3 unit III XMPP and Bluetooth protocol

Embedded Systems (Jawaharlal Nehru Technological University, Kakinada)

UNIT III

XMPP protocol

XMPP

XMPP is an XML-based specification for messaging and presence protocols. XMPP is also an open-source protocol recommended specification which is accepted by IETF. RFC is an international organisation and stands for 'Recommended for Comments'. RFC 6120 document specifies the XMPP for CoRE. Another recommendation, RFC 6121 XMPP specifies the instant messaging (IM) and presence, and RFC 6122 XMPP specifies the (message) address format.

Messages notify *presence* for the IMs to one or many at the same time. It enables chatting and Multi-User Chat (MUC) after creation of a chat room, where different users can do the IMs. XMPP enables interoperable communication: for example, Google Talk. XMPP enables IMs between many users as it uses presence-notifications and chat features.

Chat room is an application, in which all those who have subscribed (meaning persons and objects initiating chatting and messaging to one another at the same time) are provided a room-like view and use the IMs among themselves.

XMPP is extensible—XSF (XMPP standards foundation) develops and publishes the xeps (XMPP extension protocols). The xeps enable the addition of features and new applications. List of XMPP xeps for web objects is quite long. Examples of xeps are:

- xep-DataForms Format
- xep-XHTML-IM
- xep-Service Discovery
- xep-MUC
- xep-Publsih-Subscribe and Personal Eventing Protocol
- xep- File Transfer
- xep-Jingle for Voice and video

XMPP-IoT xeps extend the use of XMPP to IoT and machine-to-machine messaging.[7,8] List of extensions (xeps) is quite long. Examples of xeps are:

- xep-0322 efficient XML interchange (EXI) format
- xep-0323 Internet of Things-Sensor Data (http://xmpp.org/extensions/xep-0323.html)
- xep-0324 Internet of Things-Provisioning
- xep-0325 Internet of Things-Control (http://xmpp.org/extensions/xep-0325.html)
- xep-0326 Internet of Things-Concentrators.

Features of XMPP are:

- XMPP uses XML.
- XML elements are sent in the open-ended stream within the tag <stream> and corresponding end tag </stream>.
- Three basic types of XMPP stanzas (elements) are:
  - message
  - presence
  - iq (information/query, request/response)
- Extensibility to constrained environment messaging and presence protocols as well as IP network messaging.
- Extensibility of request-response (client-server) architecture to iq (information through querying), PubSub messaging, Chat room MUC messaging and other architecture (where group of people exchange information when present in a chat room), decentralised XMPP server.

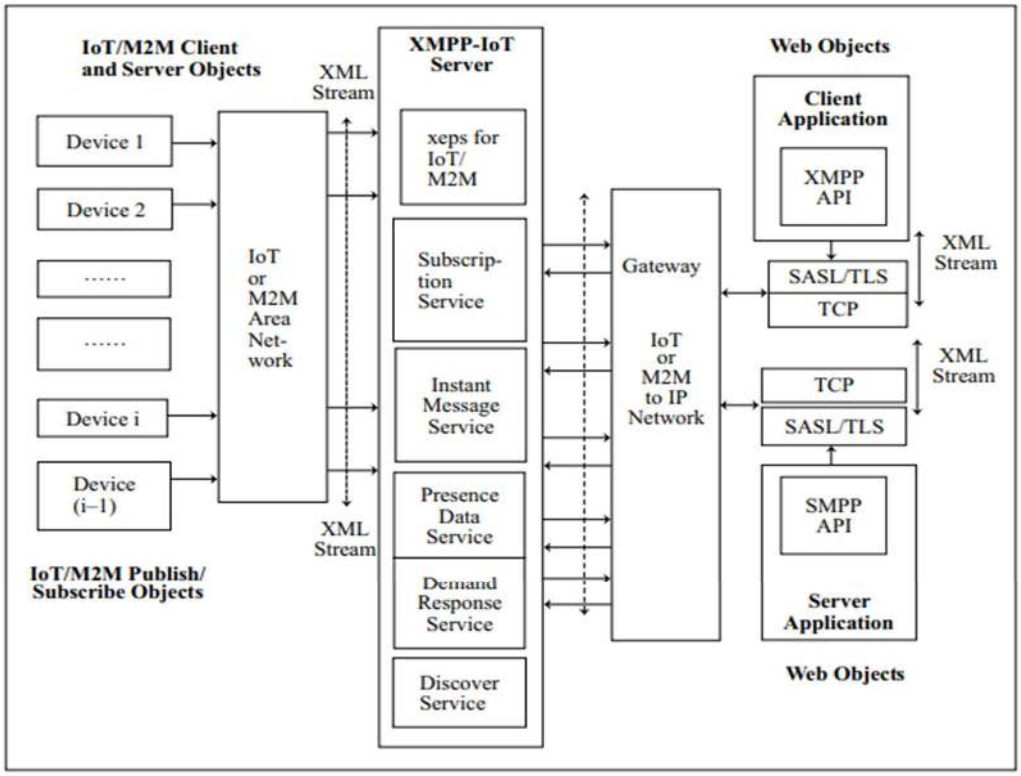

Figure 3.7 Use of XMPP and XMPP extension protocols for connected devices and web objects for the messaging, presence notifications, responses on demand and service discoveries using XML streams

- XMPP server set by anyone on the following standards recommended and using XSF xeps; for example, XMPP-IoT server, XMPP M2M server for messaging between the machines.
- Authentication by SASL/TLS, and support from intelligent and business analyst applications, and processing through XMPP server and gateway for connecting device network with IP network.

XMPP does the following:

- Binary data is first encoded using base 64 and then transmitted in-band. Therefore, the file first transmits out-of-band between nodes on messages from XMPP server but not directly like IMs.
- No end-to-end encryption
- Higher overhead being text based in place of binary implementations
- No support for QoS like MQTT does

Bluetooth Protocol

BT BR Bluetooth Basic data rate in 1.0, 2.0, 3.0 or 4.0 device

BT EDR Bluetooth Enhanced Data Rate

BT LE Bluetooth Low Energy

Bluetooth BR/EDR and Bluetooth Low Energy

Bluetooth devices follow IEEE 802.15.1 standard protocol for L1 (physical cum data-link layer). BT devices form a WPAN devices network. Two types of modes for the devices are Bluetooth BR/EDR (Basic Rate 1 Mbps/Enhanced Data Rate 2 Mbps and 3 Mbps) and Bluetooth low energy (BT LE 1Mbps). A latest version is Bluetooth v4.2. BT LE is also called *Bluetooth Smart*. Bluetooth v4.2 (December 2014) provides the LE data packet length extension, link layer privacy and secure connections, extended scanner and filter link layer policies and IPSP. BT LE range is 150 m at 10 mW power output, data transfer rate is 1 Mbps and setup time is less than 6 s.

Bluetooth v5, released in June 2016, has increased the broadcast capacity by 800%, quadrupled the range and doubled the speed.

A device may have provisions for single mode BT LE or dual mode BT BR/EDR (Mbps stands for Million Bits per second). Its features are:

- Auto-synchronisation between mobile and other devices when both use BT. BT network uses features of self-discovery, self-configuration and self-healing.
- Radio range depending on class of radio; Class 1 or 2 or radios: 100 m, 10 m or 1 m used in device BT implementation.

- Support to NFC pairing for low latency in pairing the BT devices.
- Two modes—dual or single mode devices are used for IoT/M2M devices local area network.
- IPv6 connection option for BT Smart with IPSP (Internet Protocol Support Profile).
- Smaller packets in LE mode.
- Operation in secured as well as unsecured modes (devices can opt for both link-level as well as service-level security or just service level or unsecured level).
- AES-CCM 128 authenticated encryption algorithm for confidentiality and authentication (Refer Example 2.4).
- Connection of IoT/M2M/mobile devices using BT EDR device to the Internet with 24 Mbps Wi-Fi 802.11 adaptation layer (AMP: Alternative MAC/PHY layer) or BT-enabled wire-bound connection ports or device. MAC stands for media access control sublayer at a data-link layer/sublayer.

M2M area network (for example, Bluetooth, ZigBee NFC, PAN, LAN)

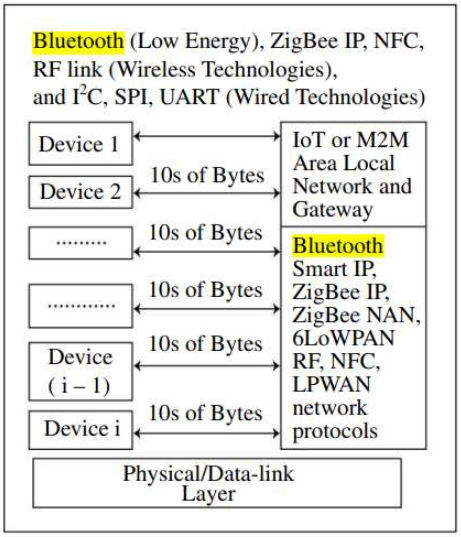

Figure 2.4 Connected devices 1st to ith connected to the local network and gateway using the WPAN or LPWAN network protocols

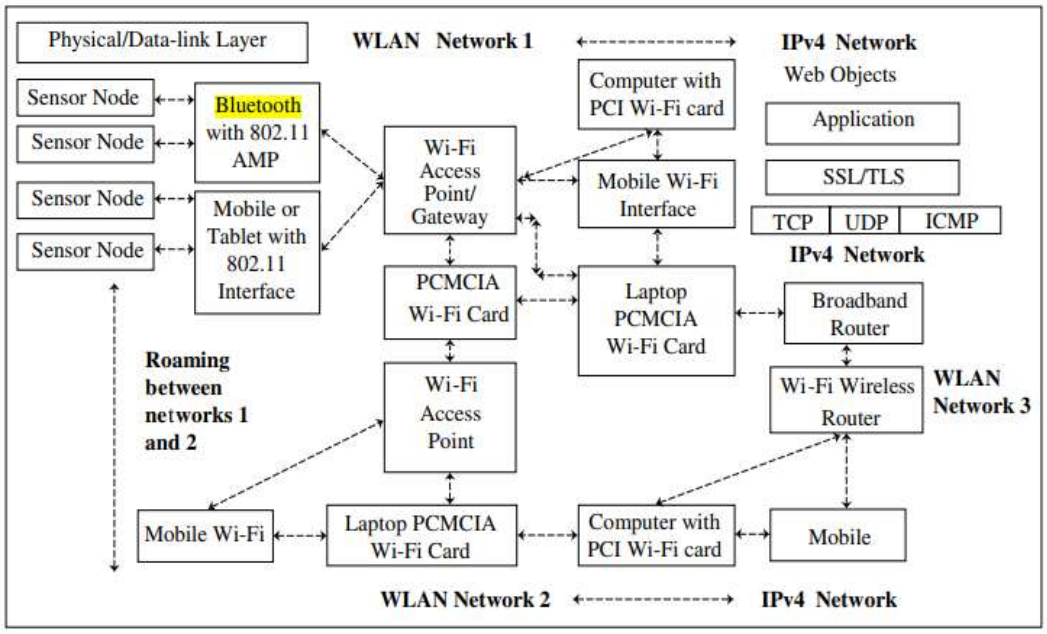

Figure 2.6 Three WLAN networks for sensor device nodes, mobiles, tablets, laptops, computers and Internet connectivity of WLAN networks with the IP4 networks (Dashed lines show wireless connectivity and solid lines show wired connectivity)

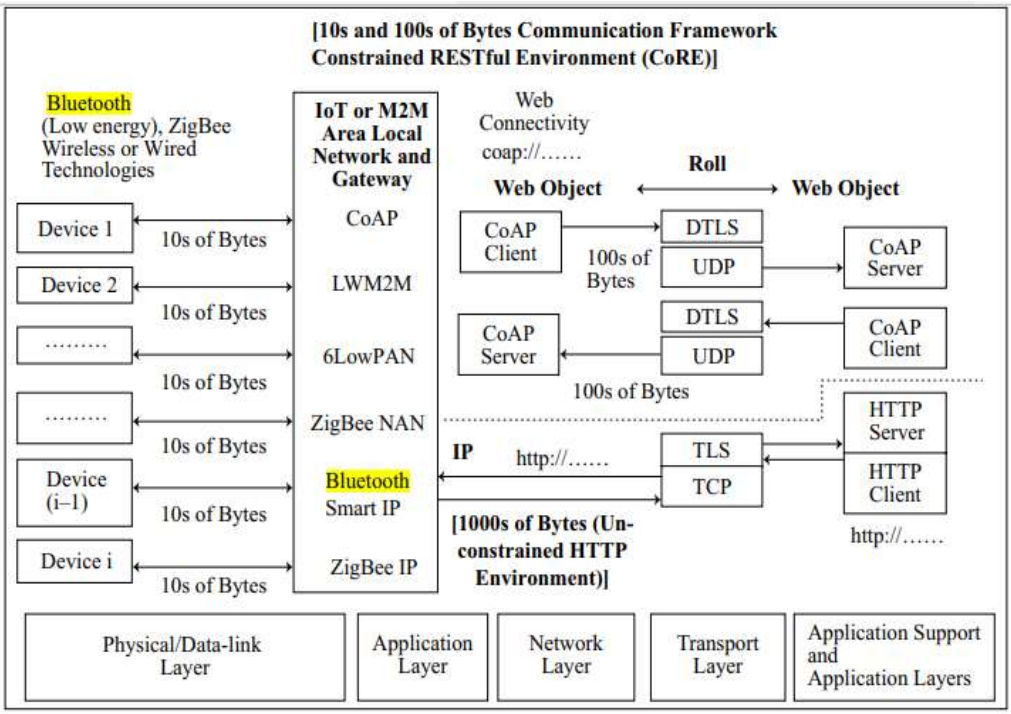

Figure 3.1 IoT or M2M devices local network connectivity and web connectivity in constrained (above thick dotted line) and unconstrained RESTful HTTP (below thick dotted line) environments using communication protocols

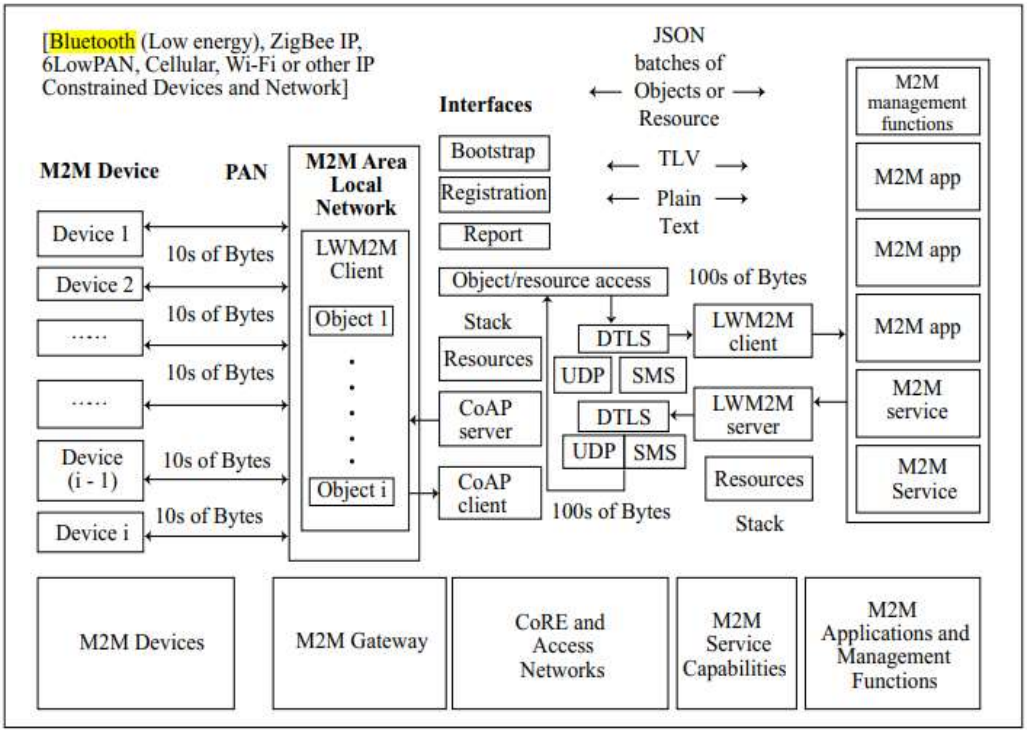

Figure 3.3 M2M devices local area network connectivity, and constrained devices network connectivity with M2M applications and services using LWM2M OMA standard specifications of LWM2M

Table 8.6 Features of mBed boards and starter kit

Board/ Shield	Application	SoC Processor/Clock	Operating/ Input V/ Perating Volate/ USB power pin output	SRAM/ Flash Memory	Analog In/Out/ Digital IOs/ PWM/ IOREF	USB host /UART Rx and Tx /I2C SDA-SCK /SPI /CAN	Ethernet port/W-Fi/ GSM/ ZigBe/RF/ Bluetooth
NXP LPC 1768 mBed	IoT and wearable ARM MCU based devices	Cortex-M3, 96MHz	3.3 V/ 4.9 V to 7 V/ 5 V	8 kB/ 32 kB	6/0/26/6/0	1 / 3 pairs/ 2 / 2 / 1	100 Mbps / 0/0/0/0/0
EA LPC 4088		Cortex-M4/120 MHz		96 kB/ 512 kB	6/0/26/6/0	1 / 3 pairs/ 2 / 2 / 1	100 Mbps / 0 /0/0/0/0
Wi-Fi Dip Cortex		Cortex-M3/72 MHz		12 kB/ 64 B	6/0/26/6/0	1 / 3 pairs/ 2 / 2 / 1	0/1/0/0/0/0
U Blox C027		Cortex-M3/96 MHz8		32 kB/ 512 kB	6/0/26/6/0	1/ 3 pairs/ 2 / 2 / 1	0/0/1/0/0/0
FRDM-K64F mbed IoT kit IBM IoT Foundation	Starter kit with USB/ Ethernet and ArduinoTM R3 compatible I/O s	MK64FN1M0VLL12 Cortex-M4 core/ up to 120 MHz	5V/ 7V–12V	256 kB/ 1 MB	6/0/14/6/1	micro-B USB host-cum-client/1/ 3 pairs/ 2 / 2 / 1	1/0/0/0/0/0
mBed RF module	RF for the kit						0/0/0/0/1/0
mBed BL LE module	Bluetooth for the kit						0/0/0/0/0/1
mBed shield	ZigBee Application						0/0/0/1
mBed shield	Wi-Fi Application						0/1/0/0 (RN-XV)

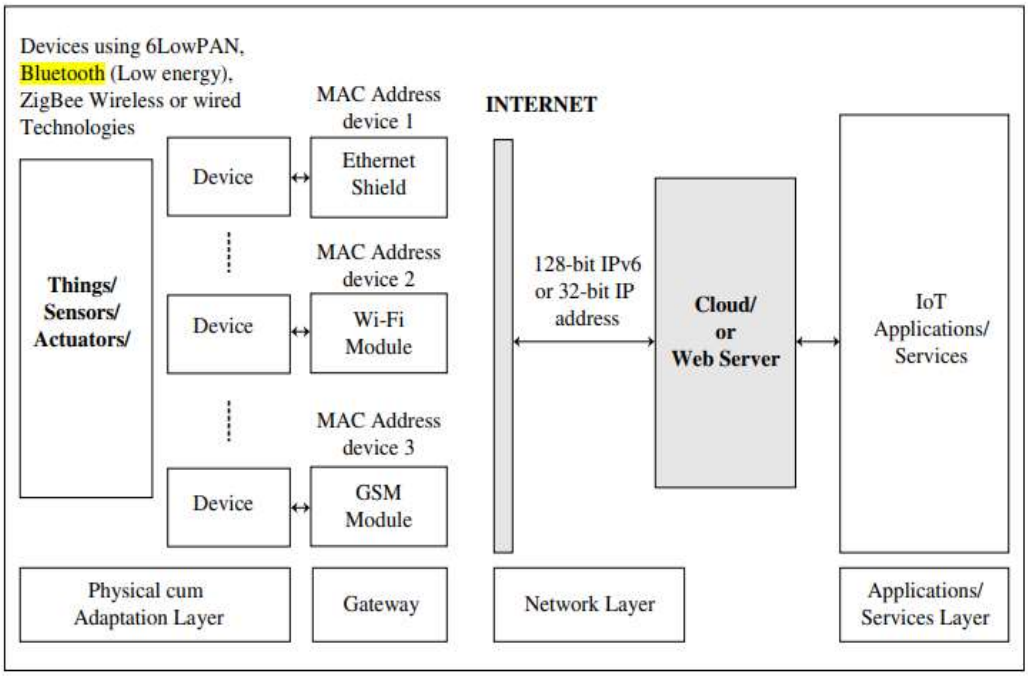

Figure 8.4 'Things', Sensors, actuators, devices and circuit boards connected to Internet and cloud or web-server for applications and services

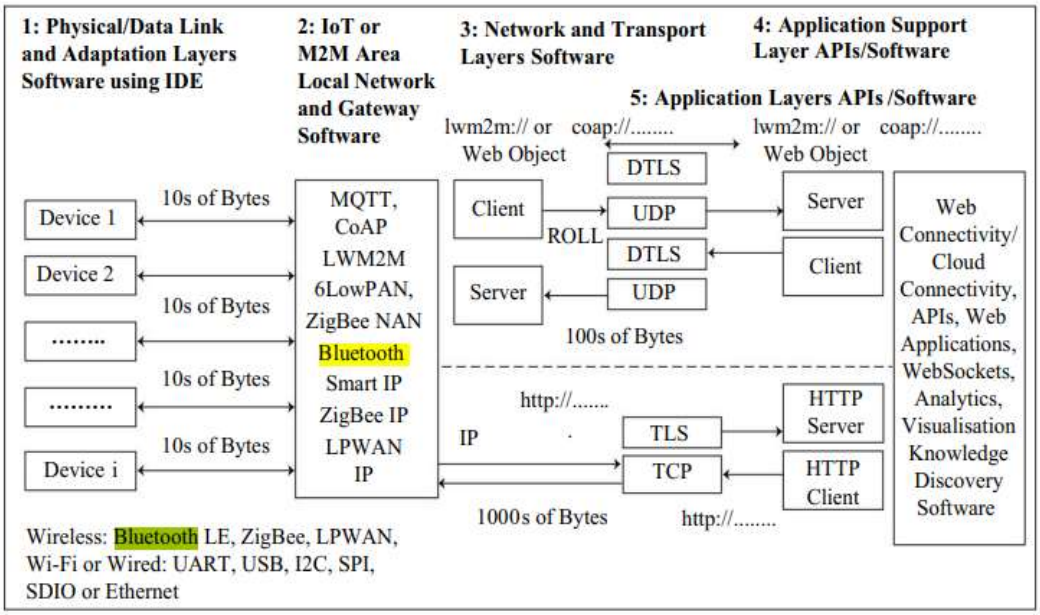

Figure 9.1 Five levels for software development for applications and services for IoT or M2M

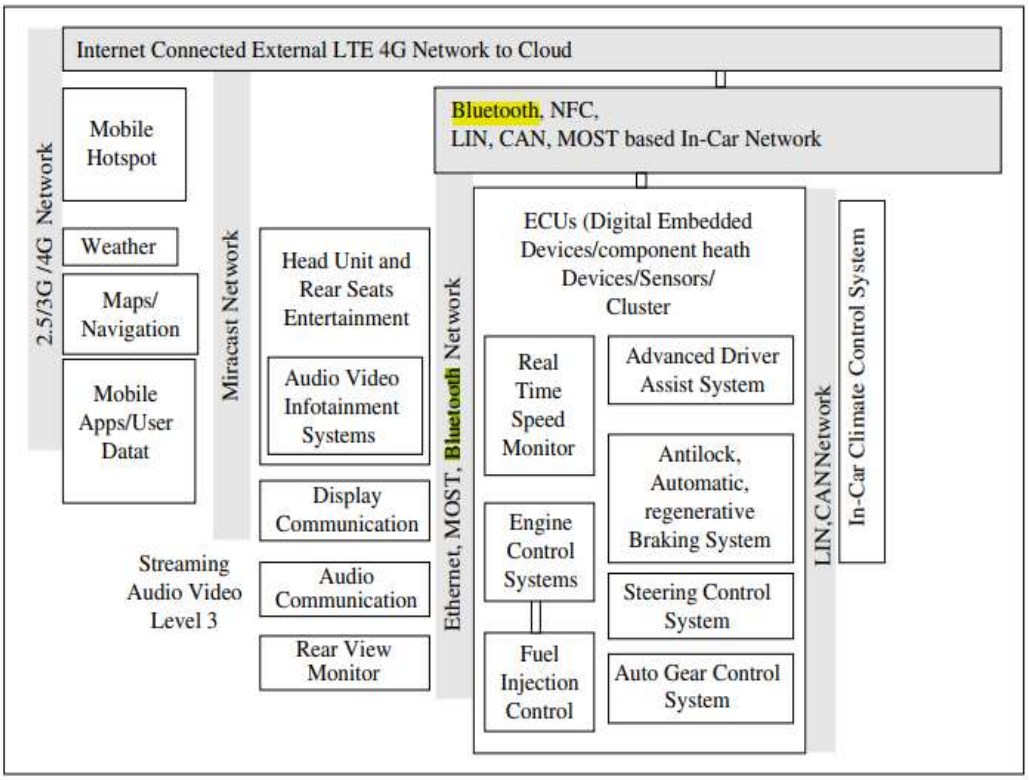

Figure 12.5 Overview of an Internet-connected car