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一、Foreword

Currently, the NB-IoT modules of Quectel are applied in wide industries, which involve multi-form and multi-style IoT applications. However, due to sensitiveness in power consumption, it is neessary to take life duration of product and battery endurance into consideration in stage of application design. Based on common "power off" and "PSM" and targeted to the NB-IoT terminal application design, relevant design procedure is sorted out and arranged in this document for reference on development design and application.

二、Illustration

- Related design procedure and utilization illustrated in this document is just for reference on application development.
 For actual application, pelase query and refer to corresponding AT document and manual.
- 2. The document will sort out based on common "Power off" and "PSM" application scenario, which will fous on main procedure design. For some solution on "interrupt", please integrate with actual bussiness. Meanwhile, please note the deployment of PSM shall be merged with power off.
- 3. The "blue" mark in the document represents the relevant AT commands to be executed. Some important URC and AT response outputs are marked with "red"; At the same time pay attention to check the "notes";
- 4. The document contains multiple application protocols, which are marked with corresponding rule identifiers. The details are as follows:

Application Protocol	CODE	INDEX	Description
LwM2M	L	L-x-y-z	
TCP	Т	T -x-y-z	x- the first digit indicates the corresponding application function y- the second digit indicates the debugging order of the corresponding function
UDP	U	U -x-y-z	z- the third digit represents the implementation methods of different functions of the corresponding application protocol, for example, -1, -2, and -3 respectively
MQTT	Q	Q -x-y-z	represent three different implementation methods. The actual required method
RAI	R	R -x-y-z	should be combined with the program processing and task invocation of mcu



三、Reference for Process of Developing Application

3.1 BC660K/BC950K

3.1.1 Access to CHN Telecom CTWING Platform(AEP)

3.1.1.1 in Power-off Mode

Application

The terminal is connected to AEP platform of CHN Telecom, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled

Index		Process of AT Command	Notes
1- Init	ial		
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY		Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2	network, or priorit >> AT+CFUN=0 >> OK >> AT+QSCLK=1 >> OK	on, if the terminal (mcu) does not need to connect to the ize other tasks, you need to perform //Enter the deepsleep state //The deepsleep is enabled by default eeds to connect to the network later, you can run //Reboot	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to enter the low power mode. If this requirement is not in the application design, skip this step to 2-1
2- Sear	ch and register ne	twork	1
2-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY >> AT+QBAND=0 >> OK >> AT+QSCLK=0 >> OK	//*If you did not execute the lock BAND in 5-1, skip the command //Disable the deepsleep	+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware design

	>> AT+CPSMS=0	//Disable th PSM	
	>> OK	// Disable (ii i Sivi	
	>> AT+CEDRXS=0,5	//Disable the eDRX	
	>> OK	// Disable the EDITA	
	// Configure the APN based on the	requirement of SIM card	If APN needs to be configured for
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<</apn>		the SIM card, please perform the
	>> OK	vasernames , spasswords	command, others can be ignored
	77 CIK		If return NO READY,indicates the
	>> AT+CPIN?	//check the SIM status	check of SIM card is failed. You
	>> +CPIN: READY	// check the shirt states	need to check the SIM card and
2-3	>>		hardware. So the program can be
	>> OK		directly powered off, or go to the
			above 1-2, into the low power state
	//Check the attribute values of the	module	above 1 2, into the low power state
	>> ATI	//Query module identification	
	>> Quectel_Ltd	,,,	
	>> xxxxxxx		
	>> Revision: xxxxxxx		
	>>		If the application design does not
2-4	>> OK		require this step, you can skip the
	>> AT+CGSN=1	//Query the IMEI	step
	>> +CGSN: <imei></imei>	,, ,	
	>>		
	>> OK		
		//Other queries	
			If the application design does not
2-5	>> AT+CSCON=1		require this step, you can skip the
	>> OK		step
	>>		
	>> +CSCON:1 //Indicates	that the RRC connection is complete	
	//To query the following parameter	s, it is recommended to query after	If the application design does not
	return +CSCON:1, or query after the	e registration network is completed	require this step, you can skip the
	>> AT+CIMI	//Query the IMSI	step
	>> 460113061353533		In the application design of the
	>>		terminal, you can execute
2-6	>> OK		AT+QENG=0 to obtain the relevant
	>> AT+NCCID	//Query the CCID of SIM	network and signal reference, and
	>> +NCCID:89861122223000411769		to encode RSRP, SNR, CELLID,
	>>		EARFCN and PCI and upload the
	>> OK		data to the server. It will helps for
		ion about the current camp on the cell	troubleshoot problems.
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8	8,-65, <mark>14</mark> ,8,"4C10",0,9,3	
	>>		
	>> OK		
	// Query the network registration st		
	>> AT+CEREG? //Query the network r	registration status	
2-7	>> +CEREG:0,2		
	>> >> OK		
1			T. Control of the Con

	//Periodic queries, such as 500ms intervals			
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1	
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card	
2-10	>> AT+CGPADDR //Query >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17 >> >> OK	the IP address obtained 7ab:01f8:98b0:032e"		
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR	
2-12	>> AT+CCLK? //Query the second of the second	he current date and time	Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times	
3- Acce	ess the AEP platform			
	>>	e deepsleep function		
	>> OK >> AT+QLWCFG="auto_reg",0 //Disable the >> >> OK	e auto_registration function		
L3-1	>> AT+QLWCONFIG=0,"221.229.214.202",5683,"86854306 //Set connection parameters of AEP platform >> >> OK	50025186",86400,3	monitor the URC output of the registration status of the platform,	
		resource for upload channel	and should reboot if the waiting window time of the program is exceeded	
	>> AT+QLWADDOBJ=19,1,1,0 //Add object19 and re >> >> OK >>	esource for download channel		

	>> +QLWADDOBJ: 0		
	>> AT+QLWREG	//Initiate registration	
	>>		
	>> OK		
	>>		
	>> +QLWURC: "registering",102,0		
	>>		
	>> +QLWREG: 0		
	>>		
	>> +QLWURC: "observe",7191,0,19	9,0,0	
	>> AT+QLWOBSRSP=7191,1,19,0,0	,2,11,"68656c6c6f20776f726c64",0	
	//Response observe resource		
	>>		
L3-2	>> OK		
	>>		
	>> +QLWOBSRSP: 0		
	>> AT+QLWSTATUS?	//Query the status of the current connection	The program or mcu can query the
	>>		registration status of the platform
L3-3	>> +QLWSTATUS: 2	//registered	by AT+QLWSTATUS. After the query
	>>		returns +QLWSTATUS: 2,then the
	>> OK		data can be sent normally
	//Report/send data to AEP	platform	
	>> AT+QLWNOTIFY=19,0,0,2,11,"6		
	//It is recommended to report data		
	<i>></i> >>		
	>> OK		CON type is recommended for
	>>		reporting or sending data. When
L3-4	>> +QLWNOTIFY: 0		"report_ack" is received, the data is
	>>		successfully sent
	>> +QLWURC: "report",60516		·
	>>		
	>> +QLWURC: "report_ack",0,6051	6	
	//the data is successfully reported	and the ACK message is received from the platform.	
	//Set the receiving data mo	de - Direct Output mode (default)	
	>>		
	>> +QLWURC: "write",40832,19,1,	0,2,9,"636f6d706c65746564",0	
	>> AT+QLWWRRSP=40832,2	//After receiving the data, respond platform	Currently, the BC660K/BC950K
L3-5	>>		supports only direct output mode
	>> OK		
	>>		
	>> +QLWWRRSP: 0		
	>> AT+QLWDEREG	//Initiate de-registration	
	>>		If the application design does not
L3-6	>> OK		require this step, you can skip the
	>>		step
	>> +QLWDEREG: 0	// de-registered	
4- Power	off after sending and re		1
	>> AT+CFUN=0	//Set minimum function	If the terminal is designed for
4-1	>> OK		power-off mode and powered off

	//Wait for the return OK, then mcu control to power off; If not return OK after running		after data interaction is complete,
		eriod of time (for example, 20s), you can power off directly.	you need to run AT+CFUN=0, then
	AITCFON-0 for a forig pe	endu of time (for example, 20s), you can power on unective	power off the terminal after return
			OK to avoid damage to the flash
b- Era	ase the historical fr		<u> </u>
		network is not successful within the set search time(such as 2min),	As described in 2-8, it is suggested
	go to		that in the program design, after
	>> AT+CFUN=0	//Erase the historical frequency based on CFUN0 th //Erase the historical frequency	the first search fails to time out, the
	>> OK		frequency clearing program must
	>> AT+QCSEARFCN		be executed. After run, follow the
	>> AT+QBAND=1,28 //*Lock a specific frequency band. Note that it is not recommended for non-specific situations		2-7 to check the search status
5-1			again;
			If the research fails to time out, you
			are advised to reboot without
	>> OK	46-7	clearing the frequency again. Or
	>> AT+QRST=1	//Reboot, and re-search	wait for the next service cycle and
	>> OK		try again.
_	Follow 2-7 above		
6- Exc	ception handling or i	nterruption	1
	1) The program or mo	u needs to add the interrupt method of time-out or failure to register	
	the AEP platform, su	uch as re-registration or reboot.	If the terminal has strict
	2) The program or mo	u needs to add the interrupt method of timeout or failure for	requirements on power
6-1	sending or receiving	g data, such as reboot.	consumption, it is recommended
	3) In the case of excep	tions, when the program or mcu performs hardware reset or power-	that the program reasonably
	off directly, you nee	d to execute AT+CFUN=0 first, and return OK, then control	control timeout
	hardware reset or p	ower-off; But software reset or reboot does not run AT+CFUN=0.	

3.1.1.2 in PSM Mode

Application

PSM function is enabled, and only the AEP platform of CHN telecom is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

Index		Process of AT Command	Notes
1- Init	ial		
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY		Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2		the terminal (mcu) does not need to connect to the other tasks, you need to perform //Enter the deepsleep state //The deepsleep is enabled by default	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or

>> OK mcu gives priority to other tasks, cfun0 can be executed to //If the terminal needs to connect to the network later, you can run enter the low power mode. >> AT+QRST=1 //Reboot If this requirement is not in the >> OK application design, skip this step to 2-1 2- Search and register network //Power on, initial +CPIN: NOT READY indicates >> RDY that the module fails to check the sim card.so you need to >> >> +CFUN: 1 check the SIM card itself or the pin connection and hardware >> >> +CPIN: READY design >> AT+QBAND=0 //*If you did not execute the lock BAND in 7-1, skip the command By AT+CPSMS=1,, >> OK "<T3412/TAU>","<T3324>", 2-1 you can configure the T3412 >> AT+QSCLK=0 //Disable the deepsleep >> OK and T3324 timers properly >> AT+CPSMS=1,,,"01000010","00000000" //Enable th PSM which you need.at the same >> OK time, after the completion of >> AT+CEDRXS=0,5 //Disable the eDRX the registration network, by AT+CEREG=5; +CEREG? You >> OK need to query the real value of >> AT+QNBIOTEVENT=1,1 //Enable the URC of PSM T3324,T3412/TAU provided by >> OK >> AT+QCFG="dsevent",1 //Disable the URC of Deepsleep the network >> OK If APN needs to be configured // Configure the APN based on the requirement of SIM card for the SIM card, please 2-2 >> AT+QCGDEFCONT="IPV4V6","<APN>", "<username>", "<password>" perform the command, others >> OK can be ignored If return NO READY, indicates the check of SIM card is failed. >> AT+CPIN? //check the SIM status You need to check the SIM card >> +CPIN: READY 2-3 and hardware. So the program >> can be directly powered off, or >> OK go to the above 1-2, into the low power state //Check the attribute values of the module >> **ATI** //Query module identification >> Quectel Ltd >> xxxxxxx >> Revision: xxxxxxx If the application design does >> 2-4 not require this step, you can >> OK skip the step >> AT+CGSN=1 //Query the IMEI >> +CGSN:<IMEI> >> >> OK //Other queries

2-5	>> AT+CSCON=1 >> OK		If the application design does not require this step, you can skip the step
2-6	>> +CSCON:1 //Indicates that the RRC connection is complete //To query the following parameters, it is recommended to query after return +CSCON:1, or query after the registration network is completed >> AT+CIMI //Query the IMSI >> 460113061353533 >> >> OK >> AT+NCCID //Query the CCID of SIM >> +NCCID:89861122223000411769 >> OK >> AT+QENG=0 //Query the information about the current camp on the cell >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3 >> OK		If the application design does not require this step, you can skip the step In the application design of the terminal, you can execute AT+QENG=0 to obtain the relevant network and signal reference, and to encode RSRP, SNR, CELLID, EARFCN and PCI and upload the data to the server. It will helps for troubleshoot problems.
2-7	<pre>>> OK // Query the network registration status >> AT+CEREG? //Query the network registration status >> +CEREG:0,2 >> >> OK //Periodic queries, such as 500ms intervals</pre>		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query the IP address obtained >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17ab:01f8:98b0:032e" >> >> OK		
2-11	>> OK >> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR

		Time conversion:
		Time conversion:
	>> AT+CCLK? //Query the current date and time	24/01/16,08:55:19+32/4(h)=
2-12	>> +CCLK: "24/01/16,08:55:19+32"	2024/01/16,16:55:19
	>>	If the default time is returned,
	>> OK	pls query the time for multiple
		times
3- Acce	ess the AEP platform	
	//Set parameters and register AEP	
	>> AT+QLWCFG="auto_reg",0 //Disable the auto_registration function	
	>>	
	>> OK	
	>> AT+QLWCONFIG=0,"221.229.214.202",5683,"868543060025186",86400,3	
	//Set connection parameters of AEP platform	
	>>	
	>> OK	
	>> AT+QLWADDOBJ=19,0,1,0 //Add object19 and resource for upload channel	
	>>	
	>> OK	
	>>	The program or MCU needs to
	>> +QLWADDOBJ: 0	monitor the URC output of the
L3-1	>> AT+QLWADDOBJ=19,1,1,0 //Add object19 and resource for download channel	registration status of the
	>>	platform, and should reboot if
	>> OK	the waiting window time of the
	>>	program is exceeded
	>> +QLWADDOBJ: 0	
	>> AT+QLWREG //Initiate registration	
	>>	
	>> OK	
	>> >>	
	>> +QLWURC: "registering",102,0	
	>>	
	>> +QLWREG: 0	
	>> \(\(\)	
	>> +QLWURC: "observe",7191,0,19,0,0	
	>> AT+QLWOBSRSP=7191,1,19,0,0,2,11,"68656c6c6f20776f726c64",0	
	//Response observe resource	
	>>	
L3-2	>> OK	
	>> >>	
	>> +QLWOBSRSP: 0	
		The program or mcu can query
	>> AT+QLWSTATUS? //Query the status of the current connection	the registration status of the
	>>	platform by AT+QLWSTATUS.
L3-3	>> +QLWSTATUS: 2 //registered	After the query returns
	>>	+QLWSTATUS: 2,then the data
	>> OK	can be sent normally
	//Report/send data to AEP platform	CON type is recommended for
L3-4	>> AT+QLWNOTIFY=19,0,0,2,11,"68656c6c6f20776f726c64",0,1	reporting or sending data.
	//It is recommended to report data of the CON type	When "report_ack" is received,
	The is resommenated to report data of the contrype	when report_ack is received,

	>>	the data is successfully sent
	>> OK	
	>>	
	>> +QLWNOTIFY: 0	
	>>	
	>> +QLWURC: "report",60516	
	>>	
	>> +QLWURC: "report_ack",0,60516	
	//the data is successfully reported and the ACK message is received from the platform.	
	//Set the receiving data mode - Direct Output mode (default)	
	>>	
	>> +QLWURC: "write",40832,19,1,0,2,9,"636f6d706c65746564",0	Currently, the BC660K/BC950K
L3-5	>> AT+QLWWRRSP=40832,2 //After receiving the data, respond platform	supports only direct output
	>>	mode
	>> OK	mode
	>>	
	>> +QLWWRRSP: 0	
4- Featı	re of RAI	
Feature	1) After the data interaction is completed, you can run AT+QPING=0,"221.229.214.202",4,1	32.1
of RAI	1, The the data interaction is completed, you can run in the of EEEEEEEE 1, 1,2	.,,,,,,
	>> AT+QPING=0,"221.229.214.202",4,1,32,1 //QPING method with RAI Flag	
	>> OK	
	>>	
	>> +QPING: 0,221.229.214.202,32,342,44	
	>>	
R4-1	>> +QPING: 0,1,1,0,342,342,342	RAI implementation method
	>>	
	>> AT+QSCLK=1 //Enable deepsleep mode	
	>> OK	
5- Enter	status PSM and Deepsleep	
	>>	
5-1	>> +QNBIOTEVENT: "ENTER PSM" //Enter the PSM state	
3-1	>>	
	>> +QNBIOTEVENT: "ENTER DEEPSLEEP" //Enter the deepsleep state	
6- Exit	status of Deepsleep and PSM	
	//BC660K&BC950K support to wake up deepsleep by executing AT	
	command or pulling down PSM EINT pin	
	>>	
	>> +QNBIOTEVENT: "EXIT DEEPSLEEP" //Exit the deepsleep state	
	>> AT+QLWRECOVER //Trigger to recovery of the Lwm2m protocol	
L6-1-1	>>	Method to trigger PSM wake-
	>> OK	up
	>>	
	>> +QLWURC: "recovered",0,102,0	
	>> AT+QLWNOTIFY=19,0,0,2,11,"68656c6c6f20776f726c64",0,1 //Send data of the CON type	
	>>	
	>> OK	
	// UN	

```
>> +QLWNOTIFY: 0
            >> +QNBIOTEVENT: "EXIT PSM"
                                                                      //Exit the PSM state
            >> +QLWURC: "report",26457
            >>
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
            >> +QLWURC: "report ack",0,26457
            //the data is successfully reported and the ACK message is received from the platform
            Go to 6-2, or goto L3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
            //If you want to obtain the accurate signal reference in the current scene
            immediately after the PSM is woked up, please refer to
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM_EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                           //Exit the deepsleep state
            >> AT+QPING=0,"221.229.214.202",4,1
                                                          //Trigger to exit PSM by PING
            >> OK
            >> +QNBIOTEVENT: "EXIT PSM"
                                                         //Exit the PSM state
            >> +CSCON: 1
            //It is recommended to obtain the signal reference after return the +CSCON:1
                                                                                                   If the program or mcu needs to
            >> +QPING: 0,221.229.214.202,32,762,44
                                                                                                   deal with other tasks, such as
                                                                                                   collecting the base station cell
            >> +QPING: 0,1,1,0,762,762,762
                                                                                                   signal after wake-up; It is
            >> AT+QENG=0
                                                         //Query signal reference
                                                                                                   recommended to refer to this
L6-1-2
            >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3
                                                                                                   method to trigger PSM wake-
            >>
                                                                                                   up and obtain the network
            >> OK
                                                                                                   signal after wake-up.
            >> AT+QLWRECOVER
                                                    //Trigger to recovery of the Lwm2m protocol
                                                                                                   If no such requirement in the
            >>
                                                                                                   program, ignore the process
            >> OK
            >> +QLWURC: "recovered",0,102,0
            >> AT+QLWNOTIFY=19,0,0,2,11,"68656c6c6f20776f726c64",0,1 //Send data of the CON type
            >>
            >> OK
            >>
            >> +QLWNOTIFY: 0
            >> +QLWURC: "report",8824
            >> +QLWURC: "report_ack",0,8824
            //the data is successfully reported and the ACK message is received from the platform
```

	For BC660K	&BC950K Development and Application Process in Power-off and PSN	M Mode
	Go to 6-2,or goto L	3-3 for sending data,or goto L3-5 for receving data,	
	and the subsequent	process	
	//Manual TAU upda	te	
	>> AT+CPSMS=0		TAU update manually can avoid
	>> OK		automatic update of TAU cycle
6-2	>> AT+CPSMS=1,,,"0100	0010","00000000"	over time, so,non-service power
	>> OK		consumption can be reduced; If
	Go to L3-3 for send	ing data,or goto L3-5 for receving data, and the	no requirement in the
	subsequent process		application, ignore this step
7– Era	ase the historical fr		
		tion network is not successful within the set search	As described in 2-8, it is
	time(such as 2min),		suggested that in the program
	>> AT+CFUN=0	//Erase the historical frequency based on CFUN0	design, after the first search
	>> OK	,,	fails to time out, the frequency
	>> AT+QCSEARFCN	//Erase the historical frequency	clearing program must be
	>> OK	,,,	executed. After run, follow the
7-1	>> AT+QBAND=1,28		2-7 to check the search status
		ency band. Note that it is not recommended for non-specific	again;
	situations	,	If the research fails to time out,
	>> OK		you are advised to reboot
	>> AT+QRST=1	//Reboot, and re-search	without clearing the frequency
	>> OK	,,,	again. Or wait for the next
	Follow 2-7 above		service cycle and try again.
8- Exc	ception handling or i	nterruption	
<u> </u>			If the terminal has strict
			requirements on power
	1) The program or mo	u shall add the interrupt method of timeout or failure of AEP	consumption, it is
		n, such as re-registration or reboot;	recommended that the
		u shall add the interrupt method of sending or receiving data	program reasonably control
	timeout or failure, s		timeout.
8-1		u should add interrupt methods that cannot enter PSM normally or	If unable to enter PSM or wake
J .	cannot wake up PSN	·	up from PSM, it is
		vi, such as reboot, itions, when the program or mcu performs hardware reset or power-	recommended to compare the
		d to execute AT+CFUN=0 first, and return OK, then control	normal time to enter PSM or
		ower-off; But software reset or reboot does not run AT+CFUN=0.	exit PSM. If the time exceeds,
	nardware reset or p	ower on, but software reset of reboot does not full AI + Croin = 0.	
			power off or reboot should can
			be operated

3.1.2 Access to Leshan Platform

3.1.2.1 in Power-off Mode

Application

The terminal is connected to Leshan platform, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled.

Index		Process of AT Command	Notes
1- Initi	al		
1-1	//Power on,initial >> >> RDY >> +CFUN: 1 >> >> +CPIN: READY		Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2	network, or priorit >> AT+CFUN=0 >> OK >> AT+QSCLK=1 >> OK	on, if the terminal (mcu) does not need to connect to the tize other tasks, you need to perform //Enter the deepsleep state //The deepsleep is enabled by default eeds to connect to the network later, you can run //Reboot	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to enter the low power mode. If this requirement is not in the application design, skip this step to 2-1
2- Searc	ch and register ne	etwork	
2-1	//Power on,initial >> >> RDY >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY >> AT+QBAND=0 >> OK >> AT+QSCLK=0 >> OK >> AT+CPSMS=0 >> OK >> AT+CPSMS=0 >> OK >> AT+CEDRXS=0,5 >> OK	//*If you did not execute the lock BAND in 5-1, skip the command //Disable the deepsleep //Disable th PSM //Disable the eDRX	+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware design
2-2		APN based on the requirement of SIM card "IPV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	If APN needs to be configured for the SIM card, please perform the command, others can be ignored
2-3	>> AT+CPIN? >> +CPIN: READY >> >> OK	//check the SIM status	If return NO READY, indicates the check of SIM card is failed. You need to check the SIM card and hardware. So the program can be directly powered off, or go to the above 1-2, into the low power state
2-4	//Query the attrib >> ATI >> Quectel_Ltd	vute values of the module //Query module identification	If the application design does not require this step, you can skip the step

	>> xxxxxxx		
	>> Revision: xxxxxxxx		
	>>		
	>> OK		
	>> AT+CGSN=1 //Query	the IMEI	
	>> +CGSN: <imei></imei>		
	>>		
	>> OK		
	//Other	queries	
	>> AT+CSCON=1		If the application design does not
2-5	>> OK		require this step, you can skip the
	77 OK		step
	>>		
	>> +CSCON:1 //Indicates that the RRC	connection is complete	
	//To query the following parameters, it is reco	mmended to query after	If the application design does not
	return +CSCON:1, or query after the registration	on network is completed	require this step, you can skip the
	>> AT+CIMI //Query	the IMSI	step
	>> 460113061353533		In the application design of the
	>>		terminal, you can execute
2-6	>> OK		AT+QENG=0 to obtain the relevant
2-0	>> AT+NCCID //Query the CCID of SIM		
	>> +NCCID:89861122223000411769		network and signal reference, and
	>>		to encode RSRP, SNR, CELLID,
	>> OK		EARFCN and PCI and upload the
	>> AT+QENG=0 //Query the information about the current camp on the cell		data to the server. It will helps for
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3		troubleshoot problems.
	>>		
	>> OK		
	// Query the network registration status		
	>> AT+CEREG? //Query the network registration st	atus	
	>> +CEREG:0,2		
2-7	>>		
	>> OK		
	//Periodic queries, such as 500ms intervals		
	>> AT+CEREG?		If the query only returns
0.0	>> +CEREG:0,0 //+CEREG:0,2		
2-8	>>		the search time (no less than 2
	>> OK		minutes); the program goes to 5-1
			If the program finally returns
	>> AT+CEREG?	>> AT+CEREG?	+CEREG:0,3 within the search time
	>> +CEREG:0,1 //+CEREG:0,5 (roaming)	>> +CEREG:0,3	(e.g. 2 minutes); Restart or try again
2-9	//the registered successfully	//the registration denied	in the next cycle. If +CEREG:0,3 is
	»	>>	still returned after multiple
	>> OK	>> OK	attempts, it is recommended to
			check the SIM card
	>> AT+CGPADDR //Quen	the IP address obtained	
2-10			
•	>> \cdr\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
2-10	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:1		

		oment and Application Process in Power-off and PSN	1
	>> OK		
2-11	>> AT+CSQ >> +CSQ:xx,99 >> >> OK	//Query the CSQ	CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? >> +CCLK: "24/01/16,08:55:19+32" >> >> OK	//Query the current date and time	Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Acce	ss the leshan platform		
	//Set parameters and register less >> AT+QSCLK=0 >> >> OK	nan //Disable the deepsleep function	
	>> AT+QIDNSCFG=0,"8.8.8.8","223.6.6.6" >> OK	//Configure the valid DNS	
L3-1	>> AT+QLWCFG="auto_reg",0 >> >> OK	//Disable the auto_registration function	
	//Set connection parameters of leshan pla	ts.io",5683,"urn:imei:866207055068526",86400,3 atform	The program or MCU needs to monitor the URC output of the
	>> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701 >>	.5850 //Add object3311 and resources	registration status of the platform, and should reboot if the waiting window time of the program is exceeded
	>> OK >> >> +QLWADDOBJ: 0		
	>> AT+QLWREG //lr >> >> OK >>	itiate registration	
	>> +QLWURC: "registering",102,0 >> >> +QLWREG: 0		
100	>>	uery the status of the current connection	The program or mcu can query the registration status of the platform
L3-2	>> +QLWSTATUS: 2 //re >> >> OK	gistered	by AT+QLWSTATUS. After the query returns +QLWSTATUS: 2,then the data can be sent normally
L3-3	>> >> +QLWURC: "observe",43605,0,3311,0, >> AT+QLWOBSRSP=43605,1,3311,0,5700		
	//Response observe resource		

	For BC000K&BC950K Development and Application Proce	.55 III I OWEI OII alia I 51VI	
	>> OK		
	>>		
	>> +QLWOBSRSP: 0		
	//Report/send data to leshan platform		
	>> AT+QLWNOTIFY=3311,0,5706,1,6,"orange",0,1		
	//It is recommended to report data of the CON type		
	»>		
	>> OK		CON type is recommended for
			reporting or sending data. When
L3-4	>>		
	>> +QLWNOTIFY: 0		"report_ack" is received, the data is
	>>		successfully sent
	>> +QLWURC: "report",60516		
	>>		
	>> +QLWURC: "report_ack",0,60516		
	//the data is successfully reported and the ACK message is received fr	om the platform.	
	//Set the receiving data mode - Direct Output mode (de	fault)	
	>>		
	>> +QLWURC: "write",38156,3311,0,5706,2,4,"626c7565",0		
105	>> AT+QLWWRRSP=38156,2 //After receiving the data, resp	ond platform	Currently, the BC660K/BC950K
L3-5	>>		supports only direct output mode
	>> OK		
	>>		
	>> +QLWWRRSP: 0		
	>>AT+QLWDELOBJ=3311 //Delete the subscribed object		
	>> >>		
	>>OK		
	>>		
	>>+QLWDELOBJ: 0		If the application design does not
L3-6	>>		require this step, you can skip the
	>>+QLWURC: "ping",0,102,0		step
	>> AT+QLWDEREG //Initiate de-registration		
	>>		
	>> OK		
	>>		
	>> +QLWDEREG: 0 // de-registered		
4- Powe	r off after sending and receiving data		
			If the terminal is designed for
	>> AT+CFUN=0 //Set minimum function		power-off mode and powered off
	>> OK		after data interaction is complete,
4-1	//Wait for the return OK, then mcu control to power off; If not re	eturn OK after running	you need to run AT+CFUN=0, then
	AT+CFUN=0 for a long period of time (for example, 20s), you can power	er on airectly.	power off the terminal after return
			OK to avoid damage to the flash
5- Eras	e the historical frequency		
	//If 2-8 the registration network is not successful within the set search		As described in 2-8, it is suggested
	to		that in the program design, after
5-1	>> AT+CFUN=0 //Erase the historical frequency based o	n CFUN0	the first search fails to time out, the
J- 1	>> OK		frequency clearing program must
	>> AT+QCSEARFCN //Erase the historical frequency		be executed. After run, follow the
	>> OK		2-7 to check the search status

	>> /	AT+QBAND=1,28	again;
	//*	Lock a specific frequency band. Note that it is not recommended for non-specific	If the research fails to time out, you
	situ	uations	are advised to reboot without
	>> (ОК	clearing the frequency again. Or
	>> /	AT+QRST=1 //Reboot, and re-search	wait for the next service cycle and
	>> OK		try again.
	Fol	low 2-7 above	
6- Exc	eptio	n handling or interruption	
	1)	The program or mcu needs to add the interrupt method of time-out or failure to regist	er
		the leshan platform, such as re-registration or reboot.	If the terminal has strict
	2)	The program or mcu needs to add the interrupt method of timeout or failure for sending	requirements on power
6-1		or receiving data, such as reboot.	consumption, it is recommended
	3)	In the case of exceptions, when the program or mcu performs hardware reset or power	r- that the program reasonably
		off directly, you need to execute AT+CFUN=0 first, and return OK, then control	control timeout
		hardware reset or power-off; But software reset or reboot does not run AT+CFUN=0.	

3.1.2.2 in PSM Mode

PSM function is enabled, and only the Leshan platform is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

Index		Process of AT Command	Notes
1- Init	ial		
	//Power on,initial		Boot log output, mcu can also
	>>		determine whether it is normal
	>> RDY		boot;
1-1	>>		If the terminal needs to
	>> +CFUN: 1		connect to the network
	>>		immediately after power on,
	>> +CPIN: READY		start from 2-1
	//After newering on if the	he towning (may) does not need to connect to the	In the application design, when
	//After powering on, if the terminal (mcu) does not need to connect to the network, or prioritize other tasks, you need to perform		the module is powered on after
	•	•	the device is powered on, if the
	>> AT+CFUN=0	//The deepsleen is enabled by default	terminal has no network
	>> OK		requirements temporarily or
1-2	>> AT+QSCLK=1		mcu gives priority to other
	>> OK		tasks, cfun0 can be executed to
			enter the low power mode.
	//If the terminal needs to	connect to the network later, you can run	If this requirement is not in the
	>> AT+QRST=1	//Reboot	application design, skip this
	>> OK		step to 2-1
2_ Saar	ob and ragister naturals		σωρ το 2-1
z sear	ch and register network		+CPIN: NOT READY indicates
0.4	//Power on,initial		
2-1	>>		that the module fails to check
	>> RDY		the sim card.so you need to

	>>	check the SIM card itself or the
	>> +CFUN: 1	pin connection and hardware
	>>	design
	>> +CPIN: READY	By AT+CPSMS=1,,
	>> AT+QBAND=0 //*If you did not execute the lock BAND in 7-1, skip the command	" <t3412 tau="">","<t3324>",</t3324></t3412>
	>> OK	you can configure the T3412
	>> AT+QSCLK=0 //Disable the deepsleep	and T3324 timers properly
	>> OK	which you need.at the same
	>> AT+CPSMS=1,,,"01000010","00000000" //Enable th PSM	time, after the completion of
	>> OK	the registration network, by
		AT+CEREG=5; +CEREG? You
	>> AT+CEDRXS=0,5 //Disable the eDRX	
	>> OK	need to query the real value of
	>> AT+QNBIOTEVENT=1,1 //Enable the URC of PSM	T3324,T3412/TAU provided by
	>> OK	the network
	>> AT+QCFG="dsevent",1 //Disable the URC of Deepsleep	
	>> OK	
	// Configure the APN based on the requirement of SIM card	If APN needs to be configured
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	for the SIM card, please
	>> OK	perform the command, others
		can be ignored
		If return NO READY, indicates
	Mahaalaha CIM shaka	the check of SIM card is failed.
	>> AT+CPIN? //check the SIM status	You need to check the SIM card
2-3	>> +CPIN: READY	and hardware. So the program
	>>	can be directly powered off, or
	>> OK	go to the above 1-2, into the
		low power state
	//Check the attribute values of the module	
	>> ATI //Query module identification	
	>> Quectel Ltd	
	>> xxxxxxx	
	>> XXXXXXX >> Revision: XXXXXXX	
	>> Revision: xxxxxxxx	If the application design does
2-4	>> Revision: xxxxxxxx >>	If the application design does not require this step, you can
2-4	>> Revision: xxxxxxxx >> >> OK	
2-4	>> Revision: xxxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI	not require this step, you can
2-4	>> Revision: xxxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei></imei>	not require this step, you can
2-4	>> Revision: xxxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >></imei>	not require this step, you can
2-4	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >> OK</imei>	not require this step, you can
2-4	>> Revision: xxxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >></imei>	not require this step, you can skip the step
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >> OK</imei>	not require this step, you can skip the step If the application design does
2-4	>> Revision: xxxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >> OK //Other queries</imei>	not require this step, you can skip the step If the application design does not require this step, you can
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1	not require this step, you can skip the step If the application design does not require this step, you can skip the step
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1	not require this step, you can skip the step If the application design does not require this step, you can
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1	not require this step, you can skip the step If the application design does not require this step, you can skip the step
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1	If the application design does not require this step, you can skip the step If the application design does not require this step, you can skip the step If the application design does
	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >> OK //Other queries >> AT+CSCON=1 >> OK >> >> +CSCON:1 //Indicates that the RRC connection is complete</imei>	not require this step, you can skip the step If the application design does not require this step, you can skip the step If the application design does not require this step, you can
2-5	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1 //Query the IMEI >> +CGSN: <imei> >> OK //Other queries >> AT+CSCON=1 >> OK >> >> +CSCON:1 //Indicates that the RRC connection is complete //To query the following parameters, it is recommended to query after</imei>	If the application design does not require this step, you can skip the step If the application design does not require this step, you can skip the step If the application design does not require this step, you can skip the step
2-5	>> Revision: xxxxxxx >> >> OK >> AT+CGSN=1	If the application design does not require this step, you can skip the step If the application design does not require this step, you can skip the step If the application design does not require this step, you can skip the step In the application design of the

	>> OK >> AT+NCCID //Query >> +NCCID:89861122223000411769 >> >> OK >> AT+QENG=0 //Query the information about the of the company of the c		reference, and to encode RSRP, SNR, CELLID, EARFCN and PCI and upload the data to the server. It will helps for troubleshoot problems.
2-7	// Query the network registration status >> AT+CEREG? //Query the network registration states >> +CEREG:0,2 >> >> OK //Periodic queries, such as 500ms intervals	tus	
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17 >> >> OK	the IP address obtained ab:01f8:98b0:032e"	
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Acces	//Set parameters and register leshan >> AT+QSCLK=0 //Disable th >>	e deepsleep function	The program or MCU needs to monitor the URC output of the registration status of the

>> OK >> AT+QIDNSCFG=0,"8.8.8.8","223.6.6.6" //Configure the valid DNS >> OK >> AT+QLWCFG="auto_reg",0 //Disable the auto_registration function >> >> OK >> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> > OK >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> > OK	time of the
>> OK >> AT+QLWCFG="auto_reg",0 //Disable the auto_registration function >> >> OK >> OK >> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> >> OK	
>> AT+QLWCFG="auto_reg",0 //Disable the auto_registration function >> >> OK >> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> OK	
>> OK >> OK >> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> >> OK	
>> OK >> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> OK	
>> AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> >> OK	
AT+QLWCONFIG=0,"leshan.eclipseprojects.io",5683,"urn:imei:866207055068526",86400,3 //Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> OK	
//Set connection parameters of leshan platform >> >> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> OK	
>> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> OK	
>> OK >> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> >> OK	
>> AT+QLWADDOBJ=3311,0,3,5706,5701,5850 //Add object3311 and resources >> >> OK	
>> >> OK	
>> OK	
>>	
>> +QLWADDOBJ: 0	
>> AT+QLWREG //Initiate registration	
>>	
>> OK	
>> >>	
>> +QLWURC: "registering",102,0	
>> \\	
>> +QLWREG: 0	
The program or mou	
>> AT+QLWSTATUS? //Query the status of the current connection the registration status	
platform by AT+OLV	
L3-2 >> +QLWSTATUS: 2 //registered After the query retu	
>> +QLWSTATUS: 2,the	
>> OK can be sent normally	
>>>	
>> +QLWURC: "observe",43605,0,3311,0,5706	
>> AT+QLWOBSRSP=43605,1,3311,0,5706,1,5,"white",0	
//Response observe resource	
L3-3	
>> OK	
>>	
>> +QLWOBSRSP: 0	
//Report/send data to leshan platform	
>> AT+QLWNOTIFY=3311,0,5706,1,6,"orange",0,1	
//It is recommended to report data of the CON type	
>>	
>> OK CON type is recomm	nended for
L3-4 >> reporting or sending	ı data.
>> +QLWNOTIFY: 0 When "report_ack"	is received,
>> the data is successfu	lly sent
>> +QLWURC: "report",60516	
>>	
>> +QLWURC: "report_ack",0,60516	
//the data is successfully reported and the ACK message is received from the platform.	

```
//Set the receiving data mode - Direct Output mode (default)
            >> +QLWURC: "write",38156,3311,0,5706,2,4,"626c7565",0
                                                                                                Currently, the BC660K/BC950K
           >> AT+QLWWRRSP=38156,2
                                             //After receiving the data, respond platform
L3-5
                                                                                                supports only direct output
            >>
                                                                                                mode
            >> OK
            >>
            >> +QLWWRRSP: 0
4- Feature of RAI
Feature
               After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1
of RAI
           >> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag
            >> OK
            >>
           >> +QPING: 0,8.8.8.8,32,275,51
R4-1
                                                                                                RAI implementation method
           >> +QPING: 0,1,1,0,275,275,275
            >>
            >> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
            >> AT+QSCLK=1
                                            //Enable deepsleep mode
            >> OK
5- Enter status PSM and Deepsleep
           >> +QNBIOTEVENT: "ENTER PSM"
                                                       //Enter the PSM state
5-1
            >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                       //Enter the deepsleep state
6- Exit status of Deepsleep and PSM
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                         //Exit the deepsleep state
           >> AT+QLWRECOVER
                                                    //Trigger to recovery of the Lwm2m protocol
            >> OK
            >> +QLWURC: "recovered",0,102,0
           >> AT+QLWNOTIFY=3311,0,5706,1,3,"red",0,1
                                                         //Send data of the CON type
                                                                                                Method to trigger PSM wake-
L6-1-1
            >>
                                                                                                up
           >> OK
            >>
           >> +QLWNOTIFY: 0
           >> +QNBIOTEVENT: "EXIT PSM"
                                                                    //Exit the PSM state
           >>
           >> +QLWURC: "report",26457
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
            >>
```

```
>> +QLWURC: "report_ack",0,26457
            //the data is successfully reported and the ACK message is received from the platform
            Go to 6-2, or goto L3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
            //If you want to obtain the accurate signal reference in the current scene
            immediately after the PSM is woked up, please refer to
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                          //Exit the deepsleep state
            >> AT+QPING=0,"8.8.8.8",4,1
                                                //Trigger to exit PSM by PING
            >> OK
            >>
           >> +QNBIOTEVENT: "EXIT PSM"
                                                         //Exit the PSM state
            >> +CSCON: 1
            //It is recommended to obtain the signal reference after return the +CSCON:1
            >> +QPING: 0,8.8.8.8,32,275,51
                                                                                                  If the program or mcu needs to
                                                                                                  deal with other tasks, such as
            >>
            >> +QPING: 0,1,1,0,275,275,275
                                                                                                  collecting the base station cell
                                                                                                  signal after wake-up; It is
            >> AT+QENG=0
                                                         //Query signal reference
            >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3
                                                                                                  recommended to refer to this
L6-1-2
                                                                                                  method to trigger PSM wake-
           >> OK
                                                                                                  up and obtain the network
            >> AT+QLWRECOVER
                                                    //Trigger to recovery of the Lwm2m protocol
                                                                                                  signal after wake-up.
                                                                                                  If no such requirement in the
            >>
                                                                                                  program, ignore the process
            >> OK
            >>
            >> +QLWURC: "recovered",0,102,0
            >> AT+QLWNOTIFY=3311,0,5706,1,3,"red",0,1 //Send data of the CON type
            >>
            >> OK
            >>
            >> +QLWNOTIFY: 0
            >>
           >> +QLWURC: "report",8824
            >> +QLWURC: "report_ack",0,8824
           //the data is successfully reported and the ACK message is received from the platform
            Go to 6-2, or goto L3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
            //Manual TAU update
                                                                                                  TAU update manually can avoid
           >> AT+CPSMS=0
                                                                                                  automatic update of TAU cycle
            >> OK
                                                                                                  over time, so, non-service
6-2
            >> AT+CPSMS=1,,,"01000010","00000000"
                                                                                                  power consumption can be
                                                                                                  reduced; If no requirement in
            Go to L3-3 for sending data, or goto L3-5 for receving data, and the
                                                                                                  the application, ignore this step
            subsequent process
```

7- Era	ase th	e historical fr	requency	
	//I	f 2-8 the registra	tion network is not successful within the set search	As described in 2-8, it is
	tin	ne(such as 2min),	go to	suggested that in the program
	>> /	AT+CFUN=0	//Erase the historical frequency based on CFUN0	design, after the first search
	>> (ОК		fails to time out, the frequency
	>> /	AT+QCSEARFCN	//Erase the historical frequency	clearing program must be
	>> (ОК		executed. After run, follow the
7-1	>> /	AT+QBAND=1,28		2-7 to check the search status
	//*	Lock a specific freque	ency band. Note that it is not recommended for non-specific	again;
	situ	ations		If the research fails to time out,
	>> (ОК		you are advised to reboot
	>> /	AT+QRST=1	//Reboot, and re-search	without clearing the frequency
	>> (ОК		again. Or wait for the next
	Fol	low 2-7 above		service cycle and try again.
8- Exc	ceptio	n handling or i	nterruption	
				If the terminal has strict
				requirements on power
	1)	The program or mc	u shall add the interrupt method of timeout or failure of leshan	consumption, it is
		platform registratio	n, such as re-registration or reboot;	recommended that the
	2)	The program or mc	u shall add the interrupt method of sending or receiving data	program reasonably control
		timeout or failure, s	uch as reboot;	timeout.
8-1	3)	The program or mc	u should add interrupt methods that cannot enter PSM normally or	If unable to enter PSM or wake
		cannot wake up PSI	M, such as reboot;	up from PSM, it is
	4)	In the case of excep	tions, when the program or mcu performs hardware reset or power-	recommended to compare the
		off directly, you nee	d to execute AT+CFUN=0 first, and return OK, then control	normal time to enter PSM or
		hardware reset or p	ower-off; But software reset or reboot does not run AT+CFUN=0.	exit PSM. If the time exceeds,
				power off or reboot should can
				be operated

3.1.3 TCP Application

3.1.3.1 in Power-off Mode

Application

The terminal is connected to the TCP server, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled

Index	Process of AT Command	Notes
1- Initi	al	
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY	Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1

			La discountre et al. 1. 1. 1. 1.
	//After powering on, if the terminal (mcu) does not need to connect to the		In the application design, when the module is powered on after the
	network, or prioritize of	device is powered on, if the	
	>> AT+CFUN=0	//Enter the deepsleep state	terminal has no network
	>> OK		
	>> AT+QSCLK=1	//The deepsleep is enabled by default	requirements temporarily or mcu
1-2	>> OK		gives priority to other tasks, cfun0
			can be executed to enter the low
		to connect to the network later, you can run	power mode.
	>> AT+QRST=1	//Reboot	If this requirement is not in the
		// Nebboot	application design, skip this step to
	>> OK		2-1
2- Searc	h and register netwo	rk	
	//Power on,initial		
	>>		
	>> RDY		
	>>		
	>> +CFUN: 1		
	>>		+CPIN: NOT READY indicates that
	>> +CPIN: READY		the module fails to check the sim
2-1	>> AT+QBAND=0 //*	*If you did not execute the lock BAND in 5-1, skip the command	card.so you need to check the SIM
	>> OK	,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,	card itself or the pin connection
	>> AT+QSCLK=0	//Disable the deepsleep	and hardware design
	>> OK	// Disable the deepsteep	and naraware design
		//Disable th DCM	
	>> AT+CPSMS=0	//Disable th PSM	
	>> OK	W	
	>> AT+CEDRXS=0,5	//Disable the eDRX	
	>> OK		
	// Configure the APN b	pased on the requirement of SIM card	If APN needs to be configured for
2-2	>> AT+QCGDEFCONT="IPV4	V6"," <apn>", "<username>", "<password>"</password></username></apn>	the SIM card, please perform the
	>> OK		command, others can be ignored
			If return NO READY, indicates the
	>> AT+CPIN?	//check the SIM status	check of SIM card is failed. You
	>> +CPIN: READY		need to check the SIM card and
2-3	>>		hardware. So the program can be
	>> OK		directly powered off, or go to the
			above 1-2, into the low power state
	//Check the attribute v	values of the module	
	>> ATI	//Query module identification	
	>> Quectel_Ltd		
	>> xxxxxxx		
	>> Revision: xxxxxxx		
	>> NEVISION: AAAAAA		If the application design does not
2-4	>> OK		require this step, you can skip the
		//Ougay+ba IMEI	step
	>> AT+CGSN=1	//Query the IMEI	
	>> +CGSN: <imei></imei>		
	>>		
	>> OK	<i>u</i>	
		//Other queries	

	. o. zooonazooon zoralopinantana Appin	ation Process in Power-on and Ps	
2-5	>> AT+CSCON=1 >> OK		If the application design does not require this step, you can skip the step
	>> +CSCON:1 //Indicates that the RRC connection is complete //To query the following parameters, it is recommended to query after return +CSCON:1, or query after the registration network is completed >> AT+CIMI //Query the IMSI >> 460113061353533 >> >> OK >> AT+NCCID //Query the CCID of SIM >> +NCCID:89861122223000411769 >> OK >> AT+QENG=0 //Query the information about the current camp on the cell >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3 >>		If the application design does not require this step, you can skip the step In the application design of the
2-6			terminal, you can execute AT+QENG=0 to obtain the relevant network and signal reference, and to encode RSRP, SNR, CELLID, EARFCN and PCI and upload the data to the server. It will helps for troubleshoot problems.
2-7	>> OK // Query the network registration status >> AT+CEREG? //Query the network registration status >> +CEREG:0,2 >> >> OK //Periodic queries, such as 500ms intervals		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query the IP address obtained >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17ab:01f8:98b0:032e" >> >> OK		
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query t >> +CCLK: "24/01/16,08:55:19+32"	he current date and time	Time conversion: 24/01/16,08:55:19+32/4(h)=

	For BC660K&BC950K Development and Application Process in Power-on and PS	
	>>	2024/01/16,16:55:19
	>> OK	If the default time is returned, pls
		query the time for multiple times
3- Conn	ect to TCP server	
	//Configure optional parameters	
	>> AT+QICFG="dataformat",0,0	
	>>	
	>> OK	Letter and development along
TO 4	>> AT+QICFG="showlength",1	In the actual development, please
T3-1	>>	configure parameters according to
	>> OK	your requirement
	>> AT+QICFG="showRA",1	
	>>	
	>> OK	
	//Set the TCP server parameters and initiate the connection	
	>> AT+QIOPEN=0,0,"TCP","220.180.239.212",8058,0,1 //Direct push mode	
	>>	
	>> OK	
	>>	
T3-2	>> +QIOPEN: 0,0	
	>> AT+QISTATE=1,0 //Query TCP connection status	
	»>	
	>> +QISTATE: 0,"TCP","220.180.239.212",8058,0,2,0,1	
	>>>	
	>> OK	
	//Send data in non-data mode	
	>> AT+QISEND=0,19,"this is a test text" //Send data	
	 >>	
	>> OK	
T3-3-1	>>	
	>> SEND OK	
	»>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Send data in data mode	
	>> AT+QISEND=0	
	»>	
	>> > this is a test text	
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	
T3-3-2	>>	
	>> OK	
	>>>	
	>> SEND OK	
	>>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Switch receiving mode to Buffer access mode	
	Or the parameter access mode of AT+QIOPEN is set to 0	In actual development, if your
T3-4	>> AT+QISWTMD=0,0 //Switch the receive mode to Buffer access mode	requirement is buffer access mode,
	>> All glow mid-ops	please configure access_mode to 0
		in AT+QIOPEN
	>> OK	

	For BC660K&BC950K Development and Application Process in Power-on and PSK	
	>> AT+QISEND=0 //Send data in data mode	
	>>	
	>> > this is a test text	
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	
	>>	
	>> OK	
	>>	
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058 //Receive the URC of data	
	>> AT+QIRD=0,1200 //Read the data in buffer	
	»>	
	>> +QIRD: 12,0,"220.180.239.212",8058,"hello world"	
	>> \(\text{\tince}\text{\texi{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ticleft{\text{\tin\tin\tin\tint{\text{\text{\text{\text{\text{\ti}}\tint{\text{\tin\tint{\ti}\titt{\text{\text{\text{\texitit{\text{\texict{\text{\tinte\tint{\text{\text{\text{\ti}}\tiint{\text{\tinte\tintet{\text{	
	>> OK	
	>> AT+QICLOSE=0 //Close TCP connection	
T0 5	>> 	
T3-5	>> OK	
	>>	
	>> CLOSE OK	
4- Powe	r off after sending and receiving data	
		If the terminal is designed for
	>> AT+CFUN=0 //Set minimum function	power-off mode and powered off
4-1	>> OK	after data interaction is complete,
4-1	//Wait for the return OK, then mcu control to power off; If not return OK after running	you need to run AT+CFUN=0, then
	AT+CFUN=0 for a long period of time (for example, 20s), you can power off directly.	power off the terminal after return
		OK to avoid damage to the flash
5- Eras	e the historical frequency	
	//If 2-8 the registration network is not successful within the set search time(such as 2min),	As described in 2.0 it is supported
	go to	As described in 2-8, it is suggested
	>> AT+CFUN=0 //Erase the historical frequency based on CFUN0	that in the program design, after
	>> OK	the first search fails to time out, the
	>> AT+QCSEARFCN //Erase the historical frequency	frequency clearing program must
	>> OK	be executed. After run, follow the
5-1	>> AT+QBAND=1,28	2-7 to check the search status
	//*Lock a specific frequency band. Note that it is not recommended for non-specific	again;
	situations	If the research fails to time out, you
	>> OK	are advised to reboot without
		clearing the frequency again. Or
		wait for the next service cycle and
	>> OK	try again.
C E	Follow 2-7 above	
b- Exce	ption handling or interruption	
	1) The program or mcu needs to add the interrupt method of time-out or failure to register	
	the AEP platform, such as re-registration or reboot.	If the terminal has strict
	2) The program or mcu needs to add the interrupt method of timeout or failure for	requirements on power
6-1	sending or receiving data, such as reboot.	consumption, it is recommended
	3) In the case of exceptions, when the program or mcu performs hardware reset or power-	that the program reasonably
	3) In the case of exceptions, when the program or mcu performs hardware reset or power-off directly, you need to execute AT+CFUN=0 first, and return OK, then control	that the program reasonably control timeout

Application

3.1.3.2 in PSM Mode

PSM function is enabled, and only the TCP server is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

Index	Proc	ess of AT Command	Notes
1- Init	ial		
	//Power on,initial		Boot log output, mcu can also
	>>		determine whether it is normal
	>> RDY		boot;
1-1	>>		If the terminal needs to connect
	>> +CFUN: 1		to the network immediately
	>>		after power on, start from 2-1
	>> +CPIN: READY		
	//After powering on, if the terminal (mcu) does not need to connect to the		In the application design, when the module is powered on after
	network, or prioritize other ta	sks, you need to perform	the device is powered on, if the
	>> AT+CFUN=0	//Enter the deepsleep state	terminal has no network
	>> OK		requirements temporarily or
1-2	>> AT+QSCLK=1	//The deepsleep is enabled by default	mcu gives priority to other
' -	>> OK		tasks, cfun0 can be executed to
			enter the low power mode.
	//If the terminal needs to con	nect to the network later, you can run	If this requirement is not in the
	>> AT+QRST=1	//Reboot	application design, skip this
	>> OK		step to 2-1
2- Sear	ch and register network		'
	//Power on,initial		
	>>		+CPIN: NOT READY indicates
	>> RDY		that the module fails to check
	>>		the sim card.so you need to
	>> +CFUN: 1		check the SIM card itself or the
	>>		pin connection and hardware
	>> +CPIN: READY		design
	>> AT+QBAND=0 //*If you di	d not execute the lock BAND in 7-1, skip the command	By AT+CPSMS=1,,
	>> OK		" <t3412 tau="">","<t3324>",</t3324></t3412>
2-1	>> AT+QSCLK=0	//Disable the deepsleep	you can configure the T3412
	>> OK		and T3324 timers properly
	>> AT+CPSMS=1,,,"01000010","0000	0000" //Enable th PSM	which you need.at the same
	>> OK	45	time, after the completion of
	>> AT+CEDRXS=0,5	//Disable the eDRX	the registration network, by
	>> OK	//Frankle the LIDC of DCC	AT+CEREG=5; +CEREG? You
	>> AT+QNBIOTEVENT=1,1	//Enable the URC of PSM	need to query the real value of
	>> OK	//Disable the LIDC of Doorstoon	T3324,T3412/TAU provided by
	>> AT+QCFG="dsevent",1	//Disable the URC of Deepsleep	the network
	>> OK		

	// Configure the APN based on the requirement of SIM card	If APN needs to be configured for the SIM card, please
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	perform the command, others
	>> OK	can be ignored
		If return NO READY,indicates
		the check of SIM card is failed.
	>> AT+CPIN? //check the SIM status	You need to check the SIM card
2-3	>> +CPIN: READY	and hardware. So the program
	>>	can be directly powered off, or
	>> OK	go to the above 1-2, into the
		low power state
	//Check the attribute values of the module	ion power state
	>> ATI //Query module identification	
	>> Quectel_Ltd	
	>> xxxxxxx	
	>> Revision: xxxxxxx	
	>> NEVISION. AAAAAAA	If the application design does
2-4	>> OK	not require this step, you can
	>> AT+CGSN=1 //Query the IMEI	skip the step
	>> +CGSN: <imei></imei>	
	>>	
	>> OK	
	//Other queries	
	//Other queries	If the application design does
2-5	>> AT+CSCON=1	not require this step, you can
2-0	>> OK	skip the step
	>>>	skip the step
	>> +CSCON:1 //Indicates that the RRC connection is complete	
	//To query the following parameters, it is recommended to query after	If the application design does
	return +CSCON:1, or query after the registration network is completed	not require this step, you can
	>> AT+CIMI //Query the IMSI	skip the step
	>> 460113061353533	In the application design of the
	>>>	terminal, you can execute
	>> OK	AT+QENG=0 to obtain the
2-6	>> AT+NCCID //Query the CCID of SIM	relevant network and signal
	>> +NCCID:89861122223000411769	reference, and to encode RSRP,
	>>	SNR, CELLID, EARFCN and PCI
	>> OK	and upload the data to the
	>> AT+QENG=0 //Query the information about the current camp on the cell	server. It will helps for
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3	troubleshoot problems.
	>>>	·
	>> OK	
	// Query the network registration status	
	>> AT+CEREG? //Query the network registration status	
	>> +CEREG:0,2	
2-7	>>	
	>> OK	
	//Periodic queries, such as 500ms intervals	
		<u> </u>

2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK >> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> OK >> OK >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1 If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM	
2-10	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17	the IP address obtained /ab:01f8:98b0:032e"	card	
2-11	>> OK >> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR	
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times	
3- Acces	ss the TCP server //Configure optional parameters			
T3-1	>> AT+QICFG="dataformat",0,0 >> >> OK >> AT+QICFG="showlength",1 >> >> OK >> AT+QICFG="showlength",1 >> >> OK >> OK >> AT+QICFG="showRA",1 >> OK		In the actual development, please configure parameters according to your requirement	
	//Set the TCP server parameters and initiate the connection >> AT+QIOPEN=0,0,"TCP","220.180.239.212",8058,0,1 //Direct push mode >> >> OK			
T3-2	>>	//Query TCP connection status		
	>> +QISTATE: 0,"TCP","220.180.239.212",8058,0,2,0,1			

	Tot bedockabessok bevelopment and Application Frocess in Tower on and Tsiv	
	>>	
	>> OK	
	//Send data in non-data mode	
	>> AT+QISEND=0,19,"this is a test text" //Send data	
	>>	
T2 2 1	>> OK	
T3-3-1	>>	
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Send data in data mode	
	>> AT+QISEND=0	
	>>	
	>> > this is a test text	
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	
T2 2 2		
T3-3-2	>>	
	>> OK	
	>>	
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Switch receiving mode to Buffer access mode	
	Or the parameter access_mode of AT+QIOPEN is set to 0	
	>> AT+QISWTMD=0,0 //Switch the receive mode to Buffer access mode	
	>>	
	>> OK	
	>> AT+QISEND=0 //Send data in data mode	
	>>	
	>>> this is a test text	
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	In actual development, if your
		requirement is buffer access
T3-4	>> OK	mode, please configure
	>>	access_mode to 0 in
	>> SEND OK	AT+QIOPEN
	>> >>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058 //Receive the URC of data	
	>>	
	>> +QIRD: 12,0,"220.180.239.212",8058,"hello world"	
	>>	
	>> OK	
4- Feat	ure of RAI	
Feature		
of RAI	1) After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1	
	>> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag	
	>> OK	
R4-1	>>	RAI implementation method
	>> +QPING: 0,8.8.8,32,729,51	
		<u> </u>

```
>> +QPING: 0,1,1,0,729,729,729
            >>
            >> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
            >> AT+QSCLK=1
                                            //Enable deepsleep mode
            >> OK
5- Enter status PSM and Deepsleep
            >> +QNBIOTEVENT: "ENTER PSM"
                                                        //Enter the PSM state
5-1
            >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                        //Enter the deepsleep state
6- Exit status of Deepsleep and PSM
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                               //Exit the deepsleep state
            >> AT+QIOPEN=0,0,"TCP","220.180.239.212",8058,0,1 //Recreate the TCP connection
            >>
            >> OK
                                                                                                Method to trigger PSM wake-
T6-1-1
            >>
                                                                                                up
            >> +QNBIOTEVENT: "EXIT PSM"
                                                               //Exit the PSM state
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
            >>
            >> +QIOPEN: 0,0
                                              //The TCP connection was established successfully
            Go to 6-2, or goto T3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
            //If you want to obtain the accurate signal reference in the current scene
            immediately after the PSM is woked up, please refer to
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM_EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                               //Exit the deepsleep state
            >> AT+QIOPEN=0,0,"TCP","220.180.239.212",8058,0,1 //Recreate the TCP connection
                                                                                                If the program or mcu needs to
            >>
                                                                                                 deal with other tasks, such as
            >> OK
                                                                                                 collecting the base station cell
                                                                                                 signal after wake-up; It is
            >> +QNBIOTEVENT: "EXIT PSM"
                                                               //Exit the PSM state
                                                                                                 recommended to refer to this
T6-1-2
                                                                                                 method to trigger PSM wake-
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
                                                                                                 up and obtain the network
                                                                                                 signal after wake-up.
            >>
            >> +QIOPEN: 0,0
                                                                                                If no such requirement in the
                                              //The TCP connection was established successfully
            >> AT+QENG=0
                                                        //Query signal reference
                                                                                                 program, ignore the process
            >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3
            >>
            >> OK
            >> AT+QISEND=0,51,"rsrp=-75,snr=14,cellid=05C4EF33,earfcn=3686,pci=121"
            //Send current signal reference data
```

	For BC660K&BC950K Development and Application Process in Power-off and PSN	/I Mode
	>> OK	
	>>	
	>> SEND OK	
	Go to 6-2,or goto T3-3 for sending data or receving data, and the	
	subsequent process	
	//Manual TAU update	TALL
	>> AT+CPSMS=0	TAU update manually can avoid
	>> OK	automatic update of TAU cycle
6-2	>> AT+CPSMS=1,,,"01000010","00000000"	over time, so,non-service power
	>> OK	consumption can be reduced; If
	Go to T3-3 for sending data or receving data, and the subsequent	no requirement in the
	process	application, ignore this step
7- Erase	the historical frequency	·
	//If 2-8 the registration network is not successful within the set search	As described in 2-8, it is
	time(such as 2min), go to	suggested that in the program
	>> AT+CFUN=0 //Erase the historical frequency based on CFUN0	design, after the first search
	>> OK	fails to time out, the frequency
	>> AT+QCSEARFCN //Erase the historical frequency	clearing program must be
	>> OK	executed. After run, follow the
7-1	>> AT+QBAND=1,28	2-7 to check the search status
	//*Lock a specific frequency band. Note that it is not recommended for non-specific	again;
	situations	If the research fails to time out,
	>> OK	you are advised to reboot
	>> AT+QRST=1 //Reboot, and re-search	without clearing the frequency
	>> OK	again. Or wait for the next
	Follow 2-7 above	service cycle and try again.
8- Excep	tion handling or interruption	
		If the terminal has strict
		requirements on power
	1) The program or mcu shall add the interrupt method of timeout or failure of leshan	consumption, it is
	platform registration, such as re-registration or reboot;	recommended that the
	2) The program or mcu shall add the interrupt method of sending or receiving data	program reasonably control
	timeout or failure, such as reboot;	timeout.
8-1	3) The program or mcu should add interrupt methods that cannot enter PSM normally or	If unable to enter PSM or wake
	cannot wake up PSM, such as reboot;	up from PSM, it is
	4) In the case of exceptions, when the program or mcu performs hardware reset or power-	recommended to compare the
	off directly, you need to execute AT+CFUN=0 first, and return OK, then control	normal time to enter PSM or
	hardware reset or power-off; But software reset or reboot does not run AT+CFUN=0.	exit PSM. If the time exceeds,
		power off or reboot should can
		be operated
		he operated

3.1.4 UDP Application

3.1.4.1 in Power-off Mode

Application

The terminal is connected to the UDP server, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled



Index	Process of AT Command	Notes		
1- Initi	nitial			
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY	Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1		
1-2	//After powering on, if the terminal (mcu) does not need to connect to the network, or prioritize other tasks, you need to perform >> AT+CFUN=0	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to enter the low power mode. If this requirement is not in the application design, skip this step to 2-1		
2- Searc	h and register network			
2-1	//Power on, initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY >> AT+QBAND=0	+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware design		
2-2	// Configure the APN based on the requirement of SIM card >> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>" >> OK</password></username></apn>	If APN needs to be configured for the SIM card, please perform the command, others can be ignored		
2-3	>> AT+CPIN? //check the SIM status >> +CPIN: READY >> >> OK	If return NO READY, indicates the check of SIM card is failed. You need to check the SIM card and hardware. So the program can be directly powered off, or go to the above 1-2, into the low power state		
2-4	//Check the attribute values of the module	If the application design does not		

	FOI BCOOUNABCSSON Development and App		
		module identification	require this step, you can skip the
	>> Quectel_Ltd		step
	>> XXXXXXX		
	>> Revision: xxxxxxx		
	>>		
	>> OK		
	>> AT+CGSN=1 //Quer	y the IMEI	
	>> +CGSN: <imei></imei>		
	>>		
	>> OK		
	//Other	queries	
	>> AT I CSCON-1		If the application design does not
2-5	>> AT+CSCON=1		require this step, you can skip the
	>> OK		step
	>>		
	>> +CSCON:1 //Indicates that the RRC	connection is complete	
	//To query the following parameters, it is reco		
	return +CSCON:1, or query after the registrat		If the application design does not
		y the IMSI	require this step, you can skip the
	>> 460113061353533		step
	>>		In the application design of the
	>> OK		terminal, you can execute
2-6		ry the CCID of SIM	AT+QENG=0 to obtain the relevant
	, ,		network and signal reference, and
	>> +NCCID:89861122223000411769		to encode RSRP, SNR, CELLID,
	>>		EARFCN and PCI and upload the
	>> OK		data to the server. It will helps for
	>> AT+QENG=0 //Query the information about the current camp on the cell		troubleshoot problems.
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3		
	>>		
	>> OK		
	// Query the network registration status		
	>> AT+CEREG? //Query the network registration status		
	>> +CEREG:0,2		
2-7	>>		
	>> OK		
	//Periodic queries, such as 500ms intervals		
	>> AT+CEREG?		If the query only returns
2-8	>> +CEREG:0,0 //+CEREG:0,2		+CEREG:0,0 or +CEREG:0,2 within
2.3	>>		the search time (no less than 2
	>> OK		minutes); the program goes to 5-1
			If the program finally returns
	>> AT+CEREG?	>> AT+CEREG?	+CEREG:0,3 within the search time
	>> +CEREG:0,1 //+CEREG:0,5 (roaming)	>> +CEREG:0,3	(e.g. 2 minutes); Restart or try again
2-9	//the registered successfully	//the registration denied	in the next cycle. If +CEREG:0,3 is
	>>	>>	still returned after multiple
	>> OK	>> OK	attempts, it is recommended to
			check the SIM card
2-10	>> AT+CGPADDR //Quei	ry the IP address obtained	
	// \duci	,	

	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17ab:01f8:98b0:032e"	
	>>	
	>> OK	
		CSQ=(RSSI+113)/2
	>> AT+CSQ //Query the CSQ	CSQ corresponds to signal
	>> +CSQ:xx,99	reference RSSI. In actual
2-11	>>	applications, it is recommended to
	>> OK	run AT+QENG=0 to obtain RSRP
		and SNR
	Wowen the second data and time	Time conversion:
	>> AT+CCLK? //Query the current date and time	24/01/16,08:55:19+32/4(h)=
2-12	>> +CCLK: "24/01/16,08:55:19+32"	2024/01/16,16:55:19
	>> OV	If the default time is returned, pls
	>> OK	query the time for multiple times
3- Conne	ect to UDP server	
	//Configure optional parameters	
	>> AT+QICFG="dataformat",0,0	
	>>	
	>> OK	In the actual development, please
U3-1	>> AT+QICFG="showlength",1	configure parameters according to
	>>	your requirement
	>> OK	
	>> AT+QICFG="showRA",1	
	>>	
	>> OK	
	//Set the TCP server parameters and initiate the connection >> AT+QIOPEN=0,0,"UDP","220.180.239.212",8058,0,1 //Direct push mode	
	>> Alt-QIOPEN-0,0, ODP , 220.160.255.212 ,6056,0,1 //Direct push mode	
	>> OK	
	>> OK	
U3-2	>> +QIOPEN: 0,0	
002	>> AT+QISTATE=1,0 //Query TCP connection status	
	>>	
	>> +QISTATE: 0,"UDP","220.180.239.212",8058,0,2,0,1	
	>>>	
	>> OK	
	//Send data in non-data mode	
	>> AT+QISEND=0,19,"this is a test text" //Send data	
	>>	
T3.3.4	>> OK	
T3-3-1	>>	
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Send data in data mode	
	>> AT+QISEND=0	
T3-3-2	>>	
	>>> this is a test text	
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	

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	>>	
	>> OK	
	>>	
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data	
	//Switch receiving mode to Buffer access mode	
	Or the parameter access mode of AT+QIOPEN is set to 0	
	>> AT+QISWTMD=0,0 //Switch the receive mode to Buffer access mode	
	>>	
	>> OK	
	>> AT+QISEND=0 //Send data in data mode	
	>> AT QUELLE-0 7/3CHd data in data mode	
	>> > this is a test text	
		In actual devalopment if your
	//After ">" is responded, input the data and tap "Ctrl" + "Z" to send it	In actual development, if your
T3-4	»	requirement is buffer access mode,
	>> OK	please configure access_mode to 0
	»	in AT+QIOPEN
	>> SEND OK	
	>>	
	>> +QIURC: "recv",0,12,"220.180.239.212",8058 //Receive the URC of data	
	>> AT+QIRD=0,1200 //Read the data in buffer	
	>>	
	>> +QIRD: 12,0,"220.180.239.212",8058,"hello world"	
	>>	
	>> OK	
	>> AT+QICLOSE=0 //Close UDP connection	
	>>	
T3-5	>> OK	
	>>	
	>> CLOSE OK	
4- Power	off after sending and receiving data	
		If the terminal is designed for
	>> AT+CFUN=0 //Set minimum function	power-off mode and powered off
	>> OK	after data interaction is complete,
4-1	//Wait for the return OK, then mcu control to power off; If not return OK after running	you need to run AT+CFUN=0, then
	AT+CFUN=0 for a long period of time (for example, 20s), you can power off directly.	power off the terminal after return
		OK to avoid damage to the flash
5- Erase	the historical frequency	<u> </u>
	//If 2-8 the registration network is not successful within the set search time(such as 2min),	As described in 2-8, it is suggested
	go to	that in the program design, after
	>> AT+CFUN=0 //Erase the historical frequency based on CFUN0	the first search fails to time out, the
	>> OK	frequency clearing program must
		be executed. After run, follow the
5-1	>> AT+QCSEARFCN //Erase the historical frequency	
	>> OK	2-7 to check the search status
	>> AT+QBAND=1,28	again;
	//*Logic appoints from the part of the transfer of the transfe	If the measure to the text of
	//*Lock a specific frequency band. Note that it is not recommended for non-specific	If the research fails to time out, you
	//*Lock a specific frequency band. Note that it is not recommended for non-specific situations >> OK	If the research fails to time out, you are advised to reboot without clearing the frequency again. Or

	>> /	AT+QRST=1	//Reboot, and re-search	wait for the next service cycle and
	>> (ОК		try again.
	Fol	ow 2-7 above		
6- Excep	tio	n handling or interruption		
	1)	The program or mcu needs to add the inte	rrupt method of time-out or failure to register	
		the AEP platform, such as re-registration o	reboot.	If the terminal has strict
	2)	The program or mcu needs to add the inte	rrupt method of timeout or failure for	requirements on power
6-1		sending or receiving data, such as reboot.		consumption, it is recommended
	3)	In the case of exceptions, when the progra	am or mcu performs hardware reset or power-	that the program reasonably
		off directly, you need to execute AT+CFUN	=0 first, and return OK, then control	control timeout
		hardware reset or power-off; But software	reset or reboot does not run AT+CFUN=0.	

3.1.4.2 in PSM Mode

	PSM function is enabled, and only the UDP server is connected. The data is
Application	reported/upload frequently, and the application logic of mcu or program is relatively
	complex

■ Reference for Process of Developing Application:

Index	Process of AT	Command	Notes
1- Initi	al		
	//Power on,initial >> >> RDY		Boot log output, mcu can also determine whether it is normal
1-1	>>		boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2	//After powering on, if the terminal (m network, or prioritize other tasks, you >> AT+CFUN=0 //En >> OK		In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to
	>> OK	he network later, you can run boot	enter the low power mode. If this requirement is not in the application design, skip this step to 2-1
2- Searc	ch and register network		
2-1	//Power on,initial >> >> RDY >> >> +CFUN: 1		+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware
	>> +CPIN: READY		design By AT+CPSMS=1,,

	>> AT+QBAND=0 //*If you did not execute the lock BAND in 7-1, skip the	
	>> OK	you can configure the T3412
	>> AT+QSCLK=0 //Disable the deepsleep	and T3324 timers properly
	>> OK	which you need at the same
	>> AT+CPSMS=1,,,"01000010","00000000" //Enable th PSM	time, after the completion of
	>> OK	the registration network, by
	>> AT+CEDRXS=0,5 //Disable the eDRX	AT+CEREG=5; +CEREG? You
	>> OK	need to query the real value of
		T3324,T3412/TAU provided by
	>> OK	the network
	>> AT+QCFG="dsevent",1 //Disable the URC of Deepsleep >> OK	
		If APN needs to be configured
0.0	// Configure the APN based on the requirement of SIM card	for the SIM card, please
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	perform the command, others
	>> OK	can be ignored
		If return NO READY,indicates
	//	the check of SIM card is failed.
	>> AT+CPIN? //check the SIM status	You need to check the SIM card
2-3	>> +CPIN: READY	and hardware. So the program
	>>	can be directly powered off, or
	>> OK	go to the above 1-2, into the
		low power state
	//Check the attribute values of the module	
	>> ATI //Query module identification	
	>> Quectel_Ltd	
	>> xxxxxxx	
	>> Revision: xxxxxxx	
2.4	>>	If the application design does
2-4	>> OK	not require this step, you can
	>> AT+CGSN=1 //Query the IMEI	skip the step
	>> +CGSN: <imei></imei>	
	>>	
	>> OK	
	//Other queries	
	>> AT+CSCON=1	If the application design does
2-5	>> OK	not require this step, you can
		skip the step
	>>	If the application design does
	>> +CSCON:1 //Indicates that the RRC connection is complete	not require this step, you can
	//To query the following parameters, it is recommended to query	
	return +CSCON:1, or query after the registration network is com	pleted In the application design of the
	>> AT+CIMI //Query the IMSI	terminal, you can execute
2-6	>> 460113061353533	AT+QENG=0 to obtain the
	>>	relevant network and signal
	>> OK	reference, and to encode RSRP,
	>> AT+NCCID //Query the CCID of SIM	SNR, CELLID, EARFCN and PCI
	>> +NCCID:89861122223000411769	and upload the data to the

	>> OK >> AT+QENG=0 //Query the information about the current camp on the cell >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3 >> >> OK		troubleshoot problems.
2-7	// Query the network registration status >> AT+CEREG? //Query the network registration status >> +CEREG:0,2 >> >> OK //Periodic queries, such as 500ms intervals		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17 >> >> OK	the IP address obtained 7ab:01f8:98b0:032e"	
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Acces	//Configure optional parameters >> AT+QICFG="dataformat",0,0 >> >> OK >> AT+QICFG="showlength",1 >> >> OK		In the actual development, please configure parameters according to your requirement

```
>> AT+QICFG="showRA",1
            >>
            >> OK
            //Set the TCP server parameters and initiate the connection
            >> AT+QIOPEN=0,0,"UDP","220.180.239.212",8058,0,1 //Direct push mode
            >>
            >> OK
T3-2
            >> +QIOPEN: 0,0
            >> AT+QISTATE=1,0
                                                                  //Query TCP connection status
            >> +QISTATE: 0,"UDP","220.180.239.212",8058,0,2,0,1
            >>
            >> OK
            //Send data in non-data mode
            >> AT+QISEND=0,19,"this is a test text"
                                                                  //Send data
            >>
            >> OK
T3-3-1
            >>
            >> SEND OK
            >> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data
            //Send data in data mode
            >> AT+QISEND=0
            >> > this is a test text
            //After ">" is responded, input the data and tap "Ctrl" + "Z" to send it
T3-3-2
            >>
            >> OK
            >>
            >> SEND OK
            >> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data
            //Switch receiving mode to Buffer access mode
            Or the parameter access mode of AT+QIOPEN is set to 0
            >> AT+QISWTMD=0,0
                                              //Switch the receive mode to Buffer access mode
            >>
            >> OK
            >> AT+QISEND=0
                                               //Send data in data mode
                                                                                                   In actual development, if your
            >>
                                                                                                   requirement is buffer access
            >> > this is a test text
T3-4
                                                                                                   mode, please configure
            //After ">" is responded, input the data and tap "Ctrl" + "Z" to send it
                                                                                                   access_mode to 0 in
            >>
                                                                                                   AT+QIOPEN
            >> OK
            >>
            >> SEND OK
            >> +QIURC: "recv",0,12,"220.180.239.212",8058 //Receive the URC of data
            >> AT+QIRD=0,1200
                                                           //Read the data in buffer
```

```
>> +QIRD: 12,0,"220.180.239.212",8058,"hello world"
           >> OK
4- Feature of RAI
Feature
                After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1
of RAI
           >> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag
           >> OK
           >>
           >> +QPING: 0,8.8.8.8,32,729,51
R4-1
                                                                                               RAI implementation method
           >> +QPING: 0,1,1,0,729,729,729
           >>
           >> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
            >> AT+QSCLK=1
                                            //Enable deepsleep mode
            >> OK
    Enter status PSM and Deepsleep
           >> +QNBIOTEVENT: "ENTER PSM"
                                                       //Enter the PSM state
5-1
           >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                       //Enter the deepsleep state
6- Exit status of Deepsleep and PSM
           //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
           >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                                 //Exit the deepsleep state
           >> AT+QISEND=0,10,"helloworld"
           //After exit deepsleep, the program or mcu can directly send UDP data
           >> OK
                                                                                               Method to trigger PSM wake-
           >>
U6-1-1
           >> SEND OK
           >>
           >> +QNBIOTEVENT: "EXIT PSM"
                                                                   //Exit the PSM state
           >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
           >> +QIURC: "recv",0,12,"220.180.239.212",8058,"hello world" //Receive data
            Go to 6-2, or goto T3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
           //If you want to obtain the accurate signal reference in the current scene
                                                                                               If the program or mcu needs to
           immediately after the PSM is woked up, please refer to
                                                                                               deal with other tasks, such as
           //BC660K&BC950K support to wake up deepsleep by executing AT
                                                                                               collecting the base station cell
U6-1-2
            command or pulling down PSM EINT pin
                                                                                               signal after wake-up; It is
                                                                                               recommended to refer to this
           >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                                                               method to trigger PSM wake-
           >> AT+QPING=0,"8.8.8.8",4,1
                                                                                               up and obtain the network
```

	101 2000114200	30K Bevelopment and Application Frocess in Fower on and Fsi	· · · · · · · · · · · · · · · · · · ·
	>>		signal after wake-up.
	>> OK		If no such requirement in the
	>>		program, ignore the process
	>> +QNBIOTEVENT: "EXIT PSN	1"	
	>>		
	>> +CSCON: 1 //Indicates th		
	>> ···	· ·	
	>> +QPING: 0,8.8.8.8,32,699,	51	
	>> \q. \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	· ·	
	>> +QPING: 0,1,1,0,699,699,6	00	
	>> AT+QENG=0	//Query signal reference	
	>> AITQENG-0	//Query signarreletetice	
		CAFF22 72 2 70 40 0 4C40 0 0 2	
		5C4EF33",-72,-2,-70,18,8,"4C10",0,0,3	
	>>		
	>> OK		
		2,snr=18,cellid=05C4EF33,earfcn=3686,pci=121"	
	//Send current signal reference	ce data	
	>>		
	>> OK		
	>>		
	>> SEND OK		
	Go to 6-2, or goto U3-3	for sending data or receving data, and the	
	subsequent process		
	//Manual TAU update		TALL
	>> AT+CPSMS=0		TAU update manually can avoid
	>> OK		automatic update of TAU cycle
6-2	>> AT+CPSMS=1,,,"01000010","00000000"		over time, so,non-service power
	>> OK		consumption can be reduced; If
	Go to U3-3 for sending	data or receving data, and the subsequent	no requirement in the
	process		application, ignore this step
7- Era	se the historical freque	ency	
		network is not successful within the set search	As described in 2-8, it is
	time(such as 2min), go		suggested that in the program
		//Erase the historical frequency based on CFUN0	design, after the first search
	22 Al I CI OII-0	// Liase the historical requertey based on el ono	
	>> OK		Talls to time out the tredilency
	>> OK	//Frase the historical frequency	fails to time out, the frequency
	>> AT+QCSEARFCN	//Erase the historical frequency	clearing program must be
7 4	>> AT+QCSEARFCN >> OK	//Erase the historical frequency	clearing program must be executed. After run, follow the
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28		clearing program must be executed. After run, follow the 2-7 to check the search status
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency by	//Erase the historical frequency	clearing program must be executed. After run, follow the 2-7 to check the search status again;
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations		clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out,
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK	pand. Note that it is not recommended for non-specific	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations		clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1 >> OK	pand. Note that it is not recommended for non-specific	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency again. Or wait for the next
7-1	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1	pand. Note that it is not recommended for non-specific	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency
	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1 >> OK	vand. Note that it is not recommended for non-specific //Reboot, and re-search	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency again. Or wait for the next
	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1 >> OK Follow 2-7 above eption handling or interpretations	vand. Note that it is not recommended for non-specific //Reboot, and re-search	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency again. Or wait for the next
8- Exc	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1 >> OK Follow 2-7 above eption handling or interest of the program or mcu shall in the program or	vand. Note that it is not recommended for non-specific //Reboot, and re-search rruption	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency again. Or wait for the next service cycle and try again.
	>> AT+QCSEARFCN >> OK >> AT+QBAND=1,28 //*Lock a specific frequency be situations >> OK >> AT+QRST=1 >> OK Follow 2-7 above eption handling or interplatform registration, such	//Reboot, and re-search	clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot without clearing the frequency again. Or wait for the next service cycle and try again. If the terminal has strict

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3.1.5 MQTT-based AWS IoT Application

3.1.5.1 in Power-off Mode

Application

The terminal is connected to the MQTT of AWS IoT platform, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled

Reference for Process of Developing Application:

Index	Process of	AT Command	Notes
1- Init	ial		
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY		Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2	network, or prioritize other tasks, yo >> AT+CFUN=0 // >> OK >> AT+QSCLK=1 // >> OK //If the terminal needs to connect to	/Enter the deepsleep state /The deepsleep is enabled by default	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to enter the low power mode. If this requirement is not in the application design, skip this step to 2-1
2- Sear	ch and register network		
2-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >>		+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware design

	>> +CPIN: READY >> AT+QBAND=0 //*If you did not execute the lock BAND in 5-1, skip the command	
	>> OK	
	>> AT+QSCLK=0 //Disable the deepsleep	
	>> OK	
	>> AT+CPSMS=0 //Disable th PSM	
	>> OK	
	>> AT+CEDRXS=0,5 //Disable the eDRX	
	>> OK	
	// Configure the APN based on the requirement of SIM card	If APN needs to be configured for
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	the SIM card, please perform the
	>> OK	command, others can be ignored
		If return NO READY, indicates the
		check of SIM card is failed. You
	>> AT+CPIN? //check the SIM status	need to check the SIM card and
2-3	>> +CPIN: READY	hardware. So the program can be
	>>	directly powered off, or go to the
	>> OK	above 1-2, into the low power
		state
	//Check the attribute values of the module	
	>> ATI //Query module identification	
	>> Quectel_Ltd	
	>> xxxxxxx	
	>> Revision: xxxxxxx	
	>>	If the application design does not
2-4	>> OK	require this step, you can skip the
	>> AT+CGSN=1 //Query the IMEI	step
	>> +CGSN: <imei></imei>	
	>>	
	>> OK	
	//Other queries	
	>> AT+CSCON=1	If the application design does not
2-5	>> OK	require this step, you can skip the
		step
	>>	
	>> +CSCON:1 //Indicates that the RRC connection is complete	If the application design does not
	//To query the following parameters, it is recommended to query after	require this step, you can skip the
	return +CSCON:1, or query after the registration network is completed	step
	>> AT+CIMI //Query the IMSI	In the application design of the
	>> 460113061353533	terminal, you can execute
	>>	AT+QENG=0 to obtain the
2-6	>> OK	relevant network and signal
	>> AT+NCCID //Query the CCID of SIM	reference, and to encode RSRP,
	>> +NCCID:89861122223000411769	SNR, CELLID, EARFCN and PCI and
	>>	upload the data to the server. It
	>> OK	will helps for troubleshoot
	>> AT+QENG=0 //Query the information about the current camp on the cell	problems.
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3	
	>>	

	>> OK		
2-7	// Query the network registration status >> AT+CEREG? //Query the network registration status >> +CEREG:0,2 >> OK //Periodic queries, such as 500ms intervals		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> OK >> OK >> OK		If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query the IP address obtained >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17ab:01f8:98b0:032e" >> >> OK		
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Conr	nect to AWS IoT server		
Q3-1	//Testing AWS IoT connectivity >> AT+QIDNSCFG=0,"8.8.8.8","8.8.4.4" >> >> OK >> AT+QPING=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazonaws.com",4,1 >> >> OK		In the actual development, please configure parameters according to your requirement
	>> +QPING: 0,54.204.191.103,32,356,237 >> +QPING: 0,1,1,0,356,356,356		
Q3-2	//Load the CA certificate and key files		

```
>> AT+QSSLCFG=0,0,"cacert" // Upload the RootCA.pem to the FILE system
           >>
           >> >
           >> -----BEGIN CERTIFICATE-----
           >> MIIDQTCCAimgAwIBAgITBmyfz5m/jAo54vB4ikPmljZbyjANBgkqhkiG9w0BAQsF
           >> rqXRfboQnoZsG4q5WTP468SQvvG5
           >> -----END CERTIFICATE-----
           >> +QSSLCFG: 0,0,"cacert",1187
           // The byte size of the indication must correspond to the byte size of the content of
           AmazonRootCA1.pem
           >>
           >> OK
           >> AT+QSSLCFG=0,0,"clientcert" // Upload the certificate.pem.crt to the FILE system
           >>
           >> >
           >> -----BEGIN CERTIFICATE-----
           >> MIIDWjCCAkKgAwIBAgIVAKp/znqyrMfoSWNqhC/Ln+qsPPI4MA0GCSqGSIb3DQEB
           >> ++kMnCN/oHJzDl2jzL65XktQm99MojobbN121jZm3v34nqOuYFT6351CaA64DQ==
           >> -----END CERTIFICATE-----
           >>
           >> +QSSLCFG: 0,0,"clientcert",1224
           // The byte size of the indication must correspond to the byte size of the content of xxx-
           certificate.pem.crt
           >>
           >> OK
           >> AT+QSSLCFG=0,0,"clientkey" // Upload the private.pem.key to the FILE system
           >>
           >> -----BEGIN RSA PRIVATE KEY-----
           >> MIIEowIBAAKCAQEA3rCImNdAS6x43he0Zn0hq7BGHrdt3ttljYmTsCVttkcdGX3+
           >> cnEBCR2U3DpU1qNrn0D8r8qCJjWbYJwzEbEoFaKi8zHuhLLVuuus
           >> -----END RSA PRIVATE KEY-----
           >>
           >> +QSSLCFG: 0,0,"clientkey",1675
           // The byte size of the indication must correspond to the byte size of the content of xxx-
           private.pem.key
           >>
           >> OK
           //MQTT and SSL configuration
           >> AT+QSSLCFG=0,0,"seclevel",2
                                                 //SSL authorization mode:server authentication
           >>
Q3-3
           >> OK
           >> AT+QMTCFG="ssl",0,1,0,0
                                              //Enable SSL and configure SSL context/connect index
           >>
           >> OK
```

```
>> AT+QMTCFG="version",0,1
                                                //Configure the MQTT version
           >>
           >> OK
           >> AT+QSSLCFG=0,0
                                   //Query and validate the results of the current configuration
           >>
           >> +QSSLCFG: 0,0,"seclevel",2
           >> +QSSLCFG: 0,0,"sslversion",4
           >> +QSSLCFG: 0,0,"dataformat",0,0
           >> +QSSLCFG: 0,0,"timeout",90
           >> +QSSLCFG: 0,0,"debug",0
           >> +QSSLCFG: 0,0,"cacert",1187
           >> +QSSLCFG: 0,0,"clientcert",1224
           >> +QSSLCFG: 0,0,"clientkey",1675
           >> +QSSLCFG: 0,0,"dtls",0
           >> +QSSLCFG: 0,0,"dtlsversion",2
           >>
           >> OK
           //MQTT of AWS IoT to connect and subscribe
           >> AT+QMTOPEN=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazonaws.com",8883
           // Open the MQTT SSL connection
           >>
           >> OK
           >> +QMTOPEN: 0,0
           >> AT+QMTCONN=0,"smartKit001"
                                               // Initiate the MQTT server connection
Q3-4
           >>
           >> OK
           >>
           >> +QMTCONN: 0,0,0
           >> AT+QMTSUB=0,1,"toaws/smartKit001/update/message",1 // Subscribe to related topic
           >> OK
           >>
           >> +QMTSUB: 0,1,0,1
           //MQTT publish
           Publish fixed-length messages in non-data mode
           AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message",23,"{"temp",22.5,"humi",68}"
           // Publish messages to related topic
Q3-5-1
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"toaws/smartKit001/update/message","{ "message": "Hello from AWS IoT
           console"}"
           //MQTT publish
Q3-5-2
           Publish fixed-length messages in data mode
```

```
>> AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message",23
           >> >
           >> "{"temp",22.5,"humi",68}"
                                                      // Publish data
           >>
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"toaws/smartKit001/update/message","{ "message": "Hello from AWS IoT
           console"}"
           //MQTT publish
           Publish variable-length messages in data mode
           >> AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message"
           >>>
           >> "{"temp",22.5,"humi",68}"
                                                      // Publish data
           >>
Q3-5-3
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"toaws/smartKit001/update/message","{ "message": "Hello from AWS IoT
           console"}"
           >> AT+QMTCLOSE=0
                                            // Initiating MQTT connection disconnected
           >>
Q3-6
           >> OK
           >>
            >> +QMTCLOSE: 0,0
    Power off after sending and receiving data
                                                                                                       If the terminal is designed for
                                                                                                       power-off mode and powered off
           >> AT+CFUN=0
                                                //Set minimum function
                                                                                                       after data interaction is complete,
4-1
                                                                                                       you need to run AT+CFUN=0,
            //Wait for the return OK, then mcu control to power off; If not return OK after running
                                                                                                       then power off the terminal after
            AT+CFUN=0 for a long period of time (for example, 20s), you can power off directly.
                                                                                                       return OK to avoid damage to the
                                                                                                       flash
5- Erase the historical frequency
            //If 2-8 the registration network is not successful within the set search time(such as 2min), go
                                                                                                       As described in 2-8, it is suggested
           to
                                                                                                       that in the program design, after
           >> AT+CFUN=0
                                                                                                       the first search fails to time out,
                                       //Erase the historical frequency based on CFUNO
           >> OK
                                                                                                       the frequency clearing program
           >> AT+QCSEARFCN
                                        //Erase the historical frequency
                                                                                                       must be executed. After run,
                                                                                                       follow the 2-7 to check the search
           >> OK
5-1
           >> AT+QBAND=1.28
                                                                                                       status again;
           //*Lock a specific frequency band. Note that it is not recommended for non-specific situations
                                                                                                       If the research fails to time out,
           >> OK
                                                                                                       you are advised to reboot without
            >> AT+QRST=1
                                                          //Reboot, and re-search
                                                                                                       clearing the frequency again. Or
                                                                                                       wait for the next service cycle and
           >> OK
            Follow 2-7 above
                                                                                                       try again.
```

6- Exception handling or interruption				
	1)	The program or mcu needs to add the interrupt method of time-out or failure to register		
		the AEP platform, such as re-registration or reboot.	If the terminal has strict	
	2)	The program or mcu needs to add the interrupt method of timeout or failure for sending	requirements on power	
6-1		or receiving data, such as reboot.	consumption, it is recommended	
	3)	In the case of exceptions, when the program or mcu performs hardware reset or power-	that the program reasonably	
		off directly, you need to execute AT+CFUN=0 first, and return OK, then control hardware	control timeout	
		reset or power-off; But software reset or reboot does not run AT+CFUN=0.		

3.1.5.2 in PSM Mode

Application

PSM function is enabled, and only the MQTT of AWS IoT platform is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

Reference for Process of Developing Application:

Index		Process of AT Command	Notes
1- Ini	tial		
	//Power on,initial		Boot log output, mcu can also
	>>		determine whether it is
	>> RDY		normal boot;
1-1	>>	>>	
	>> +CFUN: 1		connect to the network
	>>	>>	
	>> +CPIN: READY		start from 2-1
			In the application design,
	//After powering	on, if the terminal (mcu) does not need to connect to the	when the module is powered
	network, or prior	itize other tasks, you need to perform	on after the device is powered
	>> AT+CFUN=0	//Enter the deepsleep state	on, if the terminal has no
	>> OK		network requirements
1-2	>> AT+QSCLK=1	//The deepsleep is enabled by default	temporarily or mcu gives
1-2	>> OK		priority to other tasks, cfun0
			can be executed to enter the
	//If the terminal r	needs to connect to the network later, you can run	low power mode.
	>> AT+QRST=1	//Reboot	If this requirement is not in
	>> OK		the application design, skip
			this step to 2-1
2- Sea	rch and register r	network	
	//Power on,initial		+CPIN: NOT READY indicates
	>>		that the module fails to check
	>> RDY		the sim card.so you need to
	>>		check the SIM card itself or
2-1	>> +CFUN: 1		the pin connection and
Z-1	>>		hardware design
	>> +CPIN: READY		By AT+CPSMS=1,,
	>> AT+QBAND=0	//*If you did not execute the lock BAND in 7-1, skip the command	" <t3412 tau="">","<t3324>",</t3324></t3412>
	>> OK		you can configure the T3412
	>> AT+QSCLK=0	//Disable the deepsleep	and T3324 timers properly

	>> OK >> AT+CPSMS=1,,,"01000010","00000000" //Enable th PSM	which you need.at the same time, after the completion of
	>> OK >> AT+CEDRXS=0,5 //Disable the eDRX	AT+CEREG=5; +CEREG? You
	>> OK >> AT+QNBIOTEVENT=1,1 //Enable the URC of PSM >> OK	need to query the real value of T3324,T3412/TAU provided by the network
	>> AT+QCFG="dsevent",1 //Disable the URC of Deepsleep >> OK	by the network
2-2	// Configure the APN based on the requirement of SIM card >> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>" >> OK</password></username></apn>	If APN needs to be configured for the SIM card, please perform the command, others can be ignored
2-3	>> AT+CPIN? //check the SIM status >> +CPIN: READY >> >> OK	If return NO READY, indicates the check of SIM card is failed. You need to check the SIM card and hardware. So the program can be directly powered off, or go to the above 1-2, into the low power state
2-4	//Check the attribute values of the module >> ATI	If the application design does not require this step, you can skip the step
2-5	//Other queries >> AT+CSCON=1 >> OK	If the application design does not require this step, you can
2-6	>> >> +CSCON:1	If the application design does not require this step, you can skip the step In the application design of the terminal, you can execute AT+QENG=0 to obtain the relevant network and signal reference, and to encode RSRP, SNR, CELLID, EARFCN and PCI and upload the data to the server. It will helps for troubleshoot problems.

	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10	0",0,9,3	
	>>		
	>> OK // Query the network registration status		
	>> AT+CEREG? //Query the network registration status	ıs	
	>> +CEREG:0,2		
2-7	>>		
	>> OK		
	//Periodic queries, such as 500ms intervals		
			If the average only nations
	>> AT+CEREG?		If the query only returns +CEREG:0,0 or +CEREG:0,2
2-8	>> +CEREG:0,0 //+CEREG:0,2		within the search time (no less
	>> 		than 2 minutes); the program
	>> OK		goes to 5-1
			If the program finally returns
	>> AT+CEREG?	>> AT+CEREG?	+CEREG:0,3 within the search
	>> +CEREG:0,1 //+CEREG:0,5 (roaming)	>> +CEREG:0,3	time (e.g. 2 minutes); Restart
2-9	//the registered successfully	//the registration denied	or try again in the next cycle. If +CEREG:0,3 is still returned
	>>	>>	after multiple attempts, it is
	>> OK	>> OK	recommended to check the
			SIM card
	>> AT+CGPADDR //Query tl	he IP address obtained	
2-10	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17ab:01f8:98b0:032e"		
	>> >> OK		
			CSQ=(RSSI+113)/2
			CSQ corresponds to signal
	>> AT+CSQ //Query th >> +CSQ:xx,99	e CSQ	reference RSSI. In actual
2-11	>> +C3Q.xx,39		applications, it is
	>> OK		recommended to run
			AT+QENG=0 to obtain RSRP
			and SNR Time conversion:
	>> AT+CCLK? //Query the	e current date and time	24/01/16,08:55:19+32/4(h)=
2.42	>> +CCLK: "24/01/16,08:55:19+32"		2024/01/16,16:55:19
2-12	>>		If the default time is returned,
	>> OK		pls query the time for multiple
2 4	ANO L-T		times
3- Acce	//Testing AWS IoT connectivity		
	>> AT+QIDNSCFG=0,"8.8.8.8","8.8.4.4"		
	>>		In the actual development
Q3-1	>> OK		In the actual development, please configure parameters
QJ-1	>> AT+QPING=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazor	naws.com",4,1	according to your requirement
	>>		5 y
	>> OK		
	>>		

```
>> +QPING: 0,54.204.191.103,32,356,237
           >>
           >> +QPING: 0,1,1,0,356,356,356
           //Load the CA certificate and key files
           >> AT+QSSLCFG=0,0,"cacert"
                                        // Upload the RootCA.pem to the FILE system
           >>
           >> >
           >> -----BEGIN CERTIFICATE-----
           >> MIIDQTCCAimgAwIBAgITBmyfz5m/jAo54vB4ikPmljZbyjANBgkqhkiG9w0BAQsF
           >> .....
           >> rqXRfboQnoZsG4q5WTP468SQvvG5
           >> -----END CERTIFICATE-----
           >> +QSSLCFG: 0,0,"cacert",1187
           // The byte size of the indication must correspond to the byte size of the content of
           AmazonRootCA1.pem
           >>
           >> OK
           >> AT+QSSLCFG=0,0,"clientcert" // Upload the certificate.pem.crt to the FILE system
           >>
           >>>
           >> -----BEGIN CERTIFICATE-----
           >> MIIDWjCCAkKgAwIBAgIVAKp/znqyrMfoSWNqhC/Ln+qsPPI4MA0GCSqGSIb3DQEB
           >> ++kMnCN/oHJzDl2jzL65XktQm99MojobbN121jZm3v34nqOuYFT6351CaA64DQ==
Q3-2
           >> -----END CERTIFICATE-----
           >>
           >> +QSSLCFG: 0,0,"clientcert",1224
           // The byte size of the indication must correspond to the byte size of the content of xxx-
           certificate.pem.crt
           >>
           >> OK
           >> AT+QSSLCFG=0,0,"clientkey" // Upload the private.pem.key to the FILE system
           >>
           >> >
           >> -----BEGIN RSA PRIVATE KEY-----
           >> MIIEowIBAAKCAQEA3rCImNdAS6x43he0Zn0hq7BGHrdt3ttljYmTsCVttkcdGX3+
           >> cnEBCR2U3DpU1qNrn0D8r8qCJjWbYJwzEbEoFaKi8zHuhLLVuuus
           >> -----END RSA PRIVATE KEY-----
           >>
           >> +QSSLCFG: 0,0,"clientkey",1675
           // The byte size of the indication must correspond to the byte size of the content of xxx-
            private.pem.key
           >>
           >> OK
           //MQTT and SSL configuration
Q3-3
           >> AT+QSSLCFG=0,0,"seclevel",2
                                                  //SSL authorization mode:server authentication
```

```
>> OK
           >> AT+QMTCFG="ssl",0,1,0,0
                                             //Enable SSL and configure SSL context/connect index
           >> OK
           >> AT+QMTCFG="version",0,1
                                                 //Configure the MQTT version
           >>
           >> OK
           >> AT+QSSLCFG=0,0
                                    //Query and validate the results of the current configuration
           >>
           >> +QSSLCFG: 0,0,"seclevel",2
           >> +QSSLCFG: 0,0,"sslversion",4
           >> +QSSLCFG: 0,0,"dataformat",0,0
           >> +QSSLCFG: 0,0,"timeout",90
           >> +QSSLCFG: 0,0,"debug",0
           >> +QSSLCFG: 0,0,"cacert",1187
           >> +QSSLCFG: 0,0,"clientcert",1224
           >> +QSSLCFG: 0,0,"clientkey",1675
           >> +QSSLCFG: 0,0,"dtls",0
           >> +QSSLCFG: 0,0,"dtlsversion",2
           >> OK
           //MQTT of AWS IoT to connect and subscribe
           >> AT+QMTOPEN=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazonaws.com",8883
           // Open the MQTT SSL connection
           >>
           >> OK
           >> +QMTOPEN: 0,0
           >> AT+QMTCONN=0,"smartKit001"
                                                // Initiate the MQTT server connection
Q3-4
           >>
           >> OK
           >>
           >> +QMTCONN: 0,0,0
           >> AT+QMTSUB=0,1,"toaws/smartKit001/update/message",1 // Subscribe to related topic
           >>
           >> OK
           >> +QMTSUB: 0,1,0,1
           //MQTT publish
           Publish fixed-length messages in non-data mode
           AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message",23,"{"temp",22.5,"humi",68}"
           // Publish messages to related topic
Q3-5-1
           >>
           >> OK
           >> +QMTPUB: 0,1,0
           >>
```

```
>> +QMTRECV: 0,0,"toaws/smartKit001/update/message","{ "message": "Hello from AWS IoT
           console"}"
           //MQTT publish
           Publish fixed-length messages in data mode
           >> AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message",23
           >>>
           >> "{"temp",22.5,"humi",68}"
                                                   // Publish data
Q3-5-2
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"toaws/smartKit001/update/message","{ "message": "Hello from AWS IoT
           console"}"
           //MQTT publish
           Publish variable-length messages in data mode
           >> AT+QMTPUB=0,1,1,0,"aws/meter001/data/report/message"
           >>>
           >> "{"temp",22.5,"humi",68}"
                                                   // Publish data
           >>
Q3-5-3
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >>
           >> +QMTRECV: 0,0,"toaws/smartKit001/update/message", "{ "message": "Hello from AWS IoT
           console"}"
    Feature of RAI
Feature
                After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1
of RAI
           >> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag
           >> OK
           >>
           >> +QPING: 0,8.8.8.8,32,729,51
R4-1
                                                                                                 RAI implementation method
           >> +QPING: 0,1,1,0,729,729,729
           >>
           >> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
           >> AT+QSCLK=1
                                            //Enable deepsleep mode
           >> OK
5- Enter status PSM and Deepsleep
           >> +QNBIOTEVENT: "ENTER PSM"
                                                       //Enter the PSM state
5-1
           >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                       //Enter the deepsleep state
    Exit status of Deepsleep and PSM
```



```
//BC660K&BC950K support to wake up deepsleep by executing AT
           command or pulling down PSM_EINT pin
           >>
           >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                     //Exit the deepsleep state
           //Recreate the MQTT connection
           >> AT+QSSLCFG=0,0,"seclevel",2
           >>
           >> OK
           >> AT+QMTCFG="ssl",0,1,0,0
           >>
           >> OK
           >> AT+QMTCFG="version",0,1
           >>
           >> OK
           >> AT+QMTOPEN=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazonaws.com",8883
                                                                                                 Method to trigger PSM wake-
T6-1-1
           >>
                                                                                                 up
           >> OK
           >>
           >> +QNBIOTEVENT: "EXIT PSM"
                                                      //Exit the PSM state
           >>
           >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
           >> +QMTOPEN: 0,0
           >> AT+QMTCONN=0,"meter001"
           >>
           >> OK
           >>
           >> +QMTCONN: 0,0,0
                                           //The MQTT connection was established successfully
           Go to 6-2, or goto Q3-5 for sending data or receving data, and the
           subsequent process
           //If you want to obtain the accurate signal reference in the current scene
           immediately after the PSM is woked up, please refer to
           //BC660K&BC950K support to wake up deepsleep by executing AT
           command or pulling down PSM_EINT pin
                                                                                                 If the program or mcu needs
           >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                                                                 to deal with other tasks, such
           >> AT+QPING=0,"8.8.8.8",4,1
                                                                                                 as collecting the base station
           >>
                                                                                                 cell signal after wake-up; It is
           >> OK
                                                                                                 recommended to refer to this
Q6-1-2
                                                                                                 method to trigger PSM wake-
           >> +QNBIOTEVENT: "EXIT PSM"
                                                                                                 up and obtain the network
                                                                                                 signal after wake-up.
           >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
                                                                                                 If no such requirement in the
                                                                                                 program, ignore the process
           >> +QPING: 0,8.8.8.8,32,699,51
           >>
           >> +QPING: 0,1,1,0,699,699,699
           >> AT+QENG=0
                                     //Query signal reference
```

```
>> +QENG: 0,3686,11,121,"05C4EF33",-72,-2,-70,18,8,"4C10",0,0,3
           >>
           >> OK
           //Recreate the MQTT connection
           >> AT+QSSLCFG=0,0,"seclevel",2
           >> OK
           >> AT+QMTCFG="ssl",0,1,0,0
           >> OK
           >> AT+QMTCFG="version",0,1
           >> OK
           >> AT+QMTOPEN=0,"a9ohm2zbim3d5-ats.iot.us-east-1.amazonaws.com",8883
           >>
           >> OK
           >>
           >> +QMTOPEN: 0,0
           >> AT+QMTCONN=0,"meter001"
           >>
           >> OK
           >>
           >> +QMTCONN: 0,0,0
                                             //The MQTT connection was established successfully
            Go to 6-2, or goto Q3-5 for sending data or receving data, and the
           subsequent process
                                                                                                     TAU update manually can
           //Manual TAU update
                                                                                                     avoid automatic update of
           >> AT+CPSMS=0
                                                                                                     TAU cycle over time, so, non-
           >> OK
6-2
                                                                                                     service power consumption
           >> AT+CPSMS=1,,,"01000010","00000000"
                                                                                                     can be reduced; If no
                                                                                                     requirement in the
            Go toQ3-5 for sending data or receving data, and the subsequent process
                                                                                                     application, ignore this step
    Erase the historical frequency
           //If 2-8 the registration network is not successful within the set search
                                                                                                     As described in 2-8, it is
           time(such as 2min), go to
                                                                                                     suggested that in the program
           >> AT+CFUN=0
                                       //Erase the historical frequency based on CFUN0
                                                                                                     design, after the first search
           >> OK
                                                                                                     fails to time out, the frequency
           >> AT+QCSEARFCN
                                                                                                     clearing program must be
                                       //Erase the historical frequency
           >> OK
                                                                                                     executed. After run, follow the
7-1
           >> AT+QBAND=1.28
                                                                                                     2-7 to check the search status
           //*Lock a specific frequency band. Note that it is not recommended for non-specific
                                                                                                     again;
           situations
                                                                                                     If the research fails to time
           >> OK
                                                                                                     out, you are advised to reboot
           >> AT+QRST=1
                                                         //Reboot, and re-search
                                                                                                     without clearing the frequency
           >> OK
                                                                                                     again. Or wait for the next
                                                                                                     service cycle and try again.
           Follow 2-7 above
    Exception handling or interruption
               The program or mcu shall add the interrupt method of timeout or failure of leshan
                                                                                                     If the terminal has strict
8-1
                platform registration, such as re-registration or reboot;
                                                                                                     requirements on power
```

2)) The program or mcu shall add the interrupt method of sending or receiving data timeout	consumption, it is
	or failure, such as reboot;	recommended that the
3)) The program or mcu should add interrupt methods that cannot enter PSM normally or	program reasonably control
	cannot wake up PSM, such as reboot;	timeout.
4)) In the case of exceptions, when the program or mcu performs hardware reset or power-	If unable to enter PSM or
	off directly, you need to execute AT+CFUN=0 first, and return OK, then control hardware	wake up from PSM, it is
	reset or power-off; But software reset or reboot does not run AT+CFUN=0.	recommended to compare the
		normal time to enter PSM or
		exit PSM. If the time exceeds,
		power off or reboot should
		can be operated

3.1.6 MQTT-based Alibaba Cloud Application

3.1.6.1 in Power-off Mode

Application

The terminal is connected to the MQTT of Alibaba cloud platform, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled

■ Reference for Process of Developing Application:

Index	Process of A	AT Command	Notes
1- Init	ial		
1-1	//Power on,initial >> >> RDY >> >> +CFUN: 1 >> >> +CPIN: READY		Boot log output, mcu can also determine whether it is normal boot; If the terminal needs to connect to the network immediately after power on, start from 2-1
1-2	network, or prioritize other tasks, you >> AT+CFUN=0	inter the deepsleep state he deepsleep is enabled by default	In the application design, when the module is powered on after the device is powered on, if the terminal has no network requirements temporarily or mcu gives priority to other tasks, cfun0 can be executed to enter the low power mode. If this requirement is not in the application design, skip this step to 2-1
2- Sear	ch and register network		
2-1	//Power on,initial >> >> RDY >> +CFUN: 1		+CPIN: NOT READY indicates that the module fails to check the sim card.so you need to check the SIM card itself or the pin connection and hardware design

		Development and Application Frocess in Fower on and Fe	
	>>		
	>> +CPIN: READY		
	>> AT+QBAND=0 //*If you	did not execute the lock BAND in 5-1, skip the command	
	>> OK		
	>> AT+QSCLK=0	//Disable the deepsleep	
	>> OK		
	>> AT+CPSMS=0	//Disable th PSM	
	>> OK		
	>> AT+CEDRXS=0,5	//Disable the eDRX	
	>> OK	,,	
		on the requirement of SIM card	If APN needs to be configured for
2-2		APN>", " <username>", "<password>"</password></username>	the SIM card, please perform the
	>> OK	value , suscindince , spasswords	command, others can be ignored
	>> 0K		If return NO READY, indicates the
			check of SIM card is failed. You
	>> AT+CPIN?	//check the SIM status	need to check the SIM card and
2.2	>> +CPIN: READY		
2-3	>>		hardware. So the program can be
	>> OK		directly powered off, or go to the
			above 1-2, into the low power
			state
	//Check the attribute values		
	>> ATI	//Query module identification	
	>> Quectel_Ltd		
	>> xxxxxxx		
	>> Revision: xxxxxxx		If the application design does not
2-4	>>		require this step, you can skip the
_ '	>> OK		step
	>> AT+CGSN=1	//Query the IMEI	366
	>> +CGSN: <imei></imei>		
	>>		
	>> OK		
		//Other queries	
	>> AT CCCCN -4		If the application design does not
2-5	>> AT+CSCON=1		require this step, you can skip the
	>> OK		step
	>>		
	>> +CSCON:1 //	/Indicates that the RRC connection is complete	If the application design does not
	//To query the following pa	rameters, it is recommended to query after	require this step, you can skip the
		after the registration network is completed	step
	>> AT+CIMI	//Query the IMSI	In the application design of the
	>> 460113061353533		terminal, you can execute
	>>		AT+QENG=0 to obtain the
2-6	>> OK		relevant network and signal
	>> AT+NCCID	//Query the CCID of SIM	reference, and to encode RSRP,
	>> +NCCID:898611222230004117		SNR, CELLID, EARFCN and PCI and
	>>		upload the data to the server. It
	>> OK		will helps for troubleshoot
		e information about the current camp on the cell	problems.
	>> +QENG: 0,3686,11,121,"05C4E		p. 53.5
	QLNG. 0,3000,11,121, 03C4E	33 , 13, 0, 03,17,0, 4010 ,0,3,3	

	>>				
	>> >> OK				
	// Query the network registration status	_			
	>> AT+CEREG? //Query the network registration status	S			
0.7	>> +CEREG:0,2				
2-7	>>				
	>> OK				
	//Periodic queries, such as 500ms intervals				
	>> AT+CEREG?		If the query only returns		
2-8	>> +CEREG:0,0 //+CEREG:0,2		+CEREG:0,0 or +CEREG:0,2 within		
	>>		the search time (no less than 2		
	>> OK		minutes); the program goes to 5-1		
			If the program finally returns		
	>> AT+CEREG?	>> AT+CEREG?	+CEREG:0,3 within the search time		
	>> +CEREG:0,1 //+CEREG:0,5 (roaming)	>> +CEREG:0,3	(e.g. 2 minutes); Restart or try		
2-9	//the registered successfully	//the registration denied	again in the next cycle. If		
	>>	>>	+CEREG:0,3 is still returned after		
	>> OK	>> OK	multiple attempts, it is		
			recommended to check the SIM		
			card		
	>> AT+CGPADDR //Query the IP address obtained				
2-10	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17al	o:01f8:98b0:032e"			
	>>				
	>> OK		CCO_/DCCL+112\/2		
	>> AT+CSQ //Query the	000	CSQ=(RSSI+113)/2		
	>> AT+CSQ //Query the >> +CSQ:xx,99	: CSQ	CSQ corresponds to signal reference RSSI. In actual		
2-11	. ,		applications, it is recommended to		
	>>		run AT+QENG=0 to obtain RSRP		
	>> OK		and SNR		
			Time conversion:		
	>> AT+CCLK? //Query the	current date and time	24/01/16,08:55:19+32/4(h)=		
2-12	>> +CCLK: "24/01/16,08:55:19+32"		2024/01/16,16:55:19		
	>>		If the default time is returned, pls		
	>> OK		query the time for multiple times		
3- Conn	ect to Alibaba Cloud server		1 - 7 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		
	//Configuring DNS				
	>> AT+QIDNSCFG=0,"223.5.5.5","223.6.6.6"				
Q3-1	>>				
	>> OK				
	//MQTT configuration				
	>> AT+QMTCFG="version",0,1 //Configure the MC	OTT version			
	>> OK				
Q3-2	>> AT+QMTCFG="keepalive",0,1200 //Configure the kee	palive			
	>> OK	,			
	>>				
	AT+QMTCFG="aliauth",0,"i2uq00ze3N3","device001","3af2	ccf1273f1b8866effc4d64b85d07"			
	ATTENTION UNDER TO TEMPOZESTOS / GETTECOOL / SUIZEETZE/STISOSOCCHE-40-1805407				

	//Configure the device certificate for Ali Cloud:ProductKey,DeviceName,DeviceSecret	
	>>	
	>> OK	
	//MQTT of Alibaba Cloud to connect	
	>> AT+QMTOPEN=0,"iot-06z00hxss3rggno.mqtt.iothub.aliyuncs.com",1883	
	// Open the MQTT connection	
	>>	
	>> OK	
Q3-3	>> +QMTOPEN: 0,0	
	>> AT+QMTCONN=0,"device001" // Initiate the MQTT server connection	
	>>	
	>> OK	
	>>	
	>> +QMTCONN: 0,0,0	
	//MQTT publish	
	Publish fixed-length messages in non-data mode	
	>> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing/event	
	/property/post",99,"{"id":"null","params":{"temp":23.6,	
	"humi":82}, "version": "1.0", "method": "thing.event.property.post"}"	
	>>	
Q3-4-1	>> OK	
	>>	
	>> +QMTPUB: 0,1,0	
	>>	
	>> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property	
	/post_reply","{"code":200,"data":{},"id":"null","message":"success"	
	,"method":"thing.event.property.post","version":"1.0"}"	
	//MQTT publish	
	Publish fixed-length messages in data mode	
	>> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing	
	/event/property/post",99	
	>>	
	>>>	
	>> {"id":"null","params":{"temp":18.5,"humi":79},	
Q3-4-2	"version":"1.0","method":"thing.event.property.post"} // Publish data	
	>>	
	>> OK	
	>>	
	>> +QMTPUB: 0,1,0	
	>>	
	>> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property	
	/post_reply","{"code":200,"data":{},"id":"null","message":"success",	
	"method":"thing.event.property.post","version":"1.0"}"	
	//MQTT publish	
00.40	Publish variable-length messages in data mode	
Q3-4-3	>> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing	
	/event/property/post"	
	to a description	

```
>>
            >> >
            >> {"id":"null","params":{"temp":18.5,"humi":79},
            "version":"1.0","method":"thing.event.property.post"}
                                                                      // Publish data
            >>
            >> OK
            >>
            >> +QMTPUB: 0,1,0
            >>
            >> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property
            /post reply","{"code":200,"data":{},"id":"null","message":"success",
            "method": "thing.event.property.post", "version": "1.0"}"
            //MQTT server push
Q3-5
            >>
            >> +QMTRECV: 0,0,"/i2uq00ze3N3/device001/user/reply","LED status:off"
            >> AT+QMTCLOSE=0
                                            // Initiating MQTT connection disconnected
            >>
Q3-6
            >> OK
            >>
            >> +QMTCLOSE: 0,0
    Power off after sending and receiving data
                                                                                                         If the terminal is designed for
                                                                                                         power-off mode and powered off
            >> AT+CFUN=0
                                                 //Set minimum function
                                                                                                         after data interaction is complete,
            >> OK
4-1
                                                                                                         you need to run AT+CFUN=0,
            //Wait for the return OK, then mcu control to power off; If not return OK after running
                                                                                                         then power off the terminal after
            AT+CFUN=0 for a long period of time (for example, 20s), you can power off directly.
                                                                                                         return OK to avoid damage to the
                                                                                                         flash
5- Erase the historical frequency
            //If 2-8 the registration network is not successful within the set search time(such as 2min), go
                                                                                                         As described in 2-8, it is
                                                                                                         suggested that in the program
            to
            >> AT+CFUN=0
                                        //Erase the historical frequency based on CFUN0
                                                                                                         design, after the first search fails
            >> OK
                                                                                                         to time out, the frequency clearing
            >> AT+QCSEARFCN
                                         //Erase the historical frequency
                                                                                                         program must be executed. After
                                                                                                         run, follow the 2-7 to check the
            >> OK
5-1
            >> AT+QBAND=1,28
                                                                                                         search status again;
            //*Lock a specific frequency band. Note that it is not recommended for non-specific situations
                                                                                                         If the research fails to time out,
                                                                                                         you are advised to reboot without
            >> OK
            >> AT+QRST=1
                                                           //Reboot, and re-search
                                                                                                         clearing the frequency again. Or
            >> OK
                                                                                                         wait for the next service cycle and
            Follow 2-7 above
                                                                                                         try again.
6- Exception handling or interruption
            1) The program or mcu needs to add the interrupt method of time-out or failure to register
                                                                                                         If the terminal has strict
                the AEP platform, such as re-registration or reboot.
                                                                                                         requirements on power
               The program or mcu needs to add the interrupt method of timeout or failure for sending
6-1
                                                                                                         consumption, it is recommended
                or receiving data, such as reboot.
                                                                                                         that the program reasonably
                In the case of exceptions, when the program or mcu performs hardware reset or power-
                                                                                                         control timeout
                off directly, you need to execute AT+CFUN=0 first, and return OK, then control hardware
```



reset or power-off; But software reset or reboot does not run AT+CFUN=0.

3.1.6.2 in PSM Mode

Application

PSM function is enabled, and only the MQTT of Alibaba cloud platform is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

■ Reference for Process of Developing Application:

Index	Pro	cess of AT Command	Notes
1- Init	ial		
	//Power on,initial		Boot log output, mcu can also
	>>		determine whether it is
	>> RDY		normal boot;
1-1	>>		If the terminal needs to
	>> +CFUN: 1		connect to the network
	>>		immediately after power on,
	>> +CPIN: READY		start from 2-1
			In the application design,
	//After powering on, if the te	rminal (mcu) does not need to connect to the	when the module is powered
	network, or prioritize other ta	sks, you need to perform	on after the device is powered
	>> AT+CFUN=0	//Enter the deepsleep state	on, if the terminal has no
	>> OK		network requirements
1-2	>> AT+QSCLK=1	//The deepsleep is enabled by default	temporarily or mcu gives
1-2	>> OK		priority to other tasks, cfun0
			can be executed to enter the
	//If the terminal needs to con	nect to the network later, you can run	low power mode.
	>> AT+QRST=1	//Reboot	If this requirement is not in
	>> OK		the application design, skip
			this step to 2-1
2- Sear	ch and register network		
	//Power on,initial		+CPIN: NOT READY indicates
	>>		that the module fails to check
	>> RDY		the sim card.so you need to
	>>		check the SIM card itself or
	>> +CFUN: 1		the pin connection and
	>>		hardware design
	>> +CPIN: READY		By AT+CPSMS=1,,
	>> AT+QBAND=0 //*If you di	d not execute the lock BAND in 7-1, skip the command	" <t3412 tau="">","<t3324>",</t3324></t3412>
2-1	>> OK		you can configure the T3412
	>> AT+QSCLK=0	//Disable the deepsleep	and T3324 timers properly
	>> OK		which you need.at the same
	>> AT+CPSMS=1,,,"01000010","0000	0000" //Enable th PSM	time, after the completion of
	>> OK		the registration network, by
	>> AT+CEDRXS=0,5	//Disable the eDRX	AT+CEREG=5; +CEREG? You
	>> OK		need to query the real value
	>> AT+QNBIOTEVENT=1,1	//Enable the URC of PSM	of T3324,T3412/TAU provided
	>> OK		by the network

	>> AT+QCFG="dsevent",1 //Disable the URC of Deepsleep	
	>> OK	If APN needs to be configured
	// Configure the APN based on the requirement of SIM card	for the SIM card, please
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>" >> OK</password></username></apn>	perform the command, others
		can be ignored
		If return NO READY, indicates
	Websellahe CDA status	the check of SIM card is failed.
	>> AT+CPIN? //check the SIM status >> +CPIN: READY	You need to check the SIM card and hardware. So the
2-3	>> TCPIN. READY	program can be directly
	>> OK	powered off, or go to the
		above 1-2, into the low power
		state
	//Check the attribute values of the module	
	>> ATI //Query module identification	
	>> Quectel_Ltd	
	>> xxxxxxx	
	>> Revision: xxxxxxx	If the application design does
2-4	>> >> OK	not require this step, you can
	>> AT+CGSN=1 //Query the IMEI	skip the step
	>> +CGSN: <imei></imei>	
	>>	
	>> OK	
	//Other queries	
0.5	>> AT+CSCON=1	If the application design does
2-5	>> OK	not require this step, you can skip the step
	>>	Skip the step
	>> +CSCON:1 //Indicates that the RRC connection is complete	
	//To query the following parameters, it is recommended to query after	If the application design does
	return +CSCON:1, or query after the registration network is completed	not require this step, you can
	>> AT+CIMI //Query the IMSI	skip the step
	>> 460113061353533	In the application design of
	>> >> OK	the terminal, you can execute AT+QENG=0 to obtain the
2-6	>> AT+NCCID //Query the CCID of SIM	relevant network and signal
	>> +NCCID:89861122223000411769	reference, and to encode
	>>	RSRP, SNR, CELLID, EARFCN
	>> OK	and PCI and upload the data
	>> AT+QENG=0 //Query the information about the current camp on the cell	to the server. It will helps for
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3	troubleshoot problems.
	>>	
	>> OK	
	// Query the network registration status >> AT+CEREG? //Query the network registration status	
2-7	>> +CEREG: // Query the network registration status	
	>> \cented.0,2	
	I .	

	>> OK //Periodic queries, such as 500ms intervals		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> OK >> OK		If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query th >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17al >> >> OK	e IP address obtained p:01f8:98b0:032e"	
2-11	>> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Acce	ss the Alibaba Cloud server		
Q3-1	//Configuring DNS >> AT+QIDNSCFG=0,"223.5.5.5","223.6.6.6" >> >> OK		
Q3-2	//MQTT configuration >> AT+QMTCFG="version",0,1 //Configure the MQTT version >> OK >> AT+QMTCFG="keepalive",0,1200 //Configure the keepalive >> OK >> OK >> AT+QMTCFG="aliauth",0,"i2uq00ze3N3","device001","3af2ccf1273f1b8866effc4d64b85d07" //Configure the device certificate for Ali Cloud:ProductKey,DeviceName,DeviceSecret >>		
	>> OK		



```
//MQTT of Alibaba Cloud to connect
           >> AT+QMTOPEN=0,"iot-06z00hxss3rggno.mqtt.iothub.aliyuncs.com",1883
           // Open the MQTT connection
           >>
           >> OK
Q3-3
           >> +QMTOPEN: 0,0
           >> AT+QMTCONN=0,"device001"
                                              // Initiate the MQTT server connection
           >>
           >> OK
           >>
           >> +QMTCONN: 0,0,0
           //MQTT publish
           Publish fixed-length messages in non-data mode
           >> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing/event
           /property/post",99,"{"id":"null","params":{"temp":23.6,
           "humi":82}, "version": "1.0", "method": "thing.event.property.post"}"
           >>
Q3-4-1
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property
           /post_reply","{"code":200,"data":{},"id":"null","message":"success"
           ,"method":"thing.event.property.post","version":"1.0"}"
           //MQTT publish
           Publish fixed-length messages in data mode
           >> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing
           /event/property/post",99
           >>
           >>>
           >> {"id":"null","params":{"temp":18.5,"humi":79},
           "version":"1.0","method":"thing.event.property.post"}
                                                                 // Publish data
Q3-4-2
           >>
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property
           /post_reply","{"code":200,"data":{},"id":"null","message":"success",
           "method":"thing.event.property.post","version":"1.0"}"
           //MQTT publish
           Publish variable-length messages in data mode
           >> AT+QMTPUB=0,1,1,0,"/sys/i2uq00ze3N3/device001/thing
Q3-4-3
           /event/property/post"
           >>
           >> {"id":"null","params":{"temp":18.5,"humi":79},
```

```
"version":"1.0","method":"thing.event.property.post"}
                                                                 // Publish data
           >>
           >> OK
           >>
           >> +QMTPUB: 0,1,0
           >> +QMTRECV: 0,0,"/sys/i2uq00ze3N3/device001/thing/event/property
           /post_reply","{"code":200,"data":{},"id":"null","message":"success",
           "method":"thing.event.property.post","version":"1.0"}"
           //MQTT server push
Q3-5
           >> +QMTRECV: 0,0,"/i2uq00ze3N3/device001/user/reply","LED status:off"
    Feature of RAI
Feature
                After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1
of RAI
           >> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag
           >> OK
           >>
           >> +QPING: 0,8.8.8.8,32,729,51
R4-1
                                                                                                  RAI implementation method
           >> +QPING: 0,1,1,0,729,729,729
           >>
           >> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
           >> AT+QSCLK=1
                                            //Enable deepsleep mode
           >> OK
5- Enter status PSM and Deepsleep
           >> +QNBIOTEVENT: "ENTER PSM"
                                                       //Enter the PSM state
5-1
           >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                        //Enter the deepsleep state
6- Exit status of Deepsleep and PSM
           //BC660K&BC950K support to wake up deepsleep by executing AT
           command or pulling down PSM_EINT pin
           >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                      //Exit the deepsleep state
           //Recreate the MQTT connection
           AT+QMTCFG="aliauth",0,"i2uq00ze3N3","device001","3af2ccf1273f1b8866effc4d64b85d07"
           >> OK
                                                                                                  Method to trigger PSM wake-
T6-1-1
           >> AT+QMTOPEN=0,"iot-06z00hxss3rggno.mqtt.iothub.aliyuncs.com",1883
                                                                                                  up
           >>
           >> OK
           >>
           >> +QNBIOTEVENT: "EXIT PSM"
                                                      //Exit the PSM state
           >>
           >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
           >> +QMTOPEN: 0,0
```

	>> AT+QMTCONN=0,"device001"	
	>>	
	>> OK	
	>>	
	>> +QMTCONN: 0,0,0 //The MQTT connection was established successfully	
	Go to 6-2,or goto Q3-4 for sending data or receving data, and the	
	subsequent process	
	//If you want to obtain the accurate signal reference in the current scene	
	immediately after the PSM is woked up, please refer to	
	//BC660K&BC950K support to wake up deepsleep by executing AT	
	command or pulling down PSM_EINT pin	
	>>	
	>> +QNBIOTEVENT: "EXIT DEEPSLEEP"	
	>> AT+QPING=0,"8.8.8.8",4,1	
	>>	
	>> OK	
	>>	
	>> +QNBIOTEVENT: "EXIT PSM"	
	>>	
	>> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup	
	>>	
	>> +QPING: 0,8.8.8.8,32,699,51	If the program or mcu needs
	>>	to deal with other tasks, such
	>> +QPING: 0,1,1,0,699,699,699	as collecting the base station
	>> AT+QENG=0 //Query signal reference	cell signal after wake-up; It is
Q6-1-2	>>	recommended to refer to this
Q0-1-2	>> +QENG: 0,3686,11,121,"05C4EF33",-72,-2,-70,18,8,"4C10",0,0,3	method to trigger PSM wake-
	>>	up and obtain the network
	>> OK	signal after wake-up.
	//Recreate the MQTT connection	If no such requirement in the
	>>	program, ignore the process
	AT+QMTCFG="aliauth",0,"i2uq00ze3N3","device001","3af2ccf1273f1b8866effc4d64b85d07"	
	>> OK	
	>> AT+QMTOPEN=0,"iot-06z00hxss3rggno.mqtt.iothub.aliyuncs.com",1883	
	>>	
	>> OK	
	>>	
	>> +QMTOPEN: 0,0	
	>> AT+QMTCONN=0,"device001"	
	>>	
	>> OK	
	>>	
	>> +QMTCONN: 0,0,0 //The MQTT connection was established successfully	
	Go to 6-2,or goto Q3-4 for sending data or receving data, and the	
	subsequent process	TAIL
	//Manual TAU update	TAU update manually can
6-2	>> AT+CPSMS=0	avoid automatic update of
	>> OK	TAU cycle over time, so,non-
	>> AT+CPSMS=1,,,"01000010","00000000"	service power consumption

	For BC660K&BC950K Development and Application Process in Power-off and PSM Mode			
	>> OK		can be reduced; If no	
	Go to Q3-4 for send	ling data or receving data, and the subsequent process	requirement in the	
			application, ignore this step	
7– Era	ase the historical f	requency		
			As described in 2-8, it is	
	//If 2-8 the registra	tion network is not successful within the set search	suggested that in the	
	time(such as 2min),	go to	program design, after the first	
	>> AT+CFUN=0	//Erase the historical frequency based on CFUN0	search fails to time out, the	
	>> OK		frequency clearing program	
	>> AT+QCSEARFCN	//Erase the historical frequency	must be executed. After run,	
7.4	>> OK		follow the 2-7 to check the	
7-1	>> AT+QBAND=1,28		search status again;	
	//*Lock a specific freque	ency band. Note that it is not recommended for non-specific situations	If the research fails to time	
	>> OK		out, you are advised to reboot	
	>> AT+QRST=1	//Reboot, and re-search	without clearing the	
	>> OK		frequency again. Or wait for	
	Follow 2-7 above		the next service cycle and try	
			again.	
8- Exc	ception handling or	interruption		
			If the terminal has strict	
			requirements on power	
	1) The program or mc	u shall add the interrupt method of timeout or failure of leshan	consumption, it is	
	platform registratio	n, such as re-registration or reboot;	recommended that the	
	2) The program or mc	u shall add the interrupt method of sending or receiving data timeout	program reasonably control	
	or failure, such as re	eboot;	timeout.	
8-1	3) The program or mc	u should add interrupt methods that cannot enter PSM normally or	If unable to enter PSM or	
	cannot wake up PSI	M, such as reboot;	wake up from PSM, it is	
	4) In the case of excep	otions, when the program or mcu performs hardware reset or power-	recommended to compare	
	off directly, you nee	ed to execute AT+CFUN=0 first, and return OK, then control hardware	the normal time to enter PSM	
	reset or power-off;	But software reset or reboot does not run AT+CFUN=0.	or exit PSM. If the time	
			exceeds, power off or reboot	
			should can be operated	

3.1.7 HTTP(s) Application

3.1.7.1 in Power-off Mode

Application

The terminal is connected to the HTTP(s) server, the interval of data reported/upload is relatively long, the application logic of mcu or program is relatively simple, and the PSM is not enabled

■ Reference for Process of Developing Application:

Index	Process of AT Command	Notes
1- Init	ial	
	//Power on,initial	Boot log output, mcu can also
1-1	>>	determine whether it is normal
	>> RDY	boot;

	FOL RCPPOKE	&BC950K Development and Application Process in Power-off and PSN	// IVIOUE
	>>		If the terminal needs to connect to
	>> +CFUN: 1		the network immediately after
	>>		power on, start from 2-1
	>> +CPIN: READY		
	//After powering on	, if the terminal (mcu) does not need to connect to the	In the application design, when the
	network, or prioritize other tasks, you need to perform		module is powered on after the
	>> AT+CFUN=0	//Enter the deepsleep state	device is powered on, if the
	>> OK	// Lines the deepsteep state	terminal has no network
	>> AT+QSCLK=1	//The deepsleep is enabled by default	requirements temporarily or mcu
1-2		// The deepsleep is enabled by default	gives priority to other tasks, cfun0
	>> OK		can be executed to enter the low
			power mode.
	//If the terminal needs to connect to the network later, you can run		If this requirement is not in the
	>> AT+QRST=1	//Reboot	application design, skip this step to
	>> OK		2-1
2- Sear	ch and register net	work	·
	//Power on,initial		
	>>		
	>> RDY		
	>>		
	>> +CFUN: 1		
	>>		+CPIN: NOT READY indicates that
	>> +CPIN: READY		the module fails to check the sim
2-1	>> AT+QBAND=0	//*If you did not execute the lock BAND in 5-1, skip the command	card.so you need to check the SIM
	>> OK	The sound have execute the lock British in 3-2, stup the community	card itself or the pin connection
	>> AT+QSCLK=0	//Disable the deepsleep	and hardware design
	>> OK	// Disable the deepsieep	and nardware design
	>> AT+CPSMS=0	//Disable th PSM	
		// Disable til F3ivi	
	>> OK	//DischlashlashlaspDV	
	>> AT+CEDRXS=0,5	//Disable the eDRX	
	>> OK	N based on the requirement of SIM card	If APN needs to be configured for
2-2		PV4V6"," <apn>", "<username>", "<password>"</password></username></apn>	the SIM card, please perform the
2-2	>> OK	vavo, (Ariv), (username), (password)	
	>> OIN		command, others can be ignored If return NO READY,indicates the
	>> AT (CDIA)?	//chael, the CINA status	check of SIM card is failed. You
	>> AT+CPIN?	//check the SIM status	
2-3	>> +CPIN: READY		need to check the SIM card and
	>>		hardware. So the program can be
	>> OK		directly powered off, or go to the
	//Check the attribut	e values of the module	above 1-2, into the low power state
	>> ATI	//Query module identification	
	>> Quectel Ltd	// query module identification	
	_		If the application design does not
2-4	>> XXXXXXX		require this step, you can skip the
	>> Revision: xxxxxxx		step
	>>		
			I .
	>> OK >> AT+CGSN=1	//Query the IMEI	

	>> +CGSN: <imei></imei>		
	>>		
	>> OK		
	//Other c	queries	
	>> AT+CSCON=1		If the application design does not
2-5	>> OK		require this step, you can skip the
	77 GK		step
	>>		
	>> +CSCON:1 //Indicates that the RRC c		
	//To query the following parameters, it is recor	• •	If the application design does not
	return +CSCON:1, or query after the registration network is completed		require this step, you can skip the
	>> AT+CIMI //Query the IMSI		step
	>> 460113061353533		In the application design of the
	>>		terminal, you can execute
2-6	>> OK		AT+QENG=0 to obtain the relevant
		the CCID of SIM	network and signal reference, and
	>> +NCCID:89861122223000411769		to encode RSRP, SNR, CELLID,
	>> 0''		EARFCN and PCI and upload the
	>> OK	anne de la companya del companya de la companya del companya de la	data to the server. It will helps for
	>> AT+QENG=0 //Query the information about the		troubleshoot problems.
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3		
	>>		
	>> OK		
	// Query the network registration status		
	>> AT+CEREG? //Query the network registration status		
2-7	>> +CEREG:0,2		
2-1	>> \cdot \cd		
	>> 0K		
	//Periodic queries, such as 500ms intervals		
	>> AT+CEREG?		If the query only returns
	>> +CEREG:0,0 //+CEREG:0,2		+CEREG:0,0 or +CEREG:0,2 within
2-8	>> **		the search time (no less than 2
	>> OK		minutes); the program goes to 5-1
			If the program finally returns
	>> AT+CEREG?	>> AT+CEREG?	+CEREG:0,3 within the search time
	>> +CEREG:0,1 //+CEREG:0,5 (roaming)	>> +CEREG:0,3	(e.g. 2 minutes); Restart or try again
2-9	//the registered successfully	//the registration denied	in the next cycle. If +CEREG:0,3 is
	>>	>>	still returned after multiple
	>> OK	>> OK	attempts, it is recommended to
			check the SIM card
	>> AT+CGPADDR //Query	the IP address obtained	
2-10	>> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17	7ab:01f8:98b0:032e"	
Z-1 U	>>		
	>> OK		
	>> AT+CSQ //Query t	the CSQ	CSQ=(RSSI+113)/2
2-11	>> +CSQ:xx,99		CSQ corresponds to signal
4-11	>>		reference RSSI. In actual
	>> OK		

	For BC660K&BC950K Development and Application Process in Power-off and PS	SIVI IVIOGE
		run AT+QENG=0 to obtain RSRP and SNR
		Time conversion:
	>> AT+CCLK? //Query the current date and time	24/01/16,08:55:19+32/4(h)=
2-12	>> +CCLK: "24/01/16,08:55:19+32"	2024/01/16,16:55:19
2 12	>>	If the default time is returned, pls
	>> OK	query the time for multiple times
2- Copp	ect to HTTP(s) server	query the time for multiple times
3 00m	//Configure the parameters for HTTP	
	>> AT+QHTTPCFG="contextid",0	
	>> >> OK	
	>> AT+QHTTPCFG="requestheader",0	In the actual development place
110.4	>> OV	In the actual development, please
H3-1	>> OK	configure parameters according to
	>> AT+QHTTPCFG="ssl",0,0	your requirement
	>> OV	
	>> OK	
	>> AT+QHTTPCFG="contenttype",1	
	>> 	
	>> OK	
	//Set the SSL parameters for HTTPs	
	>> AT+QSSLCFG=0,0,"sslversion",4	
	>>	
	>> OK	
	>> AT+QSSLCFG=0,0,"dtls",1	
	>>	
	>> OK	In the actual development, please
H3-2	>> AT+QSSLCFG=0,0,"dtlsversion",2	configure parameters according to
	>>	your requirement
	>> OK	
	>> AT+QSSLCFG=0,0,"ciphersuite",0xFFFF	
	>> OV	
	>> OK	
	>> AT+QSSLCFG=0,0,"sni",1	
	>> OV	
	>> OK	
	//Connect to HTTPs and send a GET or POST service	
	>> AT+QIDNSCFG=0,"223.5.5.5","8.8.8.8" //Configure reliable DNS	
	>> OV	
	>> OK	
	>> AT+QHTTPURL=57,80	In the actual development, please
H3-3	»	configure parameters according to
	>>> https://ncu-receiver.fukuku.saico.dev/gas-meter/push/****	your application
	>> OK	
	>> AT+QHTTPGET=80 >>	
	>> >> OK	
	// UN	

```
>> +QHTTPGET: 0,200,99
             >> AT+QHTTPPOST=146
             >>
            >> >
             >> {"DATETIME":"20240528T143744Z","IMEI":"868020030003890","NCU_FW_VER":100,
             "GAS METER":1265035,"CSQ":29,"MCU TEMP":28,"BAT VOL":3665,"METER TYPE":7}
             >> OK
             >>
             >> +QHTTPPOST: 0,200,139
            >> AT+QHTTPREAD=139
            >> +QHTTPREAD: 139,0
             >> {"module":{"code":"700.101.1001","name":"GAS_METER_RECEIVER.PUSH_
             MEASUREMENT", "version": "1.1.3"}, "data": {"messageId": "194083404774019072"}}
             >>
             >> OK
    Power off after sending and receiving data
                                                                                                       If the terminal is designed for
             >> AT+CFUN=0
                                                 //Set minimum function
                                                                                                       power-off mode and powered off
            >> OK
                                                                                                       after data interaction is complete,
4-1
            //Wait for the return OK, then mcu control to power off; If not return OK after running
                                                                                                       you need to run AT+CFUN=0, then
             AT+CFUN=0 for a long period of time (for example, 20s), you can power off directly.
                                                                                                       power off the terminal after return
                                                                                                       OK to avoid damage to the flash
5- Erase the historical frequency
             //If 2-8 the registration network is not successful within the set search time(such as 2min),
                                                                                                       As described in 2-8, it is suggested
             go to
                                                                                                       that in the program design, after
            >> AT+CFUN=0
                                         //Erase the historical frequency based on CFUNO
                                                                                                       the first search fails to time out, the
            >> OK
                                                                                                       frequency clearing program must
             >> AT+QCSEARFCN
                                         //Erase the historical frequency
                                                                                                       be executed. After run, follow the
            >> OK
                                                                                                       2-7 to check the search status
5-1
            >> AT+QBAND=1,28
                                                                                                       again;
             //*Lock a specific frequency band. Note that it is not recommended for non-specific
                                                                                                       If the research fails to time out, you
             situations
                                                                                                       are advised to reboot without
             >> OK
                                                                                                       clearing the frequency again. Or
             >> AT+QRST=1
                                                           //Reboot, and re-search
                                                                                                       wait for the next service cycle and
             >> OK
                                                                                                       try again.
            Follow 2-7 above
6- Exception handling or interruption
                The program or mcu needs to add the interrupt method of time-out or failure to register
                 the AEP platform, such as re-registration or reboot.
                                                                                                       If the terminal has strict
                The program or mcu needs to add the interrupt method of timeout or failure for
                                                                                                       requirements on power
                                                                                                       consumption, it is recommended
6-1
                 sending or receiving data, such as reboot.
                 In the case of exceptions, when the program or mcu performs hardware reset or power-
                                                                                                       that the program reasonably
                 off directly, you need to execute AT+CFUN=0 first, and return OK, then control
                                                                                                       control timeout
                 hardware reset or power-off; But software reset or reboot does not run AT+CFUN=0.
```

Application

3.1.7.2 in PSM Mode

PSM function is enabled, and only the HTTP(s) server is connected. The data is reported/upload frequently, and the application logic of mcu or program is relatively complex

■ Reference for Process of Developing Application:

Index	Proc	cess of AT Command	Notes
1- Init	ial		
	//Power on,initial		Boot log output, mcu can also
	>>		determine whether it is normal
	>> RDY		boot;
1-1	>>		If the terminal needs to connect
	>> +CFUN: 1		to the network immediately
	>>		after power on, start from 2-1
	>> +CPIN: READY		
	//After powering on, if the te	rminal (mcu) does not need to connect to the	In the application design, when
	network, or prioritize other ta	sks, you need to perform	the module is powered on after
	>> AT+CFUN=0	//Enter the deepsleep state	the device is powered on, if the terminal has no network
	>> OK		requirements temporarily or
1-2	>> AT+QSCLK=1	//The deepsleep is enabled by default	mcu gives priority to other
1-2	>> OK		tasks, cfun0 can be executed to
			enter the low power mode.
	//If the terminal needs to con	nect to the network later, you can run	If this requirement is not in the
	>> AT+QRST=1	//Reboot	application design, skip this
	>> OK		step to 2-1
2- Sear	ch and register network		
	//Power on,initial		
	>>		+CPIN: NOT READY indicates
	>> RDY		that the module fails to check
	>>		the sim card.so you need to
	>> +CFUN: 1		check the SIM card itself or the
	>>		pin connection and hardware
	>> +CPIN: READY		design
	>> AT+QBAND=0 //*If you di	d not execute the lock BAND in 7-1, skip the command	By AT+CPSMS=1,,
	>> OK		" <t3412 tau="">","<t3324>",</t3324></t3412>
2-1	>> AT+QSCLK=0	//Disable the deepsleep	you can configure the T3412
	>> OK		and T3324 timers properly
	>> AT+CPSMS=1,,,"01000010","0000	//Enable th PSM	which you need.at the same
	>> OK		time, after the completion of
	>> AT+CEDRXS=0,5	//Disable the eDRX	the registration network, by
	>> OK	Wa	AT+CEREG=5; +CEREG? You
	>> AT+QNBIOTEVENT=1,1	//Enable the URC of PSM	need to query the real value of
	>> OK	//Dischlash - UDC - f D-	T3324,T3412/TAU provided by
	>> AT+QCFG="dsevent",1	//Disable the URC of Deepsleep	the network
	>> OK		

	// Configure the ADN based on the requirement of SIM and	If APN needs to be configured
2-2	// Configure the APN based on the requirement of SIM card	for the SIM card, please
2-2	>> AT+QCGDEFCONT="IPV4V6"," <apn>", "<username>", "<password>" >> OK</password></username></apn>	perform the command, others
	>> UK	can be ignored
		If return NO READY, indicates
	>> AT I CRIM3	the check of SIM card is failed.
	>> AT+CPIN? //check the SIM status >> +CPIN: READY	You need to check the SIM card
2-3		and hardware. So the program
	>> >> OK	can be directly powered off, or
	>> UK	go to the above 1-2, into the
		low power state
	//Check the attribute values of the module	
	>> ATI //Query module identification	
	>> Quectel_Ltd	
	>> xxxxxxx	
	>> Revision: xxxxxxx	If the application design does
2-4	>>	not require this step, you can
_ '	>> OK	skip the step
	>> AT+CGSN=1 //Query the IMEI	skip the step
	>> +CGSN: <imei></imei>	
	>>	
	>> OK	
	//Other queries	
	>> AT+CSCON=1	If the application design does
2-5	>> OK	not require this step, you can
		skip the step
	>>	
	>> +CSCON:1 //Indicates that the RRC connection is complete	
	//To query the following parameters, it is recommended to query after	If the application design does
	return +CSCON:1, or query after the registration network is completed	not require this step, you can
	>> AT+CIMI //Query the IMSI	skip the step
	>> 460113061353533	In the application design of the
	>>	terminal, you can execute
2-6	>> OK	AT+QENG=0 to obtain the
	>> AT+NCCID //Query the CCID of SIM	relevant network and signal
	>> +NCCID:89861122223000411769	reference, and to encode RSRP,
	>> OV	SNR, CELLID, EARFCN and PCI
	>> OK >> AT+QENG=0 //Query the information about the current camp on the cell	and upload the data to the server. It will helps for
	>> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3	troubleshoot problems.
		troubleshoot problems.
	>> >> OK	
	// Query the network registration status	
	>> AT+CEREG? //Query the network registration status	
	>> +CEREG:0,2	
2-7	>> \cented.0,2	
_ '	>> OK	
	//Periodic queries, such as 500ms intervals	

	For BCookwascasok Development and Applic		
2-8	>> AT+CEREG? >> +CEREG:0,0 //+CEREG:0,2 >> >> OK		If the query only returns +CEREG:0,0 or +CEREG:0,2 within the search time (no less than 2 minutes); the program goes to 5-1
2-9	>> AT+CEREG? >> +CEREG:0,1 //+CEREG:0,5 (roaming) //the registered successfully >> >> OK	>> AT+CEREG? >> +CEREG:0,3 //the registration denied >> >> OK	If the program finally returns +CEREG:0,3 within the search time (e.g. 2 minutes); Restart or try again in the next cycle. If +CEREG:0,3 is still returned after multiple attempts, it is recommended to check the SIM card
2-10	>> AT+CGPADDR //Query >> +CGPADDR: 0,"10.21.53.152","2409:8d30:0114:0242:17 >> >> OK	the IP address obtained 7ab:01f8:98b0:032e"	
2-11	>> OK >> AT+CSQ //Query the CSQ >> +CSQ:xx,99 >> >> OK		CSQ=(RSSI+113)/2 CSQ corresponds to signal reference RSSI. In actual applications, it is recommended to run AT+QENG=0 to obtain RSRP and SNR
2-12	>> AT+CCLK? //Query the current date and time >> +CCLK: "24/01/16,08:55:19+32" >> >> OK		Time conversion: 24/01/16,08:55:19+32/4(h)= 2024/01/16,16:55:19 If the default time is returned, pls query the time for multiple times
3- Acces	//Configure the parameters for HTTP >> AT+QHTTPCFG="contextid",0 >> >> OK >> AT+QHTTPCFG="requestheader",0 >> >> OK >> AT+QHTTPCFG="ssl",0,0 >> >> OK >> AT+QHTTPCFG="contenttype",1 >> OK >> OK		In the actual development, please configure parameters according to your requirement
H3-2	//Set the SSL parameters for HTTPs >> AT+QSSLCFG=0,0,"sslversion",4 >> >> OK >> AT+QSSLCFG=0,0,"dtls",1 >>		In the actual development, please configure parameters according to your requirement

```
>> OK
            >> AT+QSSLCFG=0,0,"dtlsversion",2
            >>
            >> OK
            >> AT+QSSLCFG=0,0,"ciphersuite",0xFFFF
            >> OK
            >> AT+QSSLCFG=0,0,"sni",1
            >>
            >> OK
            //Connect to HTTPs and send a GET or POST service
            >> AT+QIDNSCFG=0,"223.5.5.5","8.8.8.8"
                                                          //Configure reliable DNS
            >>
            >> OK
            >> AT+QHTTPURL=57,80
            >>
            >>>
            >> https://ncu-receiver.fukuku.saico.dev/gas-meter/push/****
            >> OK
            >> AT+QHTTPGET=80
            >>
            >> OK
            >>
            >> +QHTTPGET: 0,200,99
                                                                                                 In the actual development,
H3-3
            >> AT+QHTTPPOST=146
                                                                                                 please configure parameters
            >>
                                                                                                 according to your application
            >> >
            >> {"DATETIME":"20240528T143744Z","IMEI":"868020030003890","NCU_FW_VER":100,
            "GAS_METER":1265035,"CSQ":29,"MCU_TEMP":28,"BAT_VOL":3665,"METER_TYPE":7}
            >> OK
            >>
            >> +QHTTPPOST: 0,200,139
            >> AT+QHTTPREAD=139
            >>
            >> +QHTTPREAD: 139,0
            >> {"module":{"code":"700.101.1001","name":"GAS_METER_RECEIVER.PUSH_
            MEASUREMENT", "version": "1.1.3"}, "data": {"messageId": "194083404774019072"}}
            >>
            >> OK
    Feature of RAI
Feature
                After the data interaction is completed, you can run AT+QPING=0,"8.8.8.8",4,1,32,1
of RAI
            >> AT+QPING=0,"8.8.8.8",4,1,32,1 //QPING method with RAI Flag
            >> OK
R4-1
                                                                                                 RAI implementation method
            >> +QPING: 0,8.8.8.8,32,729,51
```

>>

>> +QPING: 0,1,1,0,729,729,729

```
>> +CSCON:0
                                            //If +CSCON:0 is returned within 0-2s, RAI is effective
            >> AT+QSCLK=1
                                             //Enable deepsleep mode
            >> OK
5- Enter status PSM and Deepsleep
            >> +QNBIOTEVENT: "ENTER PSM"
                                                        //Enter the PSM state
5-1
            >> +QNBIOTEVENT: "ENTER DEEPSLEEP"
                                                        //Enter the deepsleep state
6- Exit status of Deepsleep and PSM
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
            >>
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                               //Exit the deepsleep state
            //Recreate the HTTP connection
            H3-1,H3-2,H3-3
                                                                                                 Method to trigger PSM wake-
H6-1-1
            >> +QNBIOTEVENT: "EXIT PSM"
                                                               //Exit the PSM state
                                                                                                 up
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
            >> +QHTTPPOST: 0,200,139
                                              //The POST was established successfully
            Go to 6-2, or goto T3-3 for sending data, or goto L3-5 for receving data,
            and the subsequent process
            //If you want to obtain the accurate signal reference in the current scene
            immediately after the PSM is woked up, please refer to
            //BC660K&BC950K support to wake up deepsleep by executing AT
            command or pulling down PSM EINT pin
            >> +QNBIOTEVENT: "EXIT DEEPSLEEP"
                                                               //Exit the deepsleep state
            >> AT+QPING=0,"8.8.8.8",4,1,32
                                                               //Trigger PSM wake-up
            >>
                                                                                                 If the program or mcu needs to
            >> OK
                                                                                                 deal with other tasks, such as
                                                                                                 collecting the base station cell
            >> +QNBIOTEVENT: "EXIT PSM"
                                                                                                 signal after wake-up; It is
                                                                                                 recommended to refer to this
T6-1-2
            >> +CSCON: 1 //Indicates that the RRC connection is established after the PSM is wakeup
                                                                                                 method to trigger PSM wake-
                                                                                                 up and obtain the network
            >> +QPING: 0,8.8.8.8,32,1284,51
                                                                                                 signal after wake-up.
            >>
                                                                                                 If no such requirement in the
            >> +QPING: 0,1,1,0,1284,1284,1284
                                                                                                 program, ignore the process
            >> AT+QENG=0
                                                        //Query signal reference
            >> +QENG: 0,3686,11,121,"05C4EF33",-75,-8,-65,14,8,"4C10",0,9,3
            >>
            >> OK
            //Recreate the HTTP connection
            H3-1,H3-2,H3-3
            //It is recommended to report the data of relevant signal reference over HTTP
            "rsrp=-75,snr=14,cellid=05C4EF33,earfcn=3686,pci=121"
```

	1	REC95UK Development and Application Process in Power-off and PSN	
6-2 7– Er a	Go to 6-2, or goto R4 //Manual TAU updat >> AT+CPSMS=0 >> OK >> AT+CPSMS=1,,,"01000 >> OK Go to R4-1 ase the historical from the content of the conte	re 010","00000000"	TAU update manually can avoid automatic update of TAU cycle over time, so,non-service power consumption can be reduced; If no requirement in the application, ignore this step As described in 2-8, it is
7-1	time(such as 2min), >> AT+CFUN=0 >> OK >> AT+QCSEARFCN >> OK >> AT+QBAND=1,28		suggested that in the program design, after the first search fails to time out, the frequency clearing program must be executed. After run, follow the 2-7 to check the search status again; If the research fails to time out, you are advised to reboot
Q_ Fv	>> AT+QRST=1 >> OK Follow 2-7 above ception handling or in	//Reboot, and re-search	without clearing the frequency again. Or wait for the next service cycle and try again.
8-1	 The program or mcu platform registration The program or mcu timeout or failure, su The program or mcu cannot wake up PSM In the case of except off directly, you need 	shall add the interrupt method of timeout or failure of leshan, such as re-registration or reboot; shall add the interrupt method of sending or receiving data sch as reboot; should add interrupt methods that cannot enter PSM normally or	If the terminal has strict requirements on power consumption, it is recommended that the program reasonably control timeout. If unable to enter PSM or wake up from PSM, it is recommended to compare the normal time to enter PSM or exit PSM. If the time exceeds, power off or reboot should can be operated