HL78xx - Automatic RAT Switching

2174296-2

Author:	Sierra Wireless	Date:	July 15, 2021

APN Content Level	BASIC		INTERMEDIATE	✓	ADVANCED		Confidentiality	Public	✓	Private	

Hardware Compatibility	Product Line	AirPrime	Series	HL7800	
				HL7800-M	
				HL7802	

Software Compatibility	FW Releases 4.5.x, 4.6.x	Document Type	Application Note	✓	Technical Note	

1 Version

These documents may be updated over their lifetime. To ensure you design with the correct version, please check The Source page on source.sierrawireless.com for latest versions.

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
PRL	Preferred RAT List. The user defined list of RATs ordered by fallback preference. See AT+KSELACQ.
RAT	Radio Access Technology

4 Description

This document describes the automatic RAT switching behavior of the HL78 module and provides examples of how to use both the recommended hands-off RAT management feature (AT+KSELACQ) and the legacy RAT switching feature (AT+KSRAT).

5 AT Commands for RAT Switching

The HL78 supports two AT commands that control RAT switching:

- +KSELACQ – This command allows any RAT selection combination (single RAT included) to be performed.

  This command is recommended for exclusive control of RAT switching.

- +KSRAT – This command can be used to switch to a specific RAT. (Automatic switching between RATs is not supported.)

  This command is supported for legacy operation (e.g. for customers that cannot change their existing application to use +KSELACQ). If legacy operation compatibility is not needed, AT+KSRAT should be kept at its default setting (0).

5.1 Sample AT Command Configuration

Example – Configuring the PRL in order of RAT preference: CAT-M, NB-IoT, GSM

```
AT+KSELACQ = 0,1,2,3
OK

AT+CFUN=1,1    (A reboot is required for the new AT+KSELACQ settings to take effect.)
OK
```

For more examples of AT command use cases, see section **7 How to Use**.

6 Automatic RAT Switching Behavior

6.1 Power On

When the module powers on or transitions from radio off to radio on (i.e. by calling AT+CFUN=1 when the current +CFUN <fun> value is 0), it starts scanning for a suitable cell using the first RAT in the PRL. (To configure the PRL, use AT+KSELACQ.)

Note – When the radio is on, if it is necessary to restart scanning from the first RAT in the PRL, turn the radio off (AT+CFUN=0) and then turn it back on (AT+CFUN=1).

6.2 Scan Failure

If no suitable cell is found or all attach requests have been rejected in the current RAT after the first full scan is complete, the module switches to the next RAT in the PRL and begins scanning. If the end of the PRL is reached, the module restarts scanning from the beginning.

6.3 Out of Coverage

If the module loses coverage on the currently registered cell, it begins scanning as described in **6.1 Power On**, beginning from the currently active RAT and switching to the next RAT in the PRL if a Scan Failure occurs.

7 How to Use

RAT switching is required during module testing and deployment. The AT command to use (+KSELACQ or +KSRAT) depends on the use case.

7.1 Deployment with Hands-off RAT Management: AT+KSELACQ

All deployed modules should be configured with AT+KSELACQ to allow hands-off RAT management. There are two typical use cases for deployed module RAT preferences:

- **Use case: The user only desires a specific RAT to be active.**

  For example, the following command adds only a single RAT to the PRL. If the module loses coverage, it will continue to search for a suitable cell on that RAT only.

  ```
  AT+KSELACQ=0,<RAT>
  ```

- **Use case: The user has a preferentially ordered RAT list.**

  AT+KSELACQ configures the PRL with all RATs (primary and non-primary) that should be used to search for cells.The PRL allows the module to automatically change RATs if no cells are found on the primary RAT. Even if there is no preference between non-primary RATs, they must still be configured in the PRL – if a RAT is not added to the PRL, it will not be used to search for cells.

  For example, the following command sets <RAT1> as the primary RAT. If the module loses coverage on RAT1, it will search on RAT2, then RAT3, and then will repeat this search order (<RAT1>, <RAT2>, <RAT3>) until a suitable cell is found.

  ```
  AT+KSELACQ=0,<RAT1>,<RAT2>,<RAT3>
  ```

7.1.1 Identifying the Active RAT

While the module is switching through the RATs defined in the PRL, it is possible to identify the active RAT (i.e. the RAT that is being searched for cells). Use the AT+KSRAT READ command: AT+KSRAT?

For example, in order of preference, we want the module to search for cells in CAT-M, GSM, then NB-IoT. In this example's network environment, only NB-IoT is supported. (Note – It can be informative to enable network registration URCs with AT+CEREG to see the results of cell scans.)

```
(Enable network registration URCs)
AT+CEREG=5
OK

(Configure PRL: CAT-M, GSM, NB-IoT)
AT+KSELACQ=0,1,3,2
OK
```

(Reboot for AT+KSELACQ settings to take effect)
AT+CFUN=1,1
OK

(Module is searching for CAT-M cells)
AT+KSRAT?
+KSRAT: 0
OK

(Check again after some time, module is searching for GSM cells)
AT+KSRAT?
+KSRAT: 2
OK

(Check again after some time, module is searching for NB-IoT cells)
AT+KSRAT?
+KSRAT: 1
OK

(Module finds an NB-IoT cell)
+CEREG: 1,2B03,01AEE80C,9

7.2 Legacy RAT Switch Support: AT+KSRAT

If it is necessary to support AT+KSRAT, then it should be used exclusively without AT+KSELACQ, and AT+KSELACQ should be kept at its default setting of +KSELACQ: 0.

AT+KSRAT has a <reboot> option that allows the user to decide whether they want to perform an automatic reboot after the command is used. For example:

- Switch to a specific RAT without reboot.

  AT+KSRAT=<RAT>

- Switch to a specific RAT after a reboot.

  AT+KSRAT=<RAT>,1

7.3 Preferred RAT Reacquisition

Once the module has connected to a RAT, it remains connected until either the connection is stopped by the host platform, or the connection breaks for some reason (e.g. outage, interruption, etc.) and the module falls back (switches) to a non-preferred (secondary) RAT.

To avoid the situation where the module remains connected to a non-preferred RAT for long durations, during which a preferred RAT may become available, the host can:

1. Enable registration URCs:

   AT+CEREG=5 //Enable LTE URCs
   AT+CREG=2 //Enable GSM URCs

   These URCs will indicate when the module switches to a different RAT.

2. If the host receives a URC, it can maintain the connection for an appropriate (host-determined) duration and then attempt to switch to a preferred RAT (if one has become available):

   AT+CFUN=0 **//stop the radio**
   AT+CFUN=1 **//start the radio**

   When the radio restarts it starts scanning for a suitable cell using the first RAT in the PRL.

8 Related AT Commands

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

AT Command	Description
+CEREG	EPS Network Registration Status
+CFUN	Set Phone Functionality
+KSELACQ	Configure Preferred Radio Access Technology List (PRL)
+KSRAT	Set Radio Access Technology

9 Reference Documents

	Filename	Document #
[1]	AirPrime HL78xx AT Commands Interface Guide	41111821 Rev.12

10 Support

For direct clients: contact your Sierra Wireless FAE

For distributor clients: contact your distributor FAE

For distributors: contact your Sierra Wireless FAE

11 Document History

Level	Date	History
1	December 03, 2020	Creation

12 Legal Notice