

Summary of Technology and Resources of QuecOpen **EC2X**

Quectel preliminary

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About the Document

This document applies to EC2X platform.

History

Revision	Date	Author	Description
1.0	2017-12-11	Running Jay	Initial
1.1	2018-02-08	running	Add about hw resource illustration
1.2	2018-10-30	Stanley	Deleted the description of HSIC in 3.2.4.

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1.Introduction

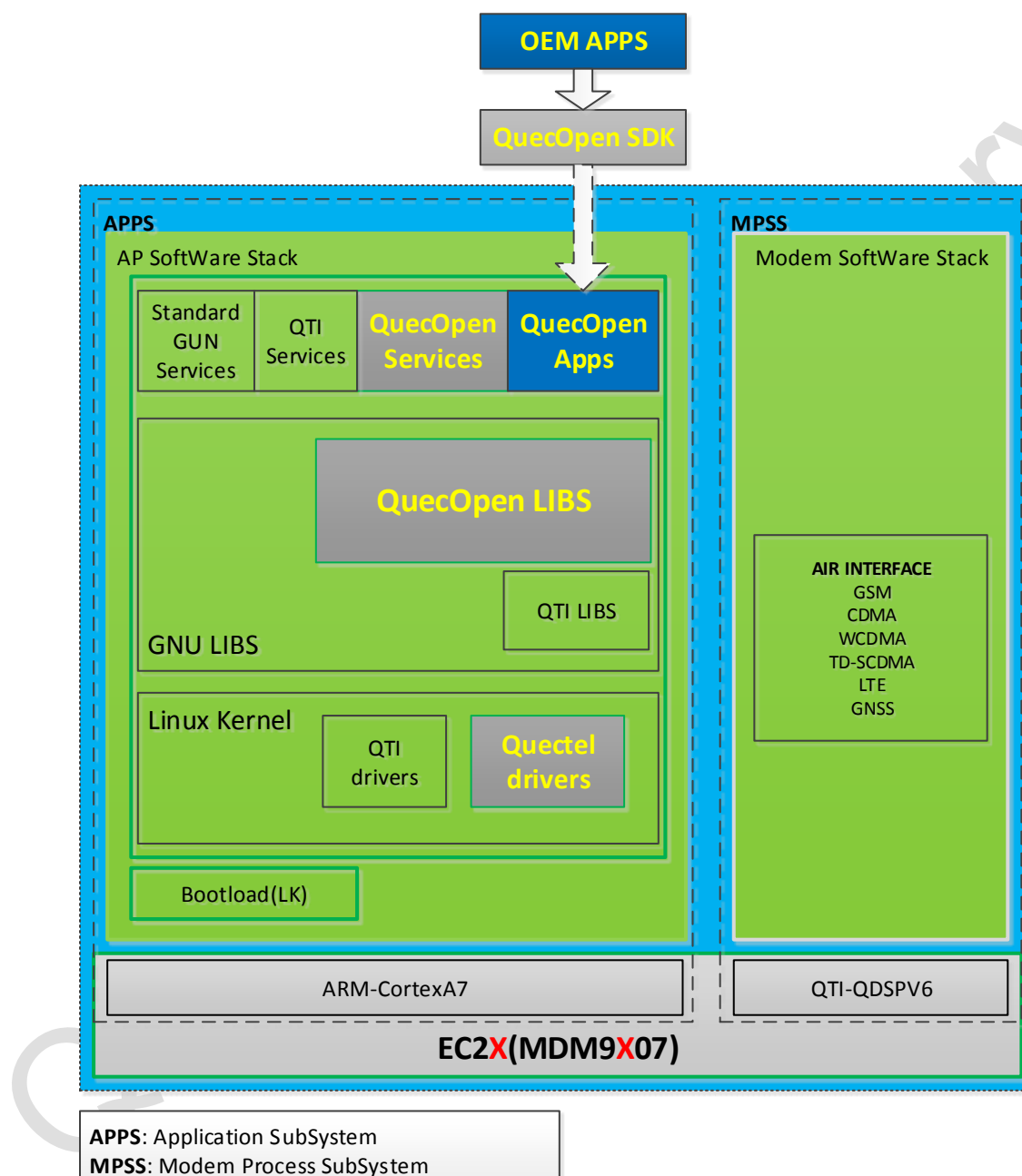
As higher requirements from customers for the function, cost, development cycle and quality of IOT products, Quectel launched the EC2X series wireless communication module and combined with the latest QuecOpen technology solutions to meet the needs of all kinds of products in wireless mobile network applications.

This document introduces the QuecOpen technology and the EC2X module.

Quectel Preliminary

2. QuecOpen Technology

2.1 System Architecture

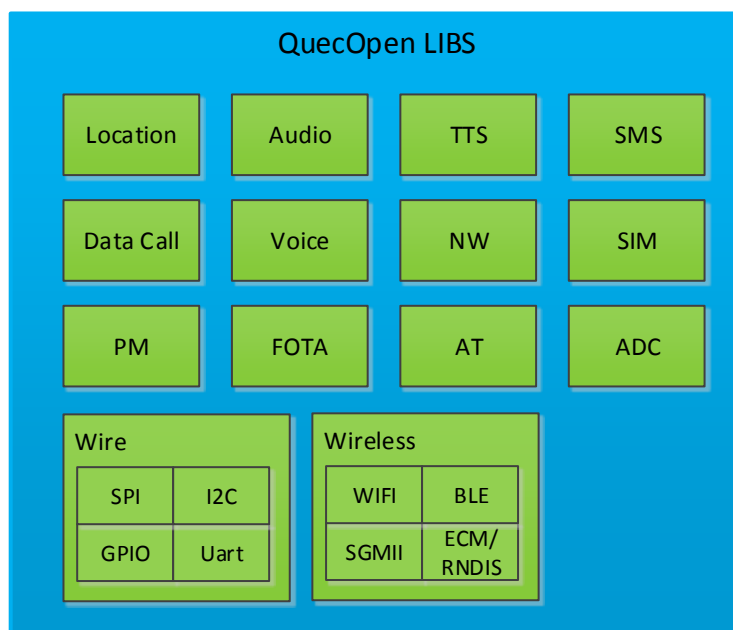


As shown in the above system architecture, QuecOpen technology is the use of Quectel mobile module open software and hardware resources, combined with QuecOpen SDK to develop various wireless mobile application APP. These APP developed by QuecOpen technology, collectively called QuecOpen Apps.

2.2 QuecOpen Characteristic

2.2.1 QuecOpen LIBS

QuecOpen LIBS utilizes QTI technology, advanced function library designed by GNU/Linux and Quectel specific functions, providing very powerful multiple application functions and streamlined API. The functions included are as following:



2.2.2 QuecOpen SDK

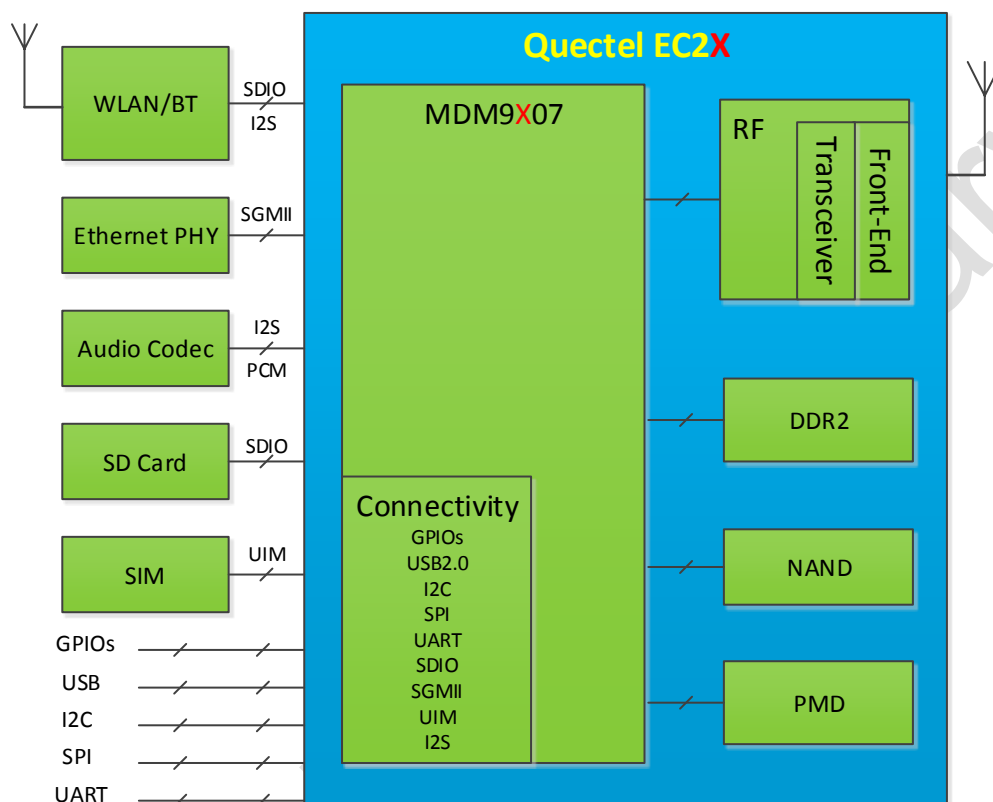
This includes platform related crosstools, firmware making tools, and various functional demo source codes. In addition, besides the common features of traditional ARM-Linux embedded development, SDK has the following features:

- (1) One key initialization
- (2) One key compilation
- (3) One key packaging
- (4) One key downloading

For the introduction and use of QuecOpen SDK, please refer to the *Guidelines for the development and use of KBA_QuecOpen_MDM9x07& MDM9X28_ applications*.

3. EC2X Resource introduction

3.1 Product Structure



3.2 Introduction of Hardware Resources

3.2.1 Processor

APPS	ARM Cortex A7 up to 1.2 GHz with 256 kB L2 cache ARM Cortex A7 – primary boot processor
MPSS	Qualcomm® Hexagon™ DSP 6 processor at up to 691 MHz (Turbo), Low-power audio postprocessing supported in the modem system, 768 kB L2 cache

3.2.2 OTA Resources

(1) Supported OTA Technology of WAN

GSM	CDMA	WCDMA	TD-SCDMA	LTE
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to EDGE 36.8/236.8 kbps	to DOrA 1X: 307.2/307.2 kbps DO :14.7/5.4 Mbps	to DC HSPA+ HSDPA+ – 42 Mbps HSUPA – 11.5 Mbps	4.2/2.2 Mbps	to non-CA Cat 4 150/50 Mbps
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(2) Supported RF band of WAN

Band name	LTE-FDD	LTE-TDD	WCDMA	TD-SCDMA	CDMA	GSM
IMT (2100)	B1	–	B1	–	BC6	–
PCS (1900)	B2	–	B2	–	BC1	1900
DCS (1800)	B3	–	B3	–	–	1800
AWS	B4	–	B4	–	BC15	–
CELL (850)	B5	–	B5	–	BC0	850
JCELL (800)	B6	–	B6	–	–	–
IMT-E (2600)	B7	–	–	–	–	–
EGSM (950)	B8	–	B8	–	–	900
J1700	B9	–	B9	–	–	–
EAWS	B10	–	B10	–	–	–
PDC (1500)	B11	–	B11	–	–	–
700 lower A-C	B12	–	–	–	–	–
700 upper C	B13	–	–	–	–	–
700 lower B-C	B17	–	–	–	–	–
B18	B18	–	–	–	–	–
B19	B19	–	B19	–	–	–
EU800	B20	–	–	–	–	–
PDC	B21	–	–	–	–	–

Band name	LTE-FDD	LTE-TDD	WCDMA	TD-SCDMA	CDMA	GSM
PCS+G	B25	–	B25	–	BC14	–
B26	B26	–	–	–	–	–
US 800	B27	–	–	–	–	–
700 APAC	B28	–	–	–	–	–
B29	B29	–	–	–	–	–
WCS	B30	–	–	–	–	–
B32	B32	–	–	–	–	–
B34	–	B34	–	B34	–	–
B38	–	B38	–	–	–	–
B39	–	B39	–	B39	–	–
B40	–	B40	–	–	–	–
B41/B41-XGP	–	B41	–	–	–	–
Sec 800	–	–	–	–	BC10	–
B66	B66	–	–	–	–	–

(3) GNSS

Global	GPS, GLONASS, BeiDou (BDS), and Galileo (GAL)
Regional	QZSS
SBAS	WASS
Assisted	AGPS, iZatXtra

(4) Wireless

*Optional for customers

WLAN

QCA9377-3	1 x 1 IEEE802.11a/b/g/n/ac
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3.2.3 Storage Resources

* According to the model of the product

(1) **RAM**

256、128MB

(2) **FLASH**

512、256、128MB

The left space of AG35 512MB NAND+256MB RAM about 120MB Flash+100MB RAM;

The remaining space of the Flash partitions can be checked by the linux cmd “df”;

RAM information can be viewed via the “cat /proc/meminfo” command: TotalMemory is the physical memory that linux partner system can manage after system start up, which equals to the total of physical memory minus Modem kernel image, reserved net, memory; customers are more concerned about the available memory for the application of MemAvailable field:

Product name	Available RAM Space	Available Root Partion of Flash Space	Available User Partition of Flash Space
EC20CEFAG	100 MB	20 MB	100 MB
EC21A/V	100 MB	20 MB	100 MB
EC25A/V	100 MB	20 MB	100 MB

*For Linux root partition, only recommend that customers save important programs and important data.

* Linux user partition can be segmented by users to save some non-critical data.

* The module itself provides a backup and restore mechanism. When the root partition is damaged and restored, the data customers saved in the root partition and bin will be also restored. So it is recommended to do a backup in the user partition.

512MB FLASH partition information

Partition	Space (MB)	Note
sbl	2.5	Sbl firmware
mibib	2.5	Partion firmware partition
efs2	22	Modem file system partition
sys_rev	5	Modem file system backup partition
rawdata	3	The use for system internal interactive information
tz	1.25	Qsee/tz firmware
rpm	1.5	Corete-M3 running firmware partition
aboot	1.25	Aboot firmware partition
boot	9	Linux kernel firmware partition
recovery	9	Linux kernel firmware backup partition
image_back	6.25	Reserve
recoveryfs_b	14	Recovery mode root file system backup
scrub	16.5	The use for QTI backup information
modem	60	Modem's NON-HLOS firmware partition
misc	1.25	The use for system internal interactive

		information
recoveryfs	30	Recovery mode root file system
qdsp6sw_b	56	NON-HLOS Firmware Backup Partition
usr_data	124.25	User file system partition
sys_back	58	HLOS root file system backup
system	88.75	HLOS root file system

All of the above partitions, only usr_data partition can be segmented and adjusted by users.

3.2.4 Peripheral Resources

* Different product models have different peripheral resources. For the detail peripheral resources please refer to *Quectel_EC20_R2.0-QuecOpen_Hardware Design Manual Guide* and *Quectel_EC20_R2.0&EC21&EC25_QuecOpen_GPIO_Assignment_Spreadsheet*.

(1) Connectivity

Type	Groups	Whether the PINs is multiplexed
UIM	1	dedicated
USB	1 , USB2.0. support master and slave mode.	dedicated
SDIO	2	SDC1 Multiplexing SDC2 dedicated
SGMII	1	dedicated
PCM	1	dedicated
UART、SPI、IIC	Refer to BLSP	Refer to BLSP

(2) BLSP

BLSP is short for BAM low speed bus, and each group of BLSP has 4 pin feet. Each group can be configured as UART, SPI, IIC and GPIO mode. QTI provides 6 sets of BLSP. Except for BLSP4, there are two feet that are not drawn (refer to GPIO Assignment Spreadsheet in detail) and all other feet are drawn. From QUECTEL's own hardware and software features, the actual number of buses available to modules is as follows:

TYPE	Maximum groups (Do not consider supporting of three kinds of buses simultaneously)	Note
UART	Domestic: 6 Abroad: 4	One of the groups defaults to the Linux login serial terminal. Abroad 2 groups are used as AT port and other functions.
SPI	2	Only support master mode
IIC	1	

(3) GPIO

When used as GPIO, all pins provided by MDM9X07 platform support multiplex other functions, the pins can be used as GPIO can refer to *Quectel_EC20_R2.1&EC21&EC25_QuecOpen_GPIO_Assignment_Spreadsheet*. The actual maximum number of GPIOs is 30(Only 23 in North America and other oversea products).

(4) **External interrupt**

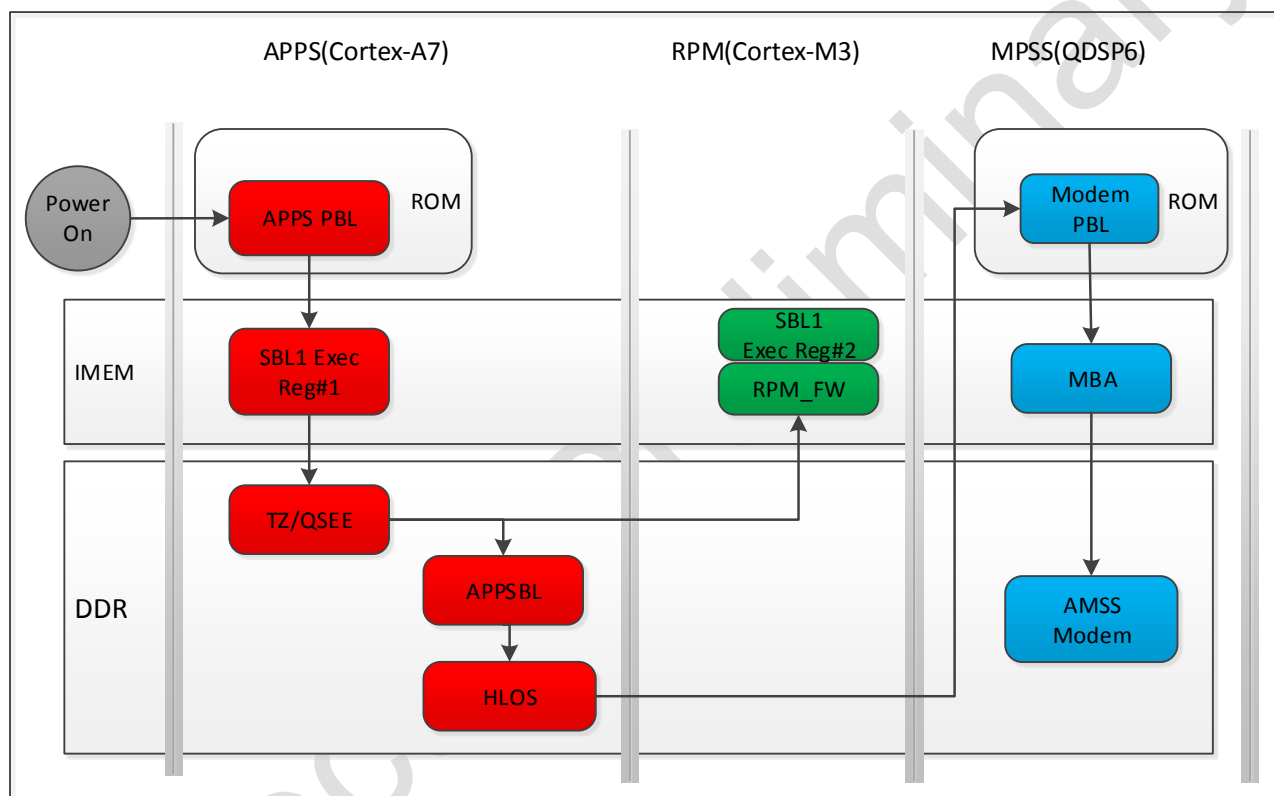
All pins that can be as gpio could support interrupt.

(5) **ADC**

Support 3 PIN, sampling accuracy 15bit, voltage range 0.3-4.5v.

3.3 Software Resource Introduction

3.3.1 Booting Process

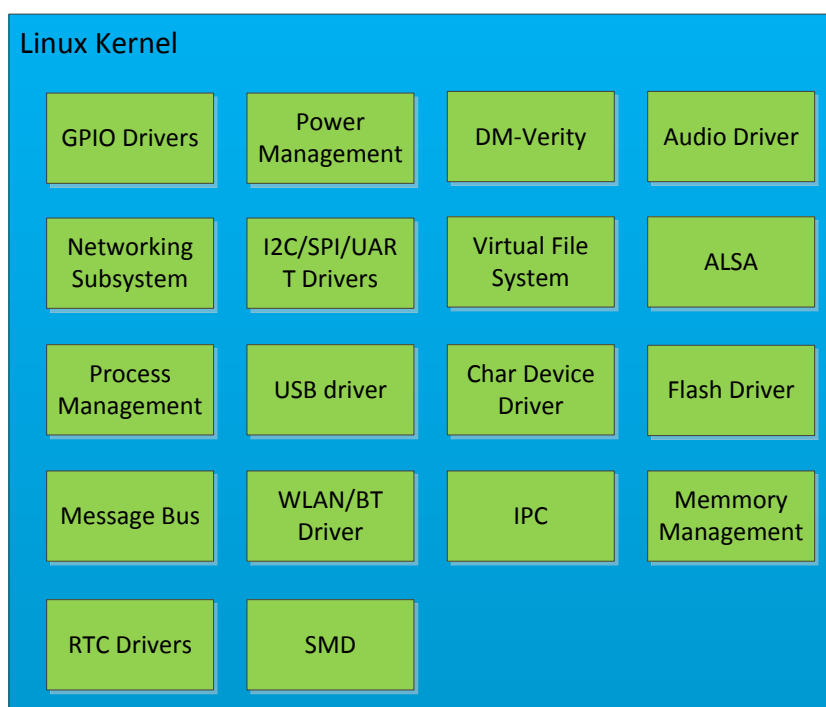


Booting Time:

Booing Node	Booting Time	Remarks
SBL	< 0.5	
aboot	< 0.5	
Kernel	< 7	o the loading init process
Linux serial port terminal booting finished	<17	"Login" shown up, and not the first starting-up of the refreshed firmware.
Modem network registered time	<20	Well LTE signal network, RDY showed at AT port.

3.3.2 Linux kernel

Linux version 3.18.20



3.3.3 GNU runtime library

attr	iputils	readline
audioalsa	iw	shadow
avahi	jquery	shadow-sysroot
base-passwd	jquery-ui	sigma-dut
busybox	kbd	sqlite3
bzip2	libcap	start-scripts-dynamic-console
conntrack-tools	libcheck	start-scripts-find-partitions
db	libdaemon	start-scripts-find-recovery-partitions
dbus	libffi	start-scripts-firmware-links
ddclient	libid3tag	start-scripts-misc-daemon
dhcpcd	libjpeg-turbo	start-scripts-mssboot
dnsmasq	libnetfilter-conntrack	sysvinit
e2fsprogs	libnfnetlink	tcpdump
ebtables	libnl	thermal-engine
expat	libogg	tinyproxy
ffmpeg	libpcap	util-linux
flac	libvorbis	wireless-tools
ftm	libxml2	xmllib
gawk	lighttpd	zlib

gcc-runtime	lrzsz	
gdb	lttng-ust	
gettext	lzo	
glib-2.0	minidlna	
glibc	miniupnpd	
gmp	netbase	
gnutls	nettle	
init-ifupdown	openssl	
initscripts	perl	
iproute2	ppp	
iptables	pugixml	

3.3.4 Cross Tool Chian

Gcc : 4.9.2, -march=armv7-a, -mfloat-abi=softfp, -mfpu=neon

```
ol@ql-Ubuntu:ql-ol-sdk-9607$ arm-oe-linux-gnueabi-gcc -v
Using built-in specs.
COLLECT_GCC=arm-oe-linux-gnueabi-gcc
COLLECT_LTO_WRAPPER=/home/ol/ol-sdk/ql-ol-sdk-9607/ql-ol-crosstool/sysroots/x86_64-oesdk-linux/usr/bin/arm-oe-linux-gnueabi/../../../../libexec/arm-oe-linux-gnueabi/gcc/arm-oe-linux-gnueabi/4.9.2/lto-wrapper
Target: arm-oe-linux-gnueabi
Configured with: /home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/work-shared/gcc-4.9.2-r0/gcc-4.9.2/configure --build=x86_64-linux --host=x86_64-oesdk-linux --target=arm-oe-linux-gnueabi --prefix=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr --exec_prefix=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr --bindir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/bin/arm-oe-linux-gnueabi --sbindir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/bin/arm-oe-linux-gnueabi --libexecdir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/libexec/arm-oe-linux-gnueabi --datadir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/share --sysconfdir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/etc --sharedstatedir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/com --localstatedir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/var --libdir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/lib/arm-oe-linux-gnueabi --includedir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/include --oldincludedir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/include --infodir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/share/info --mandir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/share/man --disable-silent-rules --disable-dependency-tracking --with-libtool-sysroot=/home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/sysroots/x86_64-nativesdk-oesdk-linux --with-gnu-ld --enable-shared --enable-languages=c,c++ --enable-threads=posix --enable-multilib --enable-c99 --enable-long-long --enable-symvers=gnu --enable-libstdcxx-pch --program-prefix=arm-oe-linux-gnueabi- --without-local-prefix --enable-target-optspace --enable-lto --enable-libssp --disable-bootstrap --disable-libmudflap --with-system-zlib --with-linker-hash-style=gnu --enable-linker-build-id --with-ppl=no --with-cloog=no --enable-checking=release --enable-cheaders=c_global --with-gxx-include-dir=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/armv7a-vfp-neon-oe-linux-gnueabi/usr/include/c++/4.9.2 --with-build-time-tools=/home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/sysroots/x86_64-linux/usr/arm-oe-linux-gnueabi/bin --with-sysroot=/usr/local/oe-core-x86_64/sysroots/x86_64-oesdk-linux/usr/armv7a-vfp-neon-oe-linux-gnueabi --with-build-sysroot=/home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/sysroots/mdm9607-perf --enable-poison-system-directories --with-mplfr=/home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/sysroots/x86_64-nativesdk-oesdk-linux --with-mpc=/home/ol/ws/ol-ql/MDM9x07/MCU_R04/apps_proc/oe-core/build/tmp-glibc/sysroots/x86_64-nativesdk-oesdk-linux --enable-nls
Thread model: posix
gcc version 4.9.2 (GCC)
```

4. Introduction to development

4.1 Hardware development guidance documentation

Hardware design instruction:

Quectel_EC20_R2.0-QuecOpen_Hardware_Design

Module schematic diagram:

EC20&EC21&EC25-TE-A_SCH

EVB board schematic diagram:

UMTS<E-EVB_SCH

PIN function definition:

Quectel_EC20_R2.1_QuecOpen_GPIO_Assignment_Speadsheet

Quectel_EC21-EC25_QuecOpen_GPIO_Assignment_Speadsheet

4.2 Software development guidance documentation

Software design instruction

KBA_QuecOpen_MDM9x07&MDM9X28_Userguide_for_App_and_Kernel_Development

Appendix

Reference

<i>KBA_QuecOpen_MDM9x07&MDM9X28_Application_Development_Munal</i>
<i>Quectel_EC20_R2.0-QuecOpen_Hardware_Design_Manual</i>
<i>Quectel_EC20 R2.0&EC21&EC25_QuecOpen_GPIO_Assignment_Speadsheet</i>
<i>KBA_QuecOpen_Slow_Power_Solution</i>
<i>KBA_QuecOpen_Multipath_APN_Data_Call_Quick_Solution</i>
<i>KBA_QuecOpen_Singlepath_APN_Data_Call_Quick_Solution</i>
<i>KBA_QuecOpen_WiFi_API_User_Guide</i>
<i>KBA_QuecOpen_SGMII_API_User_Guide</i>
<i>KBA_QuecOpen_ECM_User_Guide</i>
<i>Quectel_EC20_R2.0_AT_Commands_Manual</i>

Abbreviation

TERM	Definition
BAM	Bus Access Module
BLSP	BAM Low-Speed Peripheral
DM	Device Mapper
DSRC	Dedicated Short Range Communications
PMD	Power Management Device
QTI	Qualcomm Technologies, Inc