Wireless (NFC, RFID, Bluetooth LE, ZigBee IP, RF) protocols for the Physical-Data Link layer communication technologies
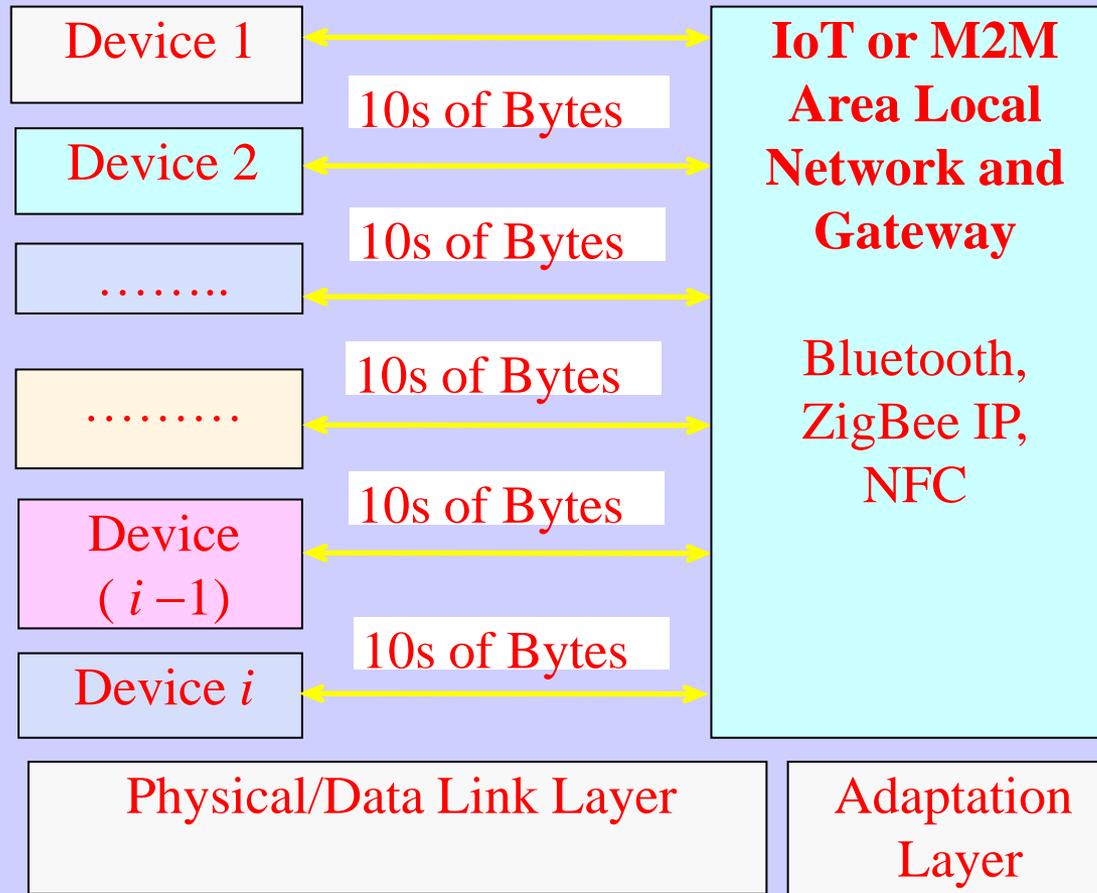
Connected devices communication to the Local Network and Gateway

- 1st to ith Connected devices connect to a Local Network and Gateway

- 10s of bytes communicate between a device and the local devices network

Physical/data-link layer: Local Network and Connectivity

- Protocols RF, Bluetooth Smart Energy, ZigBee IP, ZigBee NAN (neighbourhood area network), NFC, 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks) or Mobile GSM

Bluetooth , ZigBee IP, NFC, RF link (Wireless Technologies), and I^2C, SPI, UART (Wired technologies)

Device 1	←10s of Bytes→	**IoT or M2M Area Local Network and Gateway**
Device 2	←10s of Bytes→	
……..	←10s of Bytes→	Bluetooth, ZigBee IP, NFC
………	←10s of Bytes→	
Device ($i-1$)	←10s of Bytes→	
Device i	←10s of Bytes→	

| Physical/Data Link Layer | Adaptation Layer |

Fig. 2.4 Connectivity of Connected devices 1st to i^{th} and local Network and Gateway

NFC (Near Field Communication) wireless communication technology

- Short distance (10 cm-20 cm) Data exchange between devices

- Examples: proximity card reader/RFID/ IoT/ M2M/Mobile device, mobile payment wallet, Car electronic key, house or office entry key, Biometric passport reader.

NFC Devices

- Transmit and receive data at same instant

- Can generate RF fields for the nearby passive device such as passive RFID

- Check the RF field and detect collision of transmitted signal

- Check collision when the received signal does not match with the transmitted signal

NFC Devices

- NFC device can receive and pass the data to a Bluetooth connection or standardized LAN or Wi-Fi using the information handover functions

- data transfer rates 106 kbps, 212 kbps, 424 kbps and 848 kbps

- Setup time 0.1s

NFC Devices Communication Modes 1 and 2

(i) P2P (point to point) mode [Both devices use the active devices in which RF fields alternately generate when communicating],

(ii) Card-emulation mode

NFC Devices Communication Mode 3

(iii) Reader mode [Device using NFC reads passive RFID device. The RF field is generated by active NFC device. This enables passive device to communicate.]

2. RFID Devices Wireless Communication Technology

RFID wireless communication technology

- RF frequencies recommended by Regulator, [115 kbps data transfer rates using carrier radio frequency signals from 915 MHz and 868 MHz to 315 MHz and 27 MHz]

- Can use NFC protocol based mobile if within 20 cm range.

RFID Devices

- Transmit and receive data at same instant

- Can generate RF fields for the nearby passive device such as passive RFID

- Check the RF field and detect collision of transmitted signal

- Check collision when the received signal does not match with the transmitted signal

RFID Devices IC

- Generally contains integrated circuit and antenna embedded or labeled onto the object

RFID Devices Types 1 and 2

(i)   Passive device (without in-build power source) which gather charges from the received radiation and thus starts functioning,

(ii)   Active (with power source) [can on its own discover nearby node for data interchange]

3. Bluetooth BR/EDR and Bluetooth Low Energy

Bluetooth Protocols

- Bluetooth BR (Basic Rate 1)

- Bluetooth EDR (Enhanced Data Rate 2 Mbps and 3 Mbps)

- Bluetooth Low Energy (BT LE 1Mbps) two types of modes for the devices in the late

Bluetooth Smart

- Bluetooth v4.2. BT LE (**Bluetooth Smart**) two types of modes for the devices in the latest version

BT LE

- BT LE range is 150 m at 10 mW power output, data transfer rate is 1 Mbps and set-up time < 6s

BT Features

- Auto- synchronization between mobile and other devices when both use BT

- BT network uses features of self-discovery, self configuration and self-healing

- Support to NFC pairing for low latency in pairing the BT devices

4. ZigBee IP/ZigBee SE 2.0

ZigBee Protocols for WPAN devices network

- ZigBee IP: an enhancement for the IPv6 connectivity

- ZigBee IP RFD (reduced function device) (functions for the 'sleepy'/ battery-operated device)

- Sleepy means one that wakes up infrequently, sends data then goes back to sleep

ZigBee NAN and Smart Energy 2.0 Protocols

- ZigBee NAN (Neighbourhood Area Network)

- A version for Smart Grid

- ZigBee SE 2.0 energy management and energy efficiency capabilities using the IP network

ZigBee Protocols

- Range is 10 to 200 m data transfer rate 250 kbps, low power operation,

- ISM band frequencies direct sequence spread spectrum 16-channel radio

ZigBee Features

- Self configuring

- Self healing

- Dynamic pairing mesh network

- Support for both multicast and unicast options

ZigBee Features

- Provides link level security using AES-CCM-128 (2.4 GHz ISM band frequency hopping spread spectrum (FHSS in BT BR/EDR)

- Direct sequence spread spectrum (DSSS in LE) 40-channel radio (2400 – 2483.5 MHz)

5. WiFi

WiFi an interface technology based on IEEE 802.11 protocol

- Wireless Local Area Networks (WLANs)

- Three main applications and connectivity through home access Point, public hotspots, enterprises, universities and offices.

- Wi-Fi enables Internet Connectivity of distributed WLAN networks

WiFi Features

- Generally the 2.4 GHz IEEE 802.11b adapter or 5 GHz (802.11a or 802.11g) or 802.11n or other 802.11 series protocols,

- Interfaces use 2.4 GHz or 5 GHz antenna,

WiFi Features

- offers mobility and roaming

- have easy installation simplicity and flexibility,

WiFi Features

- Easy installation simplicity and flexibility,

- Coverage range 30 m to 125 m,

- Limited coverage version 802.11a which coexists with b and g,

- Other versions 802.11b, 802.11g for high data rates up to 54 Mbps, and 802.11n

WiFi Features

- Interoperability with wireless as well as wired infrastructure

- Ensures compatibility and enables easier access and hide complexity when enabling the wireless access to data, media and streams, applications and services

6. RF Transceivers and RF Modules

RF Modules

- Number of systems uses the RF modules

- Applications needing wireless connectivity

- Examples: security, telemetry, telematics, fleet management, home.

Simple RF circuits

- Transmitters, receivers, and transceivers

- An oscillator generates RF pulses of required active duty cycle and connects to a transmitter

IoT/M2M Applications

- Deploy ISM band RF modules with transceivers or just transmitter or receiver

7. GSM, GPRS, UMTS/ LTE and WiMax

GSM, GPRS, UMTS/ LTE and WiMax

- Mobile phones provisions for the USB wired port, BT and Wi-Fi devices

- Wireless Internet connectivity using GSM, GPRS, UMTS/ LTE and WiMax services of Mobile service provider and Wi-Fi using PCMCIA card

8. Wireless USB

Wireless USB

- Wireless extension of USB 2.0 and it operate at UWB (ultra wide band) 5.1 GHZ to 10.6 GHz frequencies. It is for short-range personal area network (high speed 480 Mbps 3 meter or 110 Mbps 10 meter channel).

Wireless USB Features

- A host wire adapter (HWA) and a device wire adapter (DWA) wireless USB solution

- Supports the dual-role devices (DRDs). A device can be a USB device as well as limited capability host.

Summary

We learnt

- Wireless protoocls

- NFC, RFID, Bluetooth, ZigBee, WiFI, RF Modules, GSM and other mobile protocols

- Wireless USB

End of Lesson 2
on
Wireless (NFC, RFID, Bluetooth LE, ZigBee IP, RF) protocols for the Physical-Data Link layer communication technologies