SNS COLLEGE OF ENGINEERING

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Department of Information Technology

Course Name – 19IT503 Internet of Things

III Year / V Semester

Unit 3 – EVOLVING IoT STANDARDS & PROTOCOLS

Topic 7 - RF4CE, Bluetooth

Radio Frequency for Consumer Electronics (RF4CE)

- RF4CE protocol has been designed for simple, two-way device-to-device control applications that do not require the full-featured mesh networking capabilities offered by ZigBee 2007.

- ZigBee RF4CE offers lower memory size requirements, thereby enabling lower cost implementations

- RF4CE is based on ZigBee and was standardized in 2009 by four consumer electronics (CE) companies:
  - Sony,
  - Philips,
  - Panasonic, and
  - Samsung.

Radio Frequency for Consumer Electronics (RF4CE)

- The ZigBee RF4CE specification defines an RC network that defines a simple, robust, and low-cost communication network allowing wireless connectivity in applications for CE devices.

- The ZigBee RF4CE specification enhances the IEEE 802.15.4 standard by providing a simple networking layer and standard application layer that can be used to create a multivendor interoperable solution for use within the home.

- RF4CE's intended use is as a device RC system, for example for television settop boxes.

- The intention is that it overcomes the common problems associated with infrared (IR): interoperability, line-of-sight (LOS), and limited enhanced features.

- At least two-chip vendors supported RF4CE as of press time: Texas Instruments and Freescale Semiconductor, Inc.

Radio Frequency for Consumer Electronics (RF4CE)

Characteristics of ZigBee RF4CE include the following

- Operation in the 2.4 GHz frequency band according to IEEE 802.15.4;
- Frequency agile solution operating over three channels;
- Incorporates power-saving mechanisms for all device classes;
- Discovery mechanism with full application confirmation;
- Pairing mechanism with full application confirmation;
- Multiple star topology with inter-PAN communication;
- Various transmission options including broadcast;
- Security key generation mechanism;
- Utilizes the industry standard AES-128 security scheme;
- Specifies a simple RC control profile for CE products;
- Support alliance-developed standards or manufacturer-specific profiles.

Bluetooth

- Bluetooth and its Low-Energy Profile
- Bluetooth is a WPAN technology based on IEEE 802.15.1.

- It is a specification for short-range wireless connectivity for portable personal devices, including computer peripherals.

- Bluetooth was initially developed by Ericsson; in the late 1990s, the Bluetooth Special Interest Group (SIG) made their specifications publicly available.

- Soon thereafter, the IEEE 802.15 Group took the Bluetooth work and developed a vendor-independent standard.

Versions
- Bluetooth 1.0 and 1.0B, Bluetooth 1.1 6.3, Bluetooth 1.2
- Bluetooth 2.0 + EDR, Bluetooth 2.1 + EDR
- Bluetooth 3.0 + HS
- Bluetooth 4.0, Bluetooth 4.1, Bluetooth 4.2
- Bluetooth 5,Bluetooth 5.1, Bluetooth 5.2

Bluetooth

Applications
- Phones
- Laptop
- Tablets
- PDA
- Keyboard
- Mouse
- Printer / Scanner
- Music System
- Headsets
- Smart watch
- Fitness devices
- Medical devices

Bluetooth

Characteristics

	BLUETOOTH V2.1	BLUETOOTH 4.0 (LE)	BLUETOOTH 5 (LE)
Range	Up to 100 m	Up to 100 m	Up to 400 m
Max range (free field)	Around 100 m (class 2 outdoors)	Around 100 m (outdoors)	Around 1,000m (outdoors)
Frequency	2.402 – 2.481 GHz	2.402 – 2.481 GHz	2.402 - 2.481 GHz
Max data rate	1- 3 Mbit/s	1 Mbit/s	2 Mbit/s
Application Troughput	0.7-2.1 Mbit/s	Up to 305 kbit/s	Up to 1,360 kbit/s
Topologies	Point-to-point, scatternet	Point-to-point, mesh network	Point-to-point, mesh network
Network Standard	IEEE 802.15.1	IEEE 802.15.1	IEEE 802.15.1

Bluetooth radios use a spread spectrum, frequency-hopping, full-duplex signal.
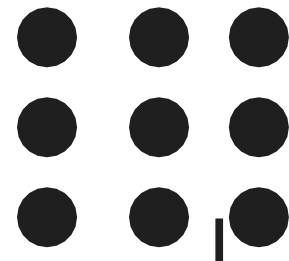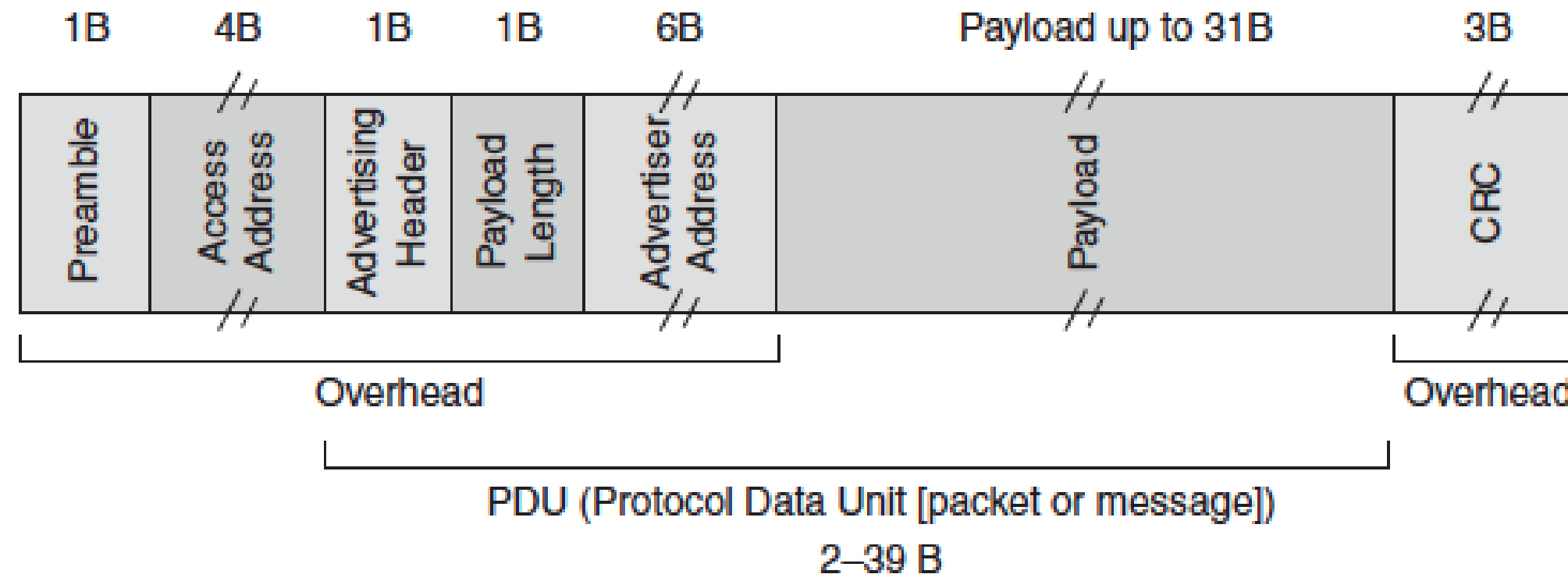
Bluetooth
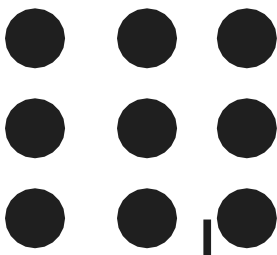
Sublayers
- RF layer: The air interface is based on antenna power range starting from 0 dBm up to 20 dBm, 2.4 GHz band, and the link range from 0.1 to 10 m.

- Baseband layer: The baseband layer establishes the Bluetooth piconet. The piconet is formed when two Bluetooth devices connect. In a piconet, one device acts as the master and the other devices act as slaves. Two or more piconets connected all together is called as scatternet.

- Link manager: The link manager establishes the link between Bluetooth devices. Additional functions include security, negotiation of Baseband packet sizes, power mode and duty cycle control of the Bluetooth device, and the connection states of a Bluetooth device in a piconet.

- L2CAP: This sublayer provides the upper-layer protocols with connectionless and connection-oriented services. The services provided by this layer include protocol multiplexing capability, segmentation and reassembly of packets, and group abstractions.

BLE

- BLE (originally known as WiBree and/or Bluetooth ultra low power [ULP]) is a low-power subset to Bluetooth v4.0, with an entirely new protocol stack for rapid build-up of simple links.

- BLE is an alternative to the "power management" features that were introduced in Bluetooth v1.0 to v3.0 as part of the standard Bluetooth protocols.

- BLE is aimed at very low-power applications running off a coin cells

- The aim of the BLE technology is to enable power-sensitive devices to be permanently connected to the Internet.

- It uses star topology

Bluetooth HDP
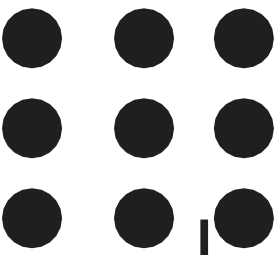
Bluetooth Health Device Profile
* Under Bluetooth, a profile defines the characteristics and features including function of a Bluetooth system.

* The HDP is used for connecting application data source devices such as blood pressure monitors, weight scales, glucose meters, thermometers, and pulse oximeters to application data sink devices such as mobile phones, laptops, desktop computers, and health appliances without the need for cables.

* This profile can be combined with BLE to make sure that medical devices can be in the operational conditions for many months and even years.

* HDP devices act as sinks and/or sources. A source is the small device that will act as the transmitter of the medical data (weight scale, glucose meter, thermometer, etc.).

* The sink is the feature-rich device that will act as the receiver of the medical data (mobile phone, desktop computer, health appliances, etc.).
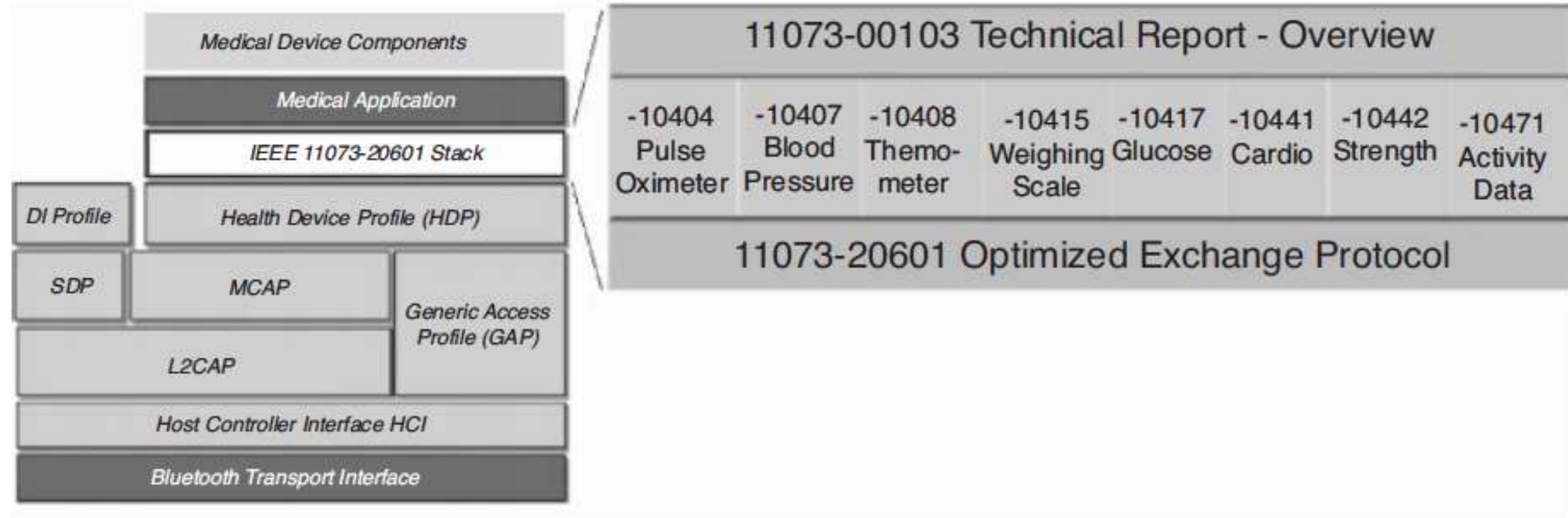
FIGURE 6.10 Bluetooth protocol and a HDP in a medical device application.

THANK YOU