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Internet of things and smart cities and communities –
Requirements and use cases

Requirements and use cases for universal communication module of mobile IoT devices

Recommendation ITU-T Y.4210



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Recommendation ITU-T Y.4210

Requirements and use cases for universal communication module of mobile IoT devices

Summary

As an important part of mobile Internet of things (IoT) devices, the universal communication module is a key component to achieve economies of scale for mobile IoT devices, accelerate the progress of research and development, and promote the application of new mobile IoT technologies.

Recommendation ITU-T Y.4210 specifies requirements for a universal communication module of mobile IoT devices.

Related use cases are provided in Appendix I. Universal communication module reference types are described in Appendix II.

History

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T Y.4210

Requirements and use cases for universal communication module of mobile IoT devices

1 Scope

Currently, the communication modules produced by different vendors of modules for mobile Internet of things (IoT) devices have different designs, which results in a fragmented communication module market and low compatibility. The universal communication module is a key component to achieve economies of scale for mobile IoT devices, accelerate the progress of research and development and promote the application of new mobile IoT technologies.

This Recommendation introduces the concept of a universal communication module of mobile IoT devices, analyses the requirements for universal communication module implementations of mobile IoT devices, and provides use cases for the universal communication module of mobile IoT devices.

In this Recommendation, the universal communication module actually represents a series of communication modules.

The communication technologies related to all the communication modules which are addressed in this Recommendation – and used by mobile IoT devices – are the 3GPP low power wide area (LPWA) technologies (currently, narrow band-Internet of things (NB-IoT) [b-3GPP TS 36.300] and enhanced machine type communication (eMTC) [b-3GPP TS 36.300]).

Different communication modules can apply to different IoT application scenarios, such as smart utility metering, smart home, logistics tracking, smart bicycles, intelligent buildings and so on.

The scope of this Recommendation includes:

- concept and classification of universal communication module of mobile IoT devices;
- requirements of universal communication module of mobile IoT devices – considering the requirements for the different communication module types of mobile IoT devices;
- use cases of universal communication module of mobile IoT devices.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ETSI TS 127 005] ETSI TS 127 005 V14.0.0 (2017-04), *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS) (3GPP TS 27.005 version 14.0.0 Release 14)*.

[ETSI TS 127 007] *ETSI TS 127 007 V13.7.0 (2018-04), Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; AT command set for User Equipment (UE) (3GPP TS 27.007 version 13.7.0 Release 13).*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.2091]: A structured set of capabilities, which provide value-added functionality supported by one or more services, which may be supported by an API interface.

3.1.2 capability [b-ITU-R M.1224-1]: The ability of an item to meet a service demand of given quantitative characteristics under given internal conditions.

3.1.3 Internet of things (IoT) [b-ITU-T Y.2060]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

3.1.4 thing [b-ITU-T Y.2060]: In the Internet of things, this is an object of the physical world (physical things) or of the information world (virtual things), which is capable of being identified and integrated into the communication networks.

3.1.5 attention (AT) [b-3GPP TS 27.007]: It is always used to start a command line to be sent from terminal equipment (TE) to terminal adaptor (TA).

3.1.6 terminal equipment (TE) [b-3GPP TS 27.007]: Terminal equipment, such as a computer, equal to data terminal equipment (DTE).

3.1.7 terminal adaptor (TA) [b-3GPP TS 27.007]: Terminal adaptor (TA) such as a global system for mobile communication (GSM) data card, equal to data circuit terminating equipment (DCE).

3.1.8 service centre [b-3GPP TS 23.040]: Function responsible for the relaying and storage and forwarding of a short message between a short message entity (SME) and a mobile subscriber (MS).

3.1.9 short message entity (SME) [b-3GPP TS 23.040]: Entity which may send or receive short messages.

3.1.10 cellular IoT (CIoT) [b-3GPP TS 23.401]: Cellular network supporting low complexity and low throughput devices for a network of things.

3.1.11 extended idle mode DRX (eDRX) [b-3GPP TS 23.682]: The user equipment (UE) and the network may negotiate over non-access stratum signalling the use of extended idle mode discontinuous reception (DRX) for reducing its power consumption, while being available for mobile terminating data and/or network originated procedures within a certain delay dependent on the DRX cycle value.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 package: A casing that holds the circuit.

NOTE – With the package, on one hand, the circuit can be protected from corrosion or physical damage; on the other hand, the circuit still has electrical contacts which can be connected with a printed circuit board.

3.2.2 pad: Physical contact on a module.

3.2.3 pad spacing: Distance between two adjacent pads on a common row or column of a module.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ADC	Analogue-to-Digital Converter
APN	Access Point Name
AT	Attention
CIoT	Cellular IoT
DC	Direct Current
DCE	Data Circuit terminating Equipment
DRX	Discontinuous Reception
DTE	Data Terminal Equipment
EDGE	Enhanced Data rate for GSM Evolution
eDRX	Extended idle mode DRX
eMTC	enhanced Machine Type Communication
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
I2C	Inter-Integrated Circuit bus
I2S	Integrated Inter Chip Sound
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identification Number
IoT	Internet of Things
IP	Internet Protocol
LCC	Leadless Chip Carriers
LGA	Land Grid Array
LPWA	Low Power Wide Area
MCU	Microcontroller Unit
MS	Mobile Subscriber
NB-IoT	Narrow Band-Internet of Things



PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
RF	Radio Frequency
RTC	Real Time Clock
SDK	Software Development Kit
SIM	Subscriber Identity Module
SME	Short Message Entity
SMS	Short Message Service
SN	Serial Number
SPI	Serial Peripheral Interface
TA	Terminal Adaptor
TBD	To Be Determined
TE	Terminal Equipment
UART	Universal Asynchronous Receiver/Transmitter
UE	User Equipment
URL	Uniform Resource Locator
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module

5 Conventions

The following conventions are used in this Recommendation:

- The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.
- The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.
- The keywords "can optionally" and "may" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Concept of universal communication module of mobile IoT devices

As an important part of mobile IoT devices, the universal communication module is a key component to achieve economies of scale for mobile IoT devices, accelerate the progress of research and development, and promote the application of new mobile IoT technologies.

A universal communication module of mobile IoT devices is required to include a baseband unit and a radio frequency (RF) front end unit, as shown in Figure 1.

A universal communication module of mobile IoT devices may also include a microcontroller unit (MCU), a global navigation satellite system (GNSS) positioning unit, a sensor unit, a subscriber identity module (SIM)/universal subscriber identity module (USIM) card and an antenna.

NOTE – The baseband unit and RF front end unit are the key parts for communication. The baseband unit and the RF front end unit are mandatory.

As the processing capability of the MCU unit embedded in the communication module may not meet the requirements, another MCU (not embedded in the communication module) may be used. The MCU unit is optional.

The GNSS unit is useful for positioning based services. Because of its specific applicability, the GNSS unit is optional.

The SIM/USIM card can be supplied by different vendors. The SIM/USIM card is optional.

The size of the antenna depends on the frequencies. The antenna is optional.

The selection of sensors depends on user requirements. The sensor unit is optional.

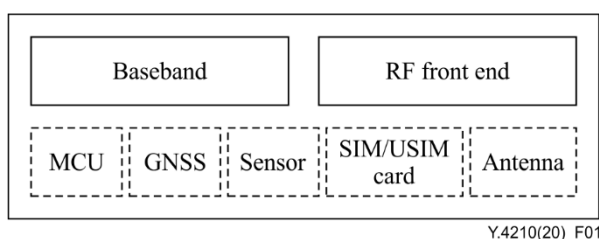


Figure 1 – Structure of a universal communication module of mobile IoT device

7 Universal communication module classification

7.1 Universal communication module characteristics

To facilitate mobile IoT device development, the following common characteristics are based on the collection and selection of characteristics from diverse mobile IoT application scenarios, including mechanical characteristics, electrical characteristics, software characteristics, performance characteristics, application scope characteristics and communication mode characteristics.

1) Mechanical characteristics:

- Package: including but not limited to leadless chip carriers (LCC) [b-Information Package-1] and land grid array (LGA) [b-Information Package-2].

NOTE 1 – LCC and LGA are widely used packages in current mobile IoT modules industry.

- Size: length, width and thickness.

NOTE 2 – Different application requirements have an effect on the module size.

- Pad size and pad spacing
- Pad assignments

2) Electrical characteristics:

- Power supply interface, used to supply the power for universal communication modules.

NOTE 3 – Power supply voltage is a key indicator of power consumption in current mobile IoT modules industry.

- RF interface, used to send or receive wireless signals for universal communication modules.

NOTE 4 – A single RF interface is widely used in current mobile IoT modules industry.

NOTE 5 – In case of position based service support, an additional RF interface for GNSS is usually used.

- Module control and status interface, used to control universal communication modules: including but not limited to Power on/off, Reset, Wakeup.
 - SIM/USIM [b-ETSI TS 102 671] interface, used to connect SIM/USIM card with universal communication modules.
 - Data input/output interfaces, used to implement data exchange between universal communication modules and external circuits: including but not limited to universal asynchronous receiver/transmitter (UART) [b-Information Electrical-Interface-2], general purpose input output (GPIO) [b-Information Electrical-Interface-1], inter-integrated circuit bus (I2C) [b-Information Electrical-Interface-1], serial peripheral interface (SPI) [b-Information Electrical-Interface-1] and universal serial bus (USB) [b-Information Electrical-Interface-2].
 - Analogue interface, used to convert an analogue signal into a digital signal by universal communication modules: including but not limited to analogue-to-digital converter (ADC) [b-Information Electrical-Interface-1].
 - Audio interface, used to support voice communication by universal communication modules: including but not limited to pulse code modulation (PCM) [b-Information Electrical-Interface-1] and integrated inter chip sound (I2S) [b-Information Electrical-Interface-1].
- 3) Software characteristics:
- Universal module management, for maintainability and usability of communication modules.
 - Debugging function, to debug the universal communication modules.
 - Minimum AT commands, for software development compatibility of universal communication modules.
- 4) Performance characteristics:
- Storage
 - Temperature
- 5) Application scope characteristics:
- The application scope deals with the applications the communication module is used for: consumer applications, industrial applications and vehicle applications.
- 6) Communication mode characteristics:
- Communication modes: as examples, global system for mobile communication (GSM)/general packet radio service (GPRS)/ enhanced data rate for GSM evolution (EDGE) [b-3GPP TS 05.01], NB-IoT, eMTC.

NOTE 6 – Based on application scenarios, a communication module may have one or more communication modes.

7.2 Universal communication module classification factors

The universal communication module is recommended to comply with the following requirements.

- Every type of universal communication module is recommended to cover a large variety of application scenarios.
- Every universal communication module of a given type (i.e., small size or normal size as identified in this clause) is recommended to be compatible with other universal communication modules of the same type.

NOTE 1 – Electrical requirements and software requirements are common to both types of universal communication module. The mechanical requirements differ among the different universal communication module types.