

Communications Technology

IT3779 Smart Object Technologies

Outline

- Communications and Smart Objects
- Types of Wireless Communication Technologies
- Short range Wireless Technology options

Communications and Smart Objects

- ❑ With evolution of technology, physical objects are turning into smart objects which is capable of being
 - Uniquely identified
 - Accessed anywhere through a global network
 - Controlled without physically accessing them
- ❑ This contributes to the emergence of Smart Objects of Internet of Things (IoT).
http://en.wikipedia.org/wiki/Internet_of_Things

Types of Wireless Communication Technologies

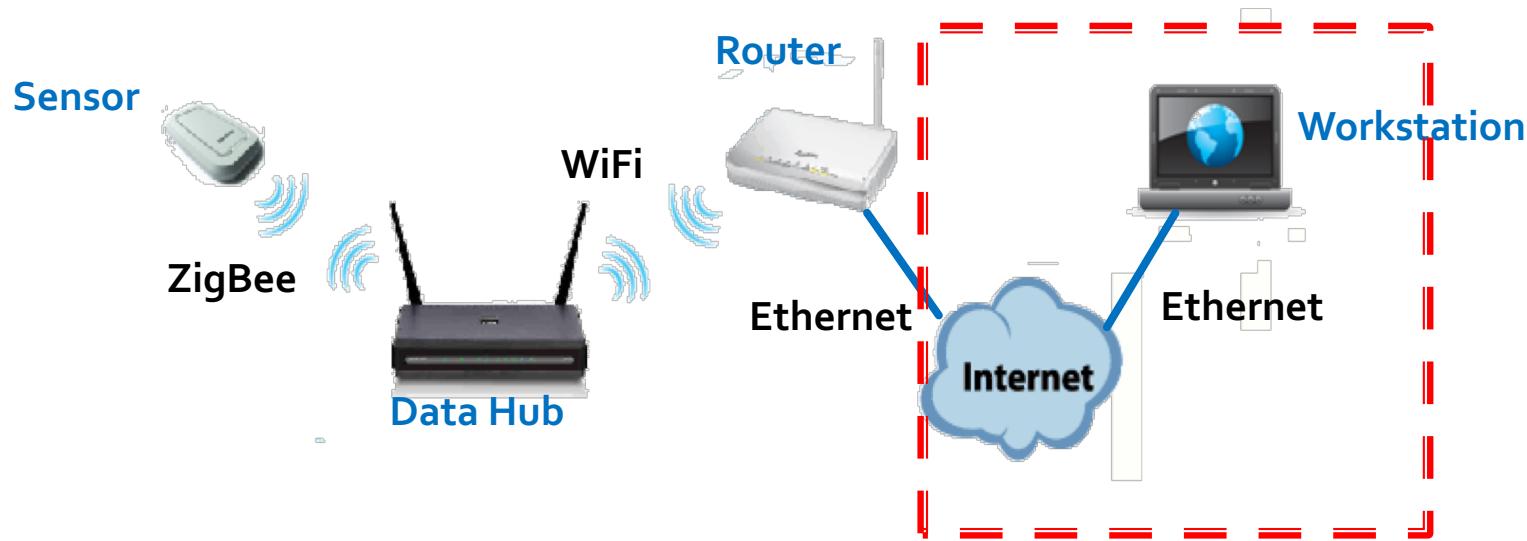
- Wireless Communication Technology describes how devices in a networking environment will interact with each other through wireless transmission.
- Different technology differs with one another in terms of
 - Power requirement
 - Transmission protocols
 - Transmission frequency
 - Transmission speed (data rate)
 - Transmission distance

Types of Wireless Communication Technologies

- The following were some examples of different types of Wireless Communication technology
 - Wi-Fi
 - Bluetooth
 - ZigBee
 - Near Field Communication (NFC)
 - GSM (Global System for Mobile communication)

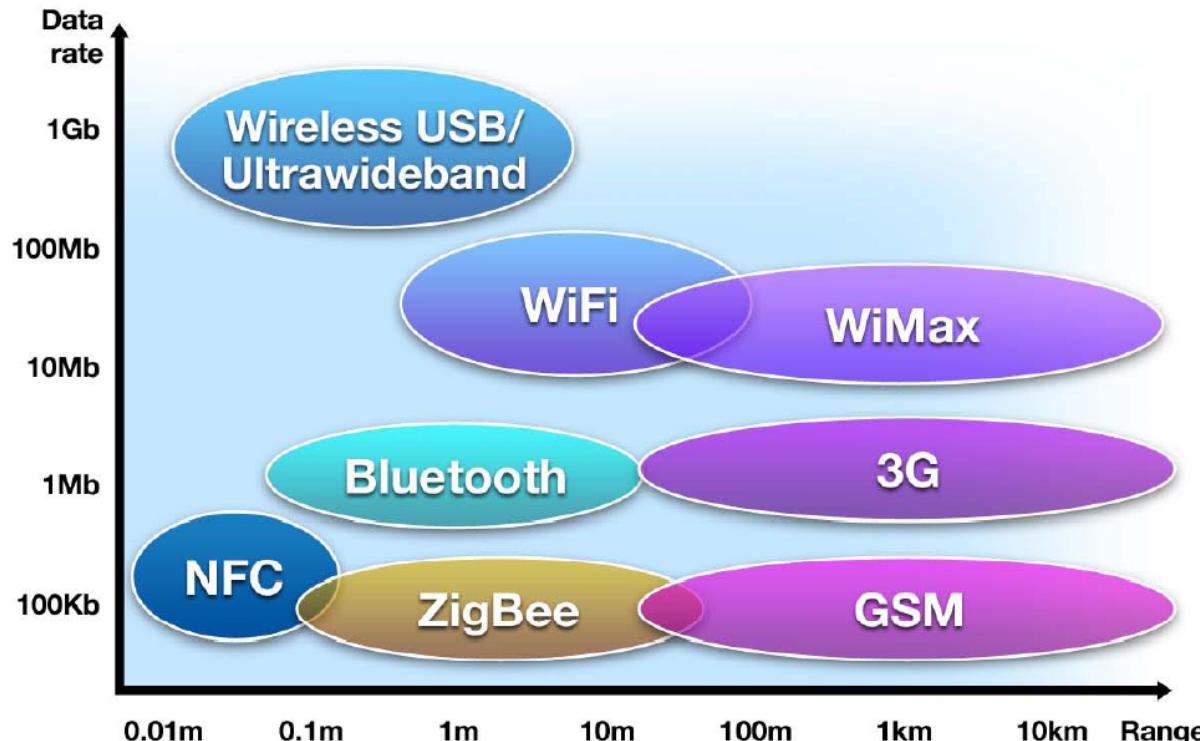
Types of Wireless Communication Technologies

- ❑ Various communication technologies may be used together to transfer data from one place to another



Types of Wireless Communication Technologies

- A graph that depicts the distance against data rate of various Wireless Communication Technologies



Types of Wireless Communication Technologies

- For smart objects, selection of Wireless Communication Technologies is based on following considerations:
 - Low power : Power should last months if not years
 - Sufficient transmission distance : distance should be sufficient to cover a wide range
 - Typical low data rate : Data from smart objects do not consume large amount of data
- We shall be looking at the following technologies in more detail
 - WiFi
 - Bluetooth
 - ZigBee

Wi-Fi



□ General

- Wi-Fi is a mechanism that allows electronic devices to exchange data over a wirelessly computer network like a Wireless Local Area Network (WLAN)
- Based on IEEE 802.11 Standards, which specifies an over-the-air interface between wireless computers
- Interoperability certification is governed by Wi-Fi Alliance



Wi-Fi

- The IEEE 802.11 WLAN standard defines how Radio Frequencies in the unlicensed ISM frequency bands is used for the physical layer and the MAC sublayer of wireless links
- Various implementation of the IEEE 802.11 standard have been developed over the years

| Standard | Maximum Speed | Frequency | Backwards Compatible |
|----------|---------------|---------------------------|----------------------|
| 802.11a | 54 Mbps | 5 GHz | No |
| 802.11b | 11 Mbps | 2.4 GHz | No |
| 802.11g | 54 Mbps | 2.4 GHz | 802.11b |
| 802.11n | 600 Mbps | 2.4 GHz or 5 GHz | 802.11b/g |
| 802.11ac | 1.3 Gbps | 2.4 GHz and 5 GHz | 802.11b/g/n |
| 802.11ad | 7 Gbps | 2.4 GHz, 5 GHz and 60 GHz | 802.11b/g/n/ac |

Wi-Fi



□ Key Features:

- High data rates
- Typical distance coverage of up to 100m
- High power consumption – battery need to be recharged every few days
- Cost
 - Present in most computers nowadays
 - Not usually bought in bulk
 - Moderate cost



Bluetooth



□ General

- A wireless technology standard for short distances communication creating wireless personal area networks (WPANs) with high levels of security
- Designed for communications between portable and peripheral devices (e.g. mouse, keyboard, headsets etc.)
- Is based on IEEE 802.15.1 Standards, specification for wireless connectivity with fixed, portable and moving devices



Bluetooth



□ General

- Interoperability certification is governed by Bluetooth Special Interest Group (SIG)



□ Key Features:

- Medium Data rates 1 M to 3 M bps
- Typical range of 10m
- Complex protocols which is designed for many different data types: Audio, Text, Raw data
- Medium power – battery may need to be recharged within a week
- Cost
 - Not usually bought in bulk
 - Low cost

Zigbee



□ General

- A wireless technology specification for transmission protocols using small, low-power digital radios creating personal area networks (PANs)
- Used in short-range wireless data transfer for consumer and industrial systems (home automation, environmental monitoring etc.)
- Is based on IEEE 802.15.4 Standards, specification for wireless connectivity with low-rate wireless personal area networks (LR-WPANs)
- Interoperability certification governed by ZigBee Alliance



Zigbee



□ Key Features:

- Low data rates **20 – 250 kbps**
- Typical range of 75m
- Power
 - Low Power : battery can typically last for years
 - Nodes can sleep most of the time
- Cost
 - Intended for small embedded devices
 - Support for production in large scale
 - Low cost



Summary of Short range Wireless Technology options for Smart Objects

| Consideration | Wi-Fi | Bluetooth | ZigBee |
|---------------|----------------|------------|---------------|
| Power | Moderate | Low | Very Low |
| Distance | 100 m | 10 m | 75 m |
| Cost | Moderate | Low | Low |
| Data Rate | 11Mbps – 7Gbps | 1 – 3 Mbps | 20 – 250 kbps |

Summary of Short range Wireless Technology options for Smart Objects

| Consideration | Wi-Fi | Bluetooth | ZigBee  |
|---------------|---|--|---|
| Power | |  |   |
| Distance |   | |  |
| Cost | |  |  |
| Data Rate |   |   |  |

Application Case Study #1

John is designing a Video Monitoring system within a building with the following requirements.

- Real time (24hr) video monitoring with wireless signal transmission
- Maximum transmission point distance about 80 m
- About 10 wireless nodes are required



Which wireless communication technology should be used ? State the reasons for your choice.

Application Case Study #2

Joanne is designing a home entertainment system within a room (about 8m x 8m x 8m) with following requirements.

- Wireless control controller for gaming and TV channel
- Wireless headset for listening to sounds and music
- Wireless mike for singing
- Do not need line of sight for transmission

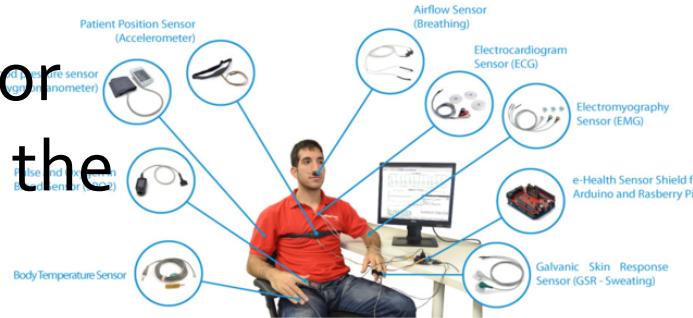


Which wireless communication technology should be used? Why?

Application Case Study #3

Joo Kian is designing a wireless sensor network for healthcare industry with the following requirements.

- Monitoring sensors may include heart rate, temperature and Blood pressure mounted on patient's body
- Measurement data for multiple patients may be transmitted in proximity within 50 m at same collation point
- Sensor data may be collated approximately hourly



Which wireless communication technology should be used? Why?

End