WIRELESS LAN, MOBILE INTERNET CONNECTIVITY, AND PERSONAL AREA NETWORK

Lesson 08

Bluetooth Protocol Layers

1

Bluetooth protocol IEEE 802.15.1 specifications

- A Bluetooth device has number of protocols that can be used at the application, presentation, session, transport, network, data link, and physical layers (layers 7-1)
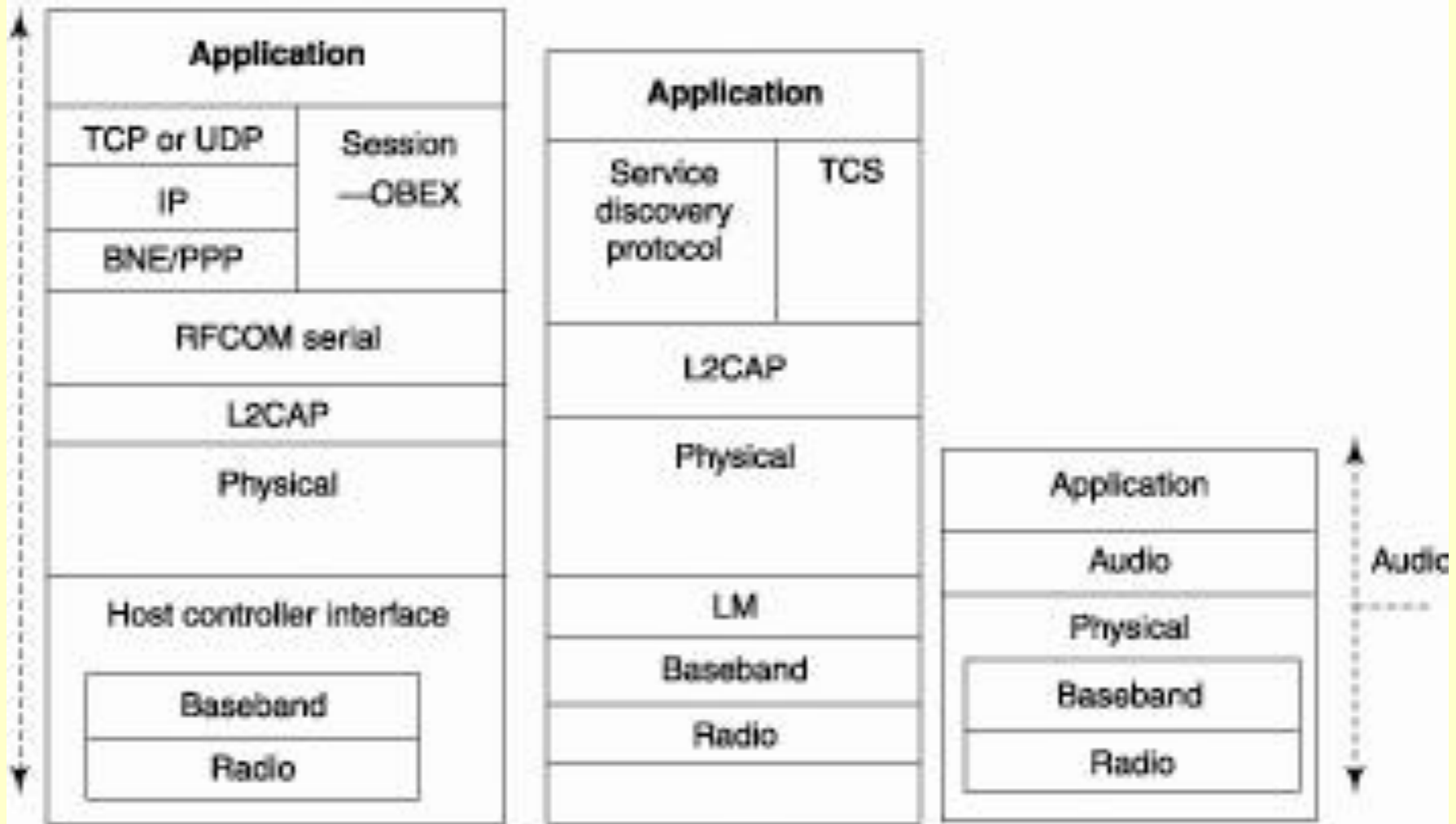
2

Protocols at the Application Layer

- vCard

- vCal

- Telephonic network protocol

- Device management protocol

- SyncML, SyncML Client, SyncML Engine

3

Functions of Protocol Layers

Application
- vCard, vCal-telephonic
- Network
- Device management, SyncML client, engine
- Modem commands to RFCOMM serial

TCSP
- Telephony control specification protocol

BNEP
- Bluetooth network encapsulation protocol

Baseband
- Fast FHSS algorithm
- Establishment of connection
- Packets formation
- Timing control for synchronization
- Basic QoS maintenance

L2CAP
(logical link control and adaptation protocol)
- Multiplexing data of higher layer protocols.
- Segmentation and reassembly of packets.
- Transmission management to a group of devices.
- Communication over the host ACL
- QoS management

Host protocol layers and other protocol layers between the object client, device and server

5

PHYSICAL LAYER

- Responsible for transmitting header fields encapsulating the payload and payload

- Payload─ means data to be transmitted after passing through the layers 7 to 2 and retrieved at other end after passing through layers 2 to 7

Bluetooth device physical layer has three sub-layers

- Link manager or host controller interface─ sub-layer responsible for interfacing with the upper layers

- Baseband─ another sub-layer generates the baseband signal used for transmission

- Radio ─ Another generates the radio signals as per the data bits from or for the MAC (layer 2)

7

RADIO

- Transmits packets received from baseband sub-layer

- At the other end of the link, it receives

- Operate at the least required power levels so that the transactions may not be detected by a distant receiver of signals, thus maintaining confidentiality

8

RADIO

- Frequency hopping CDMA ensures negligible interference and least risk of jamming by distant sources

9

Radio Sub-layer Characteristics

- Frequency band─ 2.4 GHz

- Maximum power levels for devices ─   1, 2, or 3 corresponding to 100 mW, 2.5 mW, or 1 mW

10

Radio Sub-layer Characteristics

- Bluetooth radio ─ FHSS with each carrier separated by 1 MHz, 1600 frequency hops per second among 79 carriers, and frequency changing after every 1/1600 s or 625 μs

- Transceiver modulation─ GFSK

11

Radio Sub-layer Characteristics

- Data transfer rates ─ 1 Mbps or less

- Range ─ 10 m in a piconet and 100 m in a scatternet

- Baseband─ uses a fast frequency hopping algorithm and after 625 μs, the frequency of a channel changes according to a code which defines the sequence in which the carrier frequency has to change

12

Baseband Two types of links two between Bluetooth devices

- ACL (asynchronous connectionless link)
- SCO (synchronous connection oriented) link
- ACL link provides best effort traffic
- SCO links provide real-time voice traffic using reserved bandwidth

13

Baseband Packet

- Of about 350 bytes and has a payload of 2744 bits or 343 bytes, b0-b2743

- It has 68 bits access code plus 4 bit trailer to access code (or alternatively 72-bit channel access code) at the beginning

- It is followed by a 54 bit packet header

- Packet deploys FEC for correcting the transmission errors [refer Section 12.5.1.2]

Link Manager

- Baseband and radio provide a link between master and slave

- The functions of the link manager─

(i) supervision

(ii) monitoring of power, synchronization, state, and mode of transmission,

15

Link Manager

(iii) exchange of QoS parameters (for example, packet flow latency, peak data rate, average data rate, and maximum burst size) for L2CAP and higher layers and capability information exchange

(iv) handling device pairing

(v) handling data encryption and device authentication

- Table 12.3 for details [Refer section 12.5.1.3]

16

Bluetooth host-controller interface (HCI)

- Manages the link between the upper layer and baseband and radio sub-layers of the physical layer

- It is hardware abstraction layer in place of link manager

Bluetooth host-controller interface (HCI)

- Host controller interface (HCI) interfaces RF communication serial [3 wire UART (universal asynchronous receiver and transmitter) which is an RS232 emulation in RF communication] line and mode through L2CAP software layer

18

MAC LAYER

- Data link control carried out using L2CAP

- L2CAP─ to provide logical link control and provide an adaptation mechanism using Bluetooth

- Passes the segmented or reassembled packets directly to the link manager or HCI in case of host-controller-based system

A LOGICAL-LINK ADAPTAION-REQUEST

- Received from upper layers at client device

- Then multiplexed and segmented as per available maximum transferable units (MTUs) at the baseband

- After this, the logical link adaptaion confirmation sent to higher protocol layers

20

A LOGICAL-LINK ADAPTAION-REQUEST

- Then a link program request is sent to lower layer HCI or LM

- The link program protocol confirmation is then received back at L2CAP layer

21

L2CAP

- Facilitates segmentation of packets while transmitting and reassembling of packets on reception

- Multiplexes the data between different higher layer protocols and manages forward transmission from a Bluetooth device to other devices

22

L2CAP

- Does QoS management for higher layer data

- [A program file needs error free transfer. A picture being transferred can contain errors but still look good. It means ensuring the expected level of service.]

- Provides connection-establishment-based communication after a host ACL is established

23

L2CAP THREE LOGICAL CHANNELS

(i) signalling messages between L2CAP at transmiiter and receiver devices

(ii) bi-directional connection-oriented with support for QoS parameters from higher layers, and

(iii) unidirectional connectionless broadcast from master to slave

Summary

- Bluetooth device number of protocols that can be used at the application, presentation, session, transport, network, data link, and physical layers (layers 7-1)
- Physical layer three sublayers: radio, baseband and Link manager or HCI
- MAC layer L2CAP
- Three logical channels

25

End of Lesson 08

Bluetooth Protocol Layers