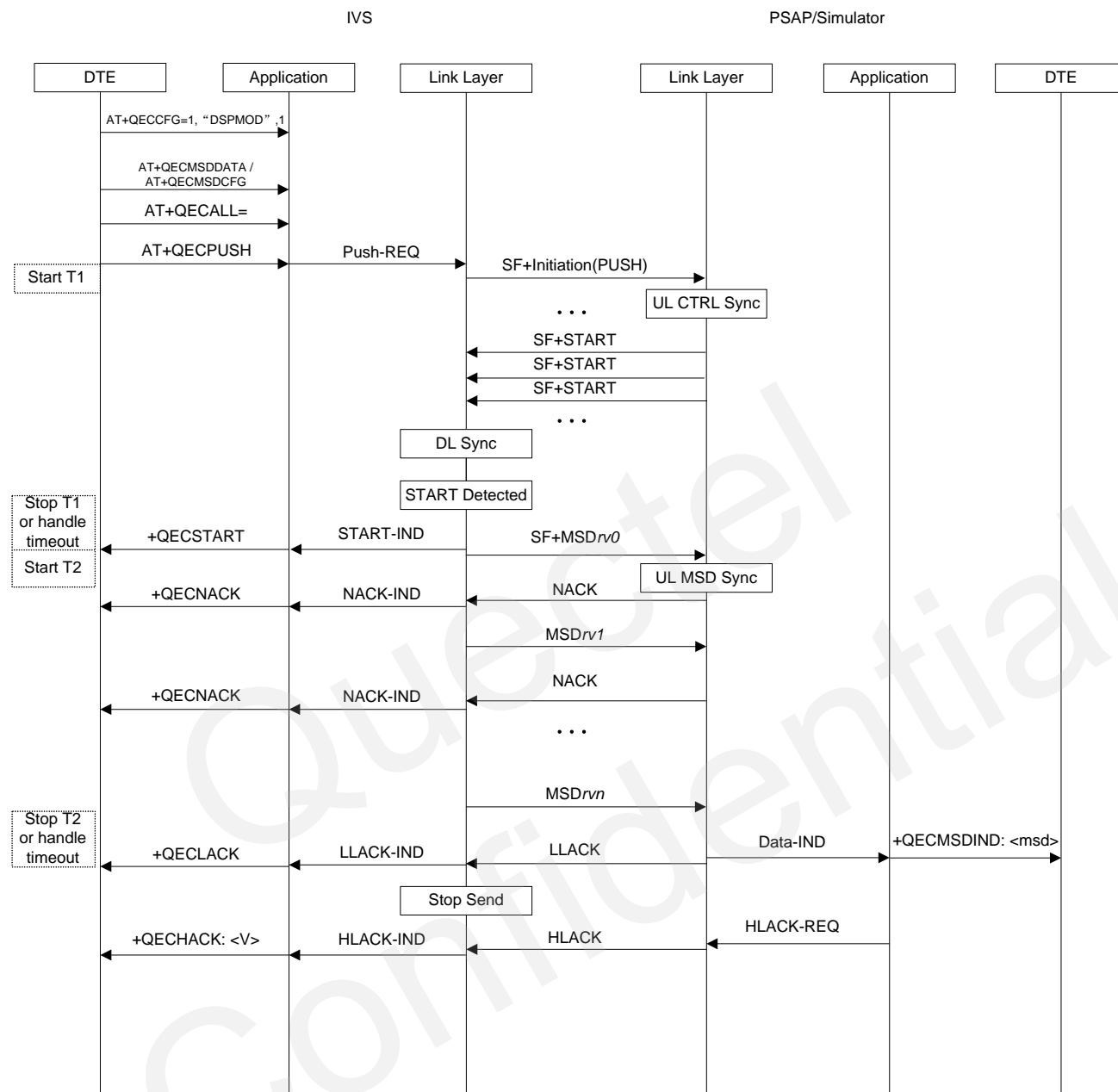
a. In *push* mode the PSAP Rx starts monitoring the incoming signal immediately after the call has been established.

b. IVS Tx continues to send the push message (SF+INITIATION). In the PSAP side, if two correct sync preambles (CONTROL_SYNC) have been detected and a subsequent *push* message has been identified, PSAP thinks it detected the push message.

c. Then PSAP triggers to START state, resets its Rx, and sends the SF+START message continuously until it detected synchronization frames (MSD_SYNC). IVS will detect the synchronization and lock the sync state after receiving two successful syncs, and the "+QECSTART" will be reported to UART.

After detection of START message, fast modulation mode is chosen, and IVS triggers the MSD SEND state.

d.   Upon detection of the START message, the IVS starts the transmission of the first MSD message with incremental redundancy version *rv*0 which is preceded by a synchronization frame.

e.   The PSAP Rx will demodulate the MSD and send NACK if CRC check failed or send ACK if CRC check passed. The PSAP simulator of current version only sends HLACK but no LLACK.

f.   If the MSD of one revision is not received correctly, IVS will receive NACK, and send next redundancy revision of the same MSD until it receives LLACK or HLACK.

g.   If LLACK is received, "+QECLACK" will be reported; If HLACK is received, "+QECHACK: <code>" will be reported while <code> represents the HLACK data.

For the error handling flow, please refer to the 3GPP TS 26.267.

The timeout mechanism in the flow chart above is not implemented in modem. It should be implemented by customers.

3.2. Pull Mode

The pull mode is mostly same with push mode, but only the MSD send is triggered by PSAP. It can be demonstrated in the figure below.
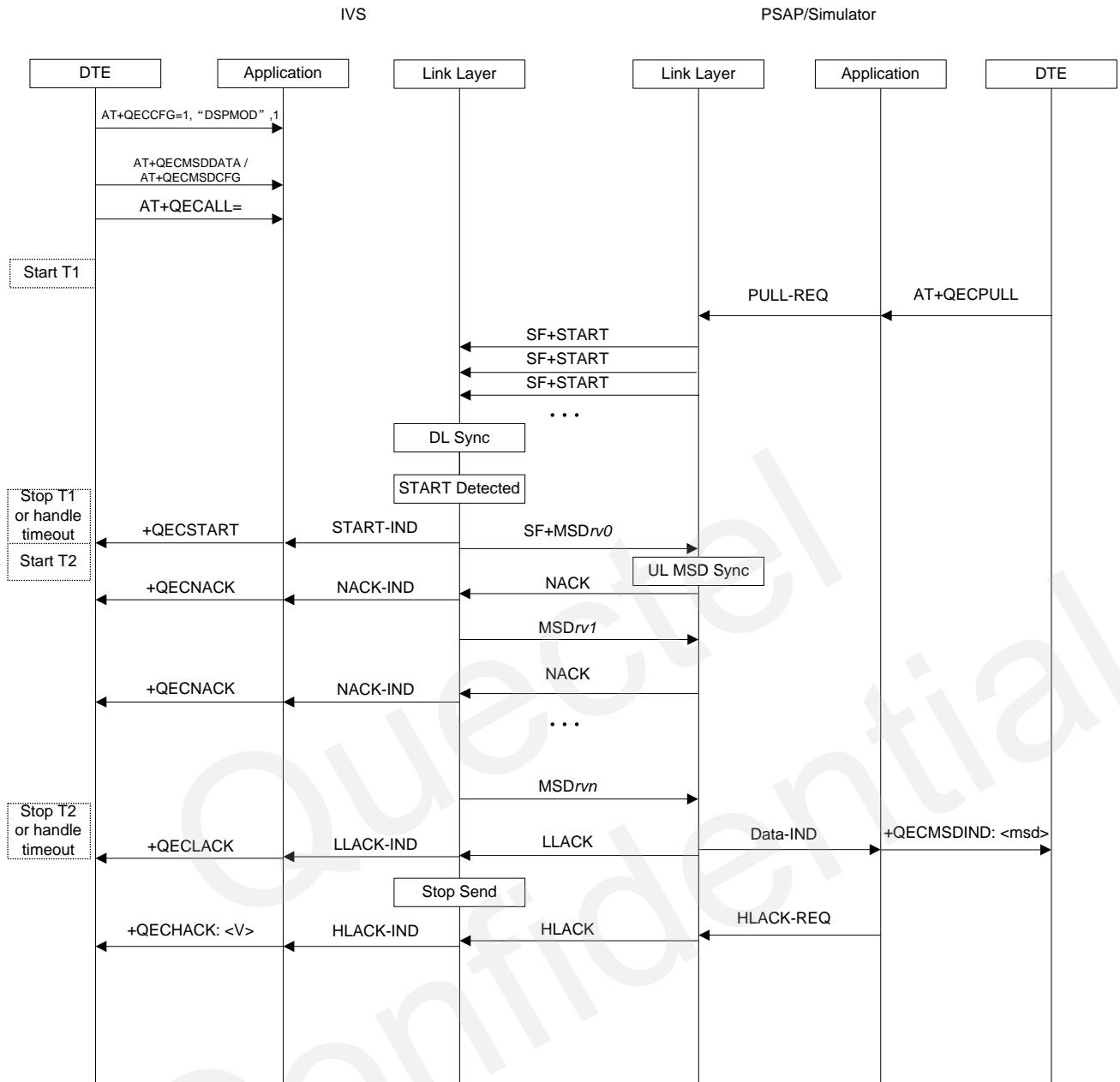
Figure 4: Pull Flow Chart

3.3. Call Release

Use AT+QECALL=0 or ATH to release the call. AT+QECCFG=1,"DM",0 can be sent to turn off DSP monitoring mode.

4 eCall Testing

4.1. Commands to be Used during the Test

AT commands maybe used in IVS side includes,

AT+QECCFG	// Configure eCall function, such as DSP mode, dial number, etc.
AT+QECMSD	// Set the whole MSD data
AT+QECALL	// Establish or release eCall
AT+QECPUSH	// IVS pushes MSD to PSAP

URC reports include:

+QECSTART	// Detected synchronization frame and START message from PSAP, IVS starts to send MSD
+QECNACK	// IVS received NACK from PSAP
+QECLACK	// IVS received Link Layer ACK from PSAP. It means data from link layer transfers successfully.
+QECHACK: <code>	// IVS received High Layer ACK from PSAP, with the 4 bit value <code> reported

To support eCall test, we add several commands so that the module can simulate PSAP.

AT commands maybe used in PASP simulator side includes,

AT+QECCFG	// Configure DSP mode to simulate PSAP
AT+QECPULL	// PSAP triggers MSD pull mode

URC report includes,

+QECMSDIND: <MSD>	// MSD is received in PSAP simulator side

Please refer to Chapter 5 for the detailed information of these AT commands.

4.2. Test Steps

1. Prepare two Quectel modules, download the same eCall firmware to the two modules then reset them.
2. Insert SIM card and make sure the two modules have registered to the network and can dial or accept the call.
3. One module is used as IVS, the other simulates PSAP. We will call them M_IVS and M_PSAP in this document.
4. Set DSP monitoring mode and MSD data.

On the M_IVS, execute AT commands:

AT+QECCFG=1,"DM",1   // Turn on IVS mode, DSP starts monitoring eCall related signal

// Set the MSD, hex bytes. This data is just an example. Max data length is 140 bytes, input as 280 characters in hex string format.
AT+QECMSD=c5e165df6a789b4aaaa46ee4a651820daaf625803735d9dfd5c7067927d821a43d4b64b 74cd2116dc582aabc6f4e45cdf9cbe2f74eb1aaf69cb4ef86cde48f86e02147d6c49ea22587144bbfdaa8 ef92c04afeb0c4e93ba93453561e65acd5065bbe12abde11819d86434039cf4e619124d5f308240ab0ea 11635aef2edfc8bc39e77768d784b67f6f7cb603

On the M_PSAP, execute AT commands:

AT+QECCFG=1,"DM",2   // Turn on PSAP simulation mode

5. Establish eCall.

On the M_IVS, execute AT commands:

AT+QECCFG=1, "DT",1,13888888888   // Set test number of PSAP. Use the actual   number of
                                                                                             M_PSAP.
AT+QECALL=1,0,0   // Establish the test eCall

Now, M_PSAP should ring. Accept the call via **ATA**.

6. Test Pull mode.

On the M_PSAP, execute AT commands:

AT+QECPULL

[Expected results] Regular noise should be heard on the two modules, and finally **+QECMSDIND** should be reported to the UART with the MSD data. The valid data received should be same as that set in M_IVS.

For example:

+QECMSDIND:C5E165DF6A789B4AAAA46EE4A651820DAAF625803735D9DFD5C7067927D821A4
3D4B64B74CD2116DC582AABC6F4E45CDF9CBE2F74EB1AAF69CB4EF86CDE48F86E02147D6C4
9EA22587144BBFDAA8EF92C04AFEB0C4E93BA93453561E65ACD5065BBE12ABDE11819D86434
039CF4E619124D5F308240AB0EA11635AEF2EDFC8BC39E77768D784B67F6F7CB603

On the M_IVS side, the following URC will be reported:

+QECSTART
+QECNACK
+QECNACK
+QECNACK
+QECHACK: 5

The PSAP simulator (M_PSAP) will send back the first 4 bits of MSD as the High Layer ACK (HL-ACK) code. This is why "+QECHACK: 5" is reported. In real PSAP, what content is sent is defined by PSAP side. Please refer to clause 6 of 3GPP TS 26.267 for the HL-ACK code definition.

The LLACK is not reported here, because the PSAP simulator did not send the LLACK actually, but only send the HLACK. A real PSAP should send the LLACK, and then module will detect and report the LLACK. The PSAP simulation function may be improved in the future.

7.   Test Push mode.

On M_IVS, execute commands:

AT+QECPUSH   // Push MSD to PSAP

[Expected Result] Same as the pull mode

8.   End test.

Release call, turn off DSP monitoring MSD.

AT+QECALL=0   //Release call
or
ATH   //Release call

On M_IVS,

AT+QECCFG=1,"DM",0   // Turn off DSP monitoring MSD

On M_PSAP

AT+QECCFG=1,"DM",0   //Turn off PSAP simulating

5 eCall AT Commands Description

5.1. AT Command Syntax

Test Command	AT+<x>=?	This command returns the list of parameters and value ranges set by the corresponding Write Command or internal processes.
Read Command	AT+<x>?	This command returns the currently set value of the parameter or parameters.
Write Command	AT+<x>=<…>	This command sets the user-definable parameter values.
Execution Command	AT+<x>	This command reads non-variable parameters affected by internal processes in the GSM engine

5.2. Description of AT Command

5.2.1. AT+QECCFG   eCall Related Configuration

AT+QECCFG eCall Related Configuration	
Test Command **AT+QECCFG =?**	Response **OK**
Write Command **AT+QECCFG=<mode>,<config_type>[,<value>,…]**	Response if <mode> is Write, **OK** If <mode> is Read, **+QECCFG: <value>** **OK**
Reference	

Parameter

<mode>	Operation mode
	0 Read – query the configuration
	1 Write – set the configuration
<config_type>	Configuration type [Optional]
	"DM" Set the DSP monitoring mode
	"DT" Set the dial number type
	"EM" Set the eCall mode
<value>	Values of one configuration
	If <config_type> == "DM",
	0 Turn off DSP monitoring mode; Close the IVS / PSAP mode.
	1 Turn on IVS mode
	2 Turn on PSAP simulation mode, only for testing
	If <config_type> == "DT",
	0 Clear both test number and reconfiguration number. Use 112 (emergency call) or FDN/SDN number (test / reconfiguration eCall)
	1[,<tnum>] <tnum> is optional. If it's given, dial the <tnum> instead of FDN for test eCall. If <tnum> is omitted, it means to clear the user defined test number.
	2[,<rnum>] <rnum> is optional. If <rnum> is assigned, dial the <rnum> instead of SDN for reconfiguration eCall. If <rnum> is omitted, it means to clear the user defined reconfiguration number.
	If <config_type> == "EM",
	0 SIM_ECALL_NONE. eCall is not allowed.
	1 SIM_ECALL_ONLY. Only emergency call is allowed
	2 SIM_ECALL_AND_NORMAL. Emergency call and normal call are allowed.
	3 SIM_ECALL_TEST_DISABLED. In such mode, the mode is decided by reading service table in SIM card, but not by AT commands.

NOTES

1. The logic of which number is used is described as below,
   ```
   If Test or Reconfigure eCall
       If test_num/ recfg_num exists, then use them.
       else
           if SIM_ECALL_ONLY, then 1st FDN as test num, 2nd FDN as reconfiguration num
           else if SIM_ECALL_AND_NORMAL, then
               get from last 2 sdn. 1st as test num, 2nd as recfg num.
           endif
       endif
   else if manually or automatically initiated eCall, then
       get num from the first customized ecc num: 112 default!
   endif
   ```

2. The first step of eCall should be enabling the IVS / PSAP mode; otherwise, other commands may fail.
3. <value> is only needed if <mode> is 1.
4. An optional proceeding '+" and numbers (0-9) are only allowed in <tnum> and <rnum>; In write mode, if <tnum> or <rnum> is omitted, it means to clear the number.
5. In general, there is no need to change the eCall mode, which is configured via SIM card by default.

Example

AT+QECCFG=1,"DM",1	// Turn on the IVS mode, let the DSP monitor the eCall related signal in speech frames.
OK	
AT+QECCFG=0,"DM"	// Query the DSP mode
+QECCFG: 1	
OK	
AT+QECCFG=1,"DM",0	// Turn off the IVS or PSAP simulation mode
OK	
AT+QECCFG=0,"DT"	// Query the dial number type
+QECCFG: 1,12345678	// If any number is set, it will be printed.
+QECCFG: 2,+8612345678	
OK	
AT+QECCFG=1,"DT",0	// Clear the test number and reconfiguration number
OK	
AT+QECCFG=0,"DT",1	// Query the test number setting
OK	// Empty, only OK printed. It means test number is not set.
AT+QECCFG=0,"DT",2	// Query the reconfiguration number setting
OK	
AT+QECCFG=1,"DT",2,+861234567	// Set the reconfiguration number
OK	
AT+QECCFG=0,"DT",2	// Query the reconfiguration number
+QECCFG: +861234567	// Number printed
OK	
AT+QECCFG=1,"DT",2	// Without number. Clear the reconfiguration number.
OK	
AT+QECCFG=0,"DT",2	// Query the reconfiguration number
OK	// Empty. It means reconfiguration number is not set.

5.2.2. AT+QECMSD   Set the Whole MSD Data

AT+QECMSD Set the Whole MSD Data	
Test Command **AT+QECMSD=?**	Response **OK**
Write Command **AT+QECMSD=<MSD_data>**	Response **OK**
Reference	

Parameter

<MSD_data>   MSD data. Should be hex bytes written in string format, refer to examples below.

> **NOTES**
>
> 1. This command will fail if IVS mode is not enabled.
> 2. Do not include the MSD string in quotes. See examples below.
> 3. Max length of <MSD_data> is 280 hex characters, which can represent 140 bytes of MSD data.
> 4. Spaces in <MSD_data> are skipped; and characters out of the range '0' ~ 'f' will be regarded as '0'.
> 5. The MSD data set in this command will not be saved to NV memory.

Example

```
// Set the 140 bytes of MSD
AT+QECMSD=c5e165df6a789b4aaaa46ee4a651820daaf625803735d9dfd5c7067927d821a43d4b64b
74cd2116dc582aabc6f4e45cdf9cbe2f74eb1aaf69cb4ef86cde48f86e02147d6c49ea22587144bbfdaa8
ef92c04afeb0c4e93ba93453561e65acd5065bbe12abde11819d86434039cf4e619124d5f308240ab0ea
11635aef2edfc8bc39e77768d784b67f6f7cb603
OK
```

5.2.3. AT+QECALL   Establish / Release eCall

AT+QECALL Establish / Release eCall	
Test Command **AT+QECALL=?**	Response **+QECALL: (list of supported <session>s),(list of supported <activation_type>s),(list of <type_of_call>s)** **OK**

Read Command	Response
AT+QECALL?	**+QECALL: <session>[,<activation_type>,<type_of_call>]**
	OK
Write Command	Response
AT+QECALL=<session>[,<activation_type>,<type_of_call>]	**OK**
	If error is related to ME functionality:
	+CME ERROR: <err>
Reference	

Parameter

<session>	Establish / release eCall	
	0	Release eCall
	1	Establish eCall
<activation_type>	Activation type of eCall	
	0	Manually initialized eCall
	1	Automatically initialized eCall
<type_of_call>	eCall type	
	0	Test call
	1	Emergency call
	2	Reconfiguration call

NOTES

1. If no eCall exists, "AT+QECALL?" will return "+QECALL: 0".
2. If <session> is 0, <activation_type> and <type_of_call> will be ignored.
3. For manually and automatically initialized eCall (<type_of_call> is 1), the dial number is got from emergency call list. The first item, it is 112 by default. For test / reconfiguration eCall (<type_of_call> is 0 or 2), if test reconfiguration number is set, it is preferred to be used. If test reconfiguration number is not set or cancelled, the number will be got from the FDN or SDN. Refer to the notes of AT+QECCFG.
4. For test and reconfiguration call, it will return ERROR if failed to get dial number or the eCall mode is incorrect.
5. This command is only used in IVS side.

Example

AT+QECALL=1,0,0	// Establish a test eCall
OK	
AT+QECALL?	// Query eCall state
+QECALL: 1,0,0	

```
OK
AT+QECALL=1,0,2          // Establish a reconfiguration eCall
OK
AT+QECALL=1,0,1          // Establish a manually initiated eCall
OK
AT+QECALL=1,1,1          // Establish an automatically initiated eCall
OK
AT+QECALL=0              // In IVS side, release the eCall session, like ATH.
OK
AT+QECALL?               // Query eCall state
+QECALL: 0

OK
```

5.2.4. AT+QECPUSH   Push MSD Data to PSAP

AT+QECPUSH Push MSD Data to PSAP	
Test Command AT+QECPUSH =?	Response OK
Execution Command AT+QECPUSH	Response OK
Reference	

Example

```
AT+QECPUSH               // Transfer MSD in push mode
OK
```

5.2.5. AT+QECPULL   Transfer MSD in Pull mode, only for Simulating

AT+QECPULL PSAP Pull MSD from IVS, only for Simulating	
Test Command AT+QECPULL=?	Response OK
Execution Command AT+QECPULL	Response OK
Reference	

> **NOTE**
>
> Only applied when PSAP simulating mode is turned on.

Example

AT+QECPULL	// Transfer MSD in pull mode
OK	

5.3. Summary of URC

Table 1: eCall Related URC

Index	URC display	Meaning	Condition
1	+QECSTART	Detected synchronization frame and START message from PSAP, IVS starts to send MSD	
2	+QECNACK	IVS received NACK from PSAP	
3	+QECLACK	IVS received Link Layer ACK from PSAP, data from link layer transfers successfully.	Only sent when data from link layer transfers successfully.
4	+QECHACK	IVS received High Layer ACK from PSAP, with the 4 bit value <code> reported.	
5	+QECMSDIND: <MSD>	The MSD data is received by PSAP.	

6 Appendix A Reference

Table 2: Related Documents

SN	Document name	Remark
[1]	Mxx_ATC	Mxx AT commands set
[2]	3GPP TS 26.267	eCall Data Transfer; In-band modem solution; General description
[3]	3GPP TS 22.101	Service aspects; Service principles
[4]	3GPP TS 26.268	eCall Data Transfer; In-band modem solution; ANSI-C reference code
[5]	CEN EN 15722	Road transport and traffic telematics – eSafety – eCall minimum set of data

Table 3: Terms and Abbreviations

Abbreviation	Description
ME	Mobile Equipment
TA	Terminal Adapter
MS	Mobile Station
ACK	Acknowledgement
HL-ACK	High Layer ACK
LL-ACK	Link Layer ACK
DTE	Data Terminal Equipment
IVS	In-Vehicle System
MSD	Minimum Set of Data

PSAP	Public Safety Answering Point
URC	Unsolicited Response Code
NV	Non-volatile