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Hardware Compatibility	Product Line	AirPrime	Series	HL7800					
				HL7800-M					
				HL7802					
Software Compatibility	FW Releases 4.5.x, 4.6.x			Document Type	Application Note	<input checked="" type="checkbox"/>	Technical Note		



1 Version

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2 Introduction

This document is provided to Sierra Wireless distributors and clients to aid more rapid development of embedded applications using the Sierra Wireless portfolio of cellular solutions. To request a new application/technical note, contact your regional Sierra Wireless Product Marketing Manager.

3 Glossary

Term/Initials	Definition
Active Timer	Also known as the T3324 timer, this defines the time for which the UE will remain reachable for mobile terminated services on transition from Connected to Idle mode. This transition period commonly applies to the time after a TAU or MO data.
CE	Coverage Enhancement
CE Level	Number (1-4) assigned to the UE by the network to indicate signal coverage level at the UE's position. Higher numbers indicate a higher UL repetition factor will be used in communications. For details, refer to +CRCES in [1] AirPrime HL78xx AT Commands Interface Guide.
eDRX Sleep	State between two Paging Time Windows where the modem is registered to the network with a successful eDRX negotiation, but is not listening to the paging channel.
MO	Mobile Originated
MT	Mobile Terminated
PSM Dormant	State where modem is registered to the network with a successful PSM negotiation and is not listening to the paging channel.
TAU	Tracking Area Update
UE	User Equipment
UL	Uplink
UL Repetition Factor	Number of times that MO data will be retransmitted. Dependent on CE Level. If the UE is in IDLE or RACH state, this number applies to RACH messages. If the UE is in Connected state, this number applies to PUSCH messages.
URC	Unsolicited Response Code

4 Description

This document describes the new "Signal Quality URC on Wakeup" feature that has been integrated into Sierra Wireless' existing +KCELLMEAS AT command as of firmware HL78XX.4.5.0.

5 Signal Quality URC on Wakeup

This new +KCELLMEAS URC provides the user with updated signal quality information to inform the decision to transmit data, potentially saving power in poor coverage scenarios. Currently, this feature supports PSM (NB-IOT and LTE-M RATs) and eDRX (LTE-M only). Key characteristics of this URC are as follows:

- A +KCELLMEAS URC is produced after the host raises the WAKEUP pin (drives the pin high) during **PSM Dormant**, or **eDRX Sleep** while the modem is in low power mode (Sleep, Lite Hibernate, or Hibernate). For low power mode details, refer to [2] AirPrime HL7800 Low Power Modes Application Note.
The URC contains updated signal quality information that the user can use to determine when/if they should transmit data. In poor coverage scenarios, data transmission can require multiple repetitions (UL Repetition Factor) and consume excessive power. The URC data gives the user more control over power consumption in these scenarios.
- URC format: +KCELLMEAS: <Rev 1 data>
- The <timeout> parameter of AT+KCELLMEAS (see section 5.1 below) should be set according to the user's power budget. The more time the module spends trying to acquire fresh signal quality measurements, the more power will be consumed in a reduced or out-of-coverage scenario.

5.1 Changes to +KCELLMEAS AT Command

The +KCELLMEAS AT command has been modified to implement the Signal Quality URC on Wakeup feature:

- Revision 1 data has been added
 - Appends CE Level and UL Repetition Factor to Revision 0 measurement data
 - See [1] AirPrime HL78xx AT Commands Interface Guide Rev.12 command format details.
- An optional <timeout> parameter has been added to configure the Signal Quality URC on Wakeup feature.

5.2 [PSM only] Data transmission and Active Timer Interaction

As noted above, the +KCELLMEAS URC is triggered by raising the WAKEUP pin during PSM Dormant. When the module wakes to send data and/or a TAU, the +KCELLMEAS URC feature is temporarily disabled, and then re-enabled after the Active Timer expires and a +CEREG: 4 URC is received.

- If the WAKEUP pin is low while the Active Timer is running, the module will return to sleep after receiving the +CEREG: 4 URC.
- If the WAKEUP pin is high while the Active Timer is running, the host should wait for the Active Timer to expire before lowering the pin. If the pin is lowered before the +CEREG: 4 URC is received, the subsequent Active Timer expiry will wake the module, consuming excess power. For this reason, it is recommended to choose an Active Timer that balances time to receive MT data with time spent in non-hibernate state.
- If there was no data transmission, but the WAKEUP pin was raised and a +CEREG: 1 or +CEREG: 5 URC was received, then lowering the pin will allow the module to return to sleep.

This behavior only applies to operation in PSM Dormant. The +CEREG: 4 URC condition does not apply to eDRX Sleep – in eDRX operation the WAKEUP pin can be lowered after data transmission is complete.

5.3 How To Use

To use the Signal Quality URC on Wakeup feature:

1. Drive the WAKEUP pin high.
2. Enable network registration URCs:
AT+CEREG=5
OK
3. Configure the sleep level:
AT+KSLEEP=1 ,<level>
OK
4. Configure PSM and/or eDRX:
 - Enable PSM:
AT+CPSMS
OK

- Enable eDRX:
AT+KEDRXCFCG
OK
5. Configure the +KCELLMEAS URC:
AT+KCELLMEAS=1,<timeout>
OK
 6. For PSM only:
 - a. Wait for the module to camp on cell and display a +CEREG URC (+CEREG: 1 or +CEREG: 5) with PSM timers.
 - b. Wait for Active Timer timeout (+CEREG:4, <timers>)
 7. Leave WAKEUP floating or tie it low.
 8. Allow the module to enter Sleep/Lite Hibernate/Hibernate. (For details regarding how to monitor the activation of Hibernate mode, refer to [2] AirPrime HL7800 Low Power Modes Application Note.)
 9. Drive the WAKEUP pin high.
 10. The module automatically tries to acquire fresh signal quality measurements. Wait for a +KCELLMEAS URC, which indicates the measurement attempt succeeded, timed out, or failed due to a network issue.

For example:

- Example – Successful measurement attempt URC:
+KCELLMEAS: -93.0,112.0,0.0,0.0,10.0,1,1
 - Example – Unsuccessful measurement attempt URC:
+KCELLMEAS: / / / / / / / /
11. Based on the +KCELLMEAS URC values, decide whether to proceed with data transmission.
 12. When finished, leave WAKEUP floating or tie it low.

The module will return to sleep.

6 Related AT Commands

The following AT commands are referenced in this document. For usage details, refer to [1] AirPrime HL78xx AT Commands Interface Guide.

AT Command	Description
+CEREG	EPS Network Registration Status
+CPSMS	Power Saving Mode Setting
+KCELLMEAS	Request LTE Network Coverage Information and Configure URC on Wakeup
+KEDRXCFCG	Configure eDRX
+KSLEEP	Power Management Control

7 Reference Documents

	Filename	Document #
[1]	AirPrime HL78xx AT Commands Interface Guide	41111821 Rev.12
[2]	AirPrime HL7800 Low Power Modes Application Note	2174229 Rev.2.0

8 Support

For direct clients: contact your Sierra Wireless FAE

For distributor clients: contact your distributor FAE

For distributors: contact your Sierra Wireless FAE

9 Document History

Level	Date	History
1	December 11, 2020	Creation

10 Legal Notice

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

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Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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