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**THAPAR INSTITUTE**
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(Deemed to be University)

# Course: Computer and Communication Networks

## Topic: Bluetooth

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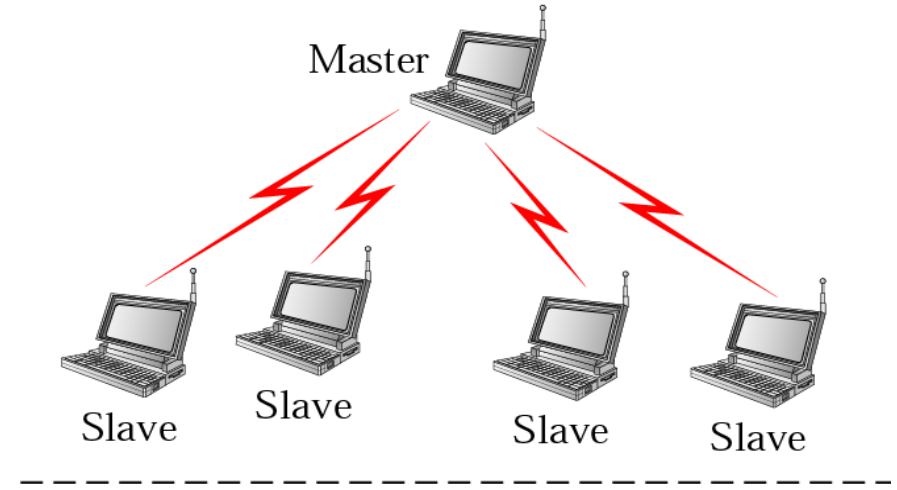
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# *OUTLINE*

- Overview of Bluetooth.
- Architecture
- Bluetooth Communication
- Features

# *Overview of Bluetooth*

- The **inventor** and engineer from the Netherlands worked in the mobile phone division of LM Ericsson Telephone throughout the mid-1990s.

- Bluetooth was named after a Danish king, King Harald Blatand

- It uses short-wavelength UHF radio waves in an ISM band that ranges from 2.4 to 2.485 GHz.

- Bluetooth is a way to send or receive data and allows a device to wirelessly exchange data with other Bluetooth devices.

- Bluetooth is a wireless LAN technology designed to connect devices of different functions.

- A Bluetooth LAN is an ad hoc network.

- Peripheral devices such as a wireless Mouse or keyboard can communicate with the computer through this technology.

- Low power consumption of Bluetooth technology and an offered range of up to ten meters has paved the way for several usage models.
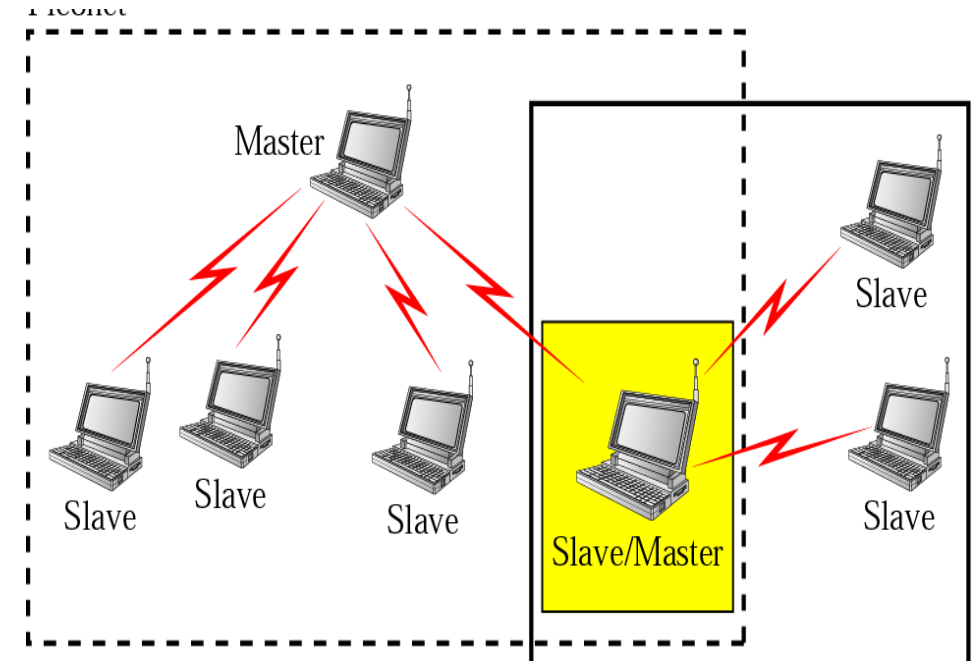
Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

# Architecture

- ## Piconets

- Bluetooth enabled electronic devices connect and communicate wirelessly through shortrange devices known as **Piconets.**

- A Piconet can contain up to seven slaves clustered around a single master.

- All the secondary stations synchronize their clocks and hopping with primary.

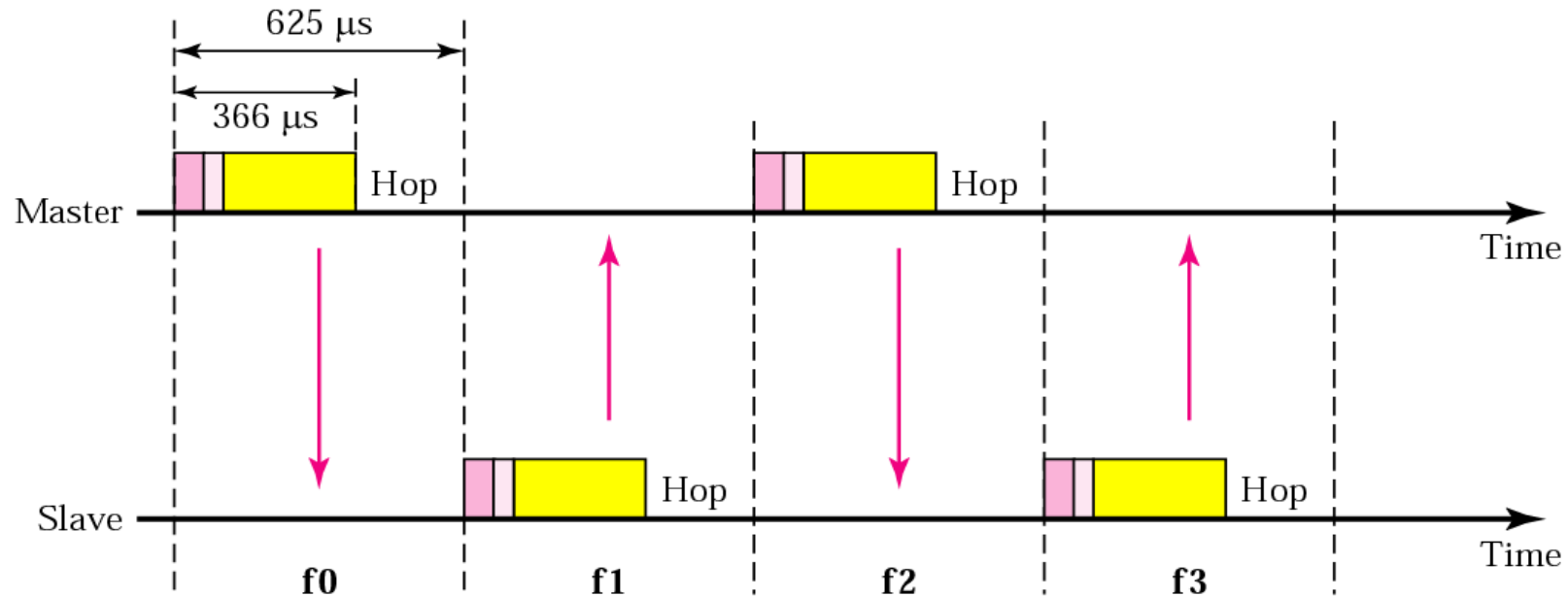- Communication may be one to one or one to many and no direct connection between slaves.



Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

- ## Scatternet:

- Devices resident in adjacent piconets provide a bridge to support inner-piconet connections, allowing assemblies of linked piconets to form a physically extensible communication infrastructure known as **Scatternet**.

- In other words, Piconets can be combined to form Scatternet

- A secondary in one piconet can be primary in another piconet.

- Station can receive the messge as secondary from one piconet and deliver as primary in another piconet.
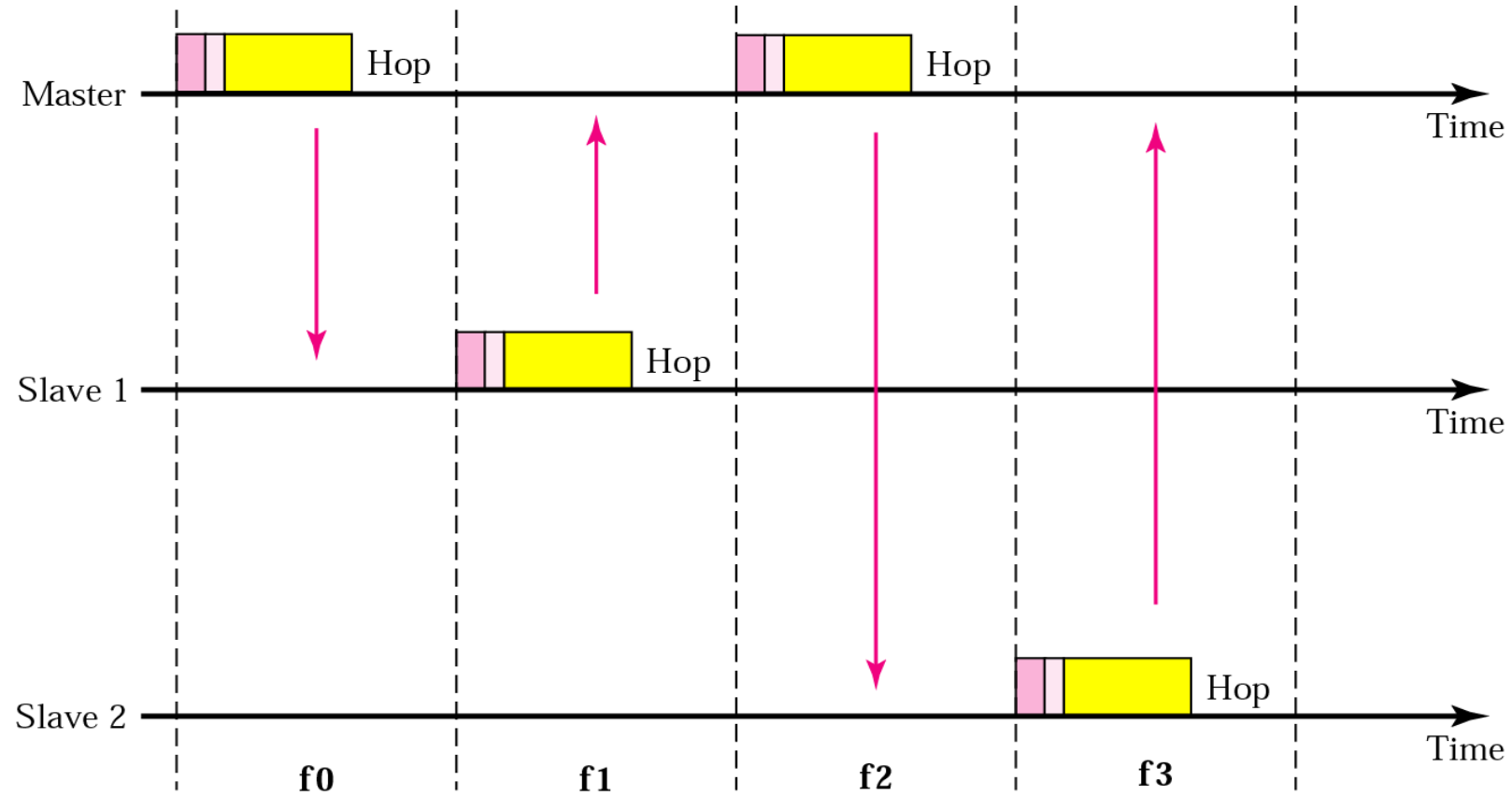
- A station can be a member of 2 piconets.

# Bluetooth Communication

- Single slave

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication
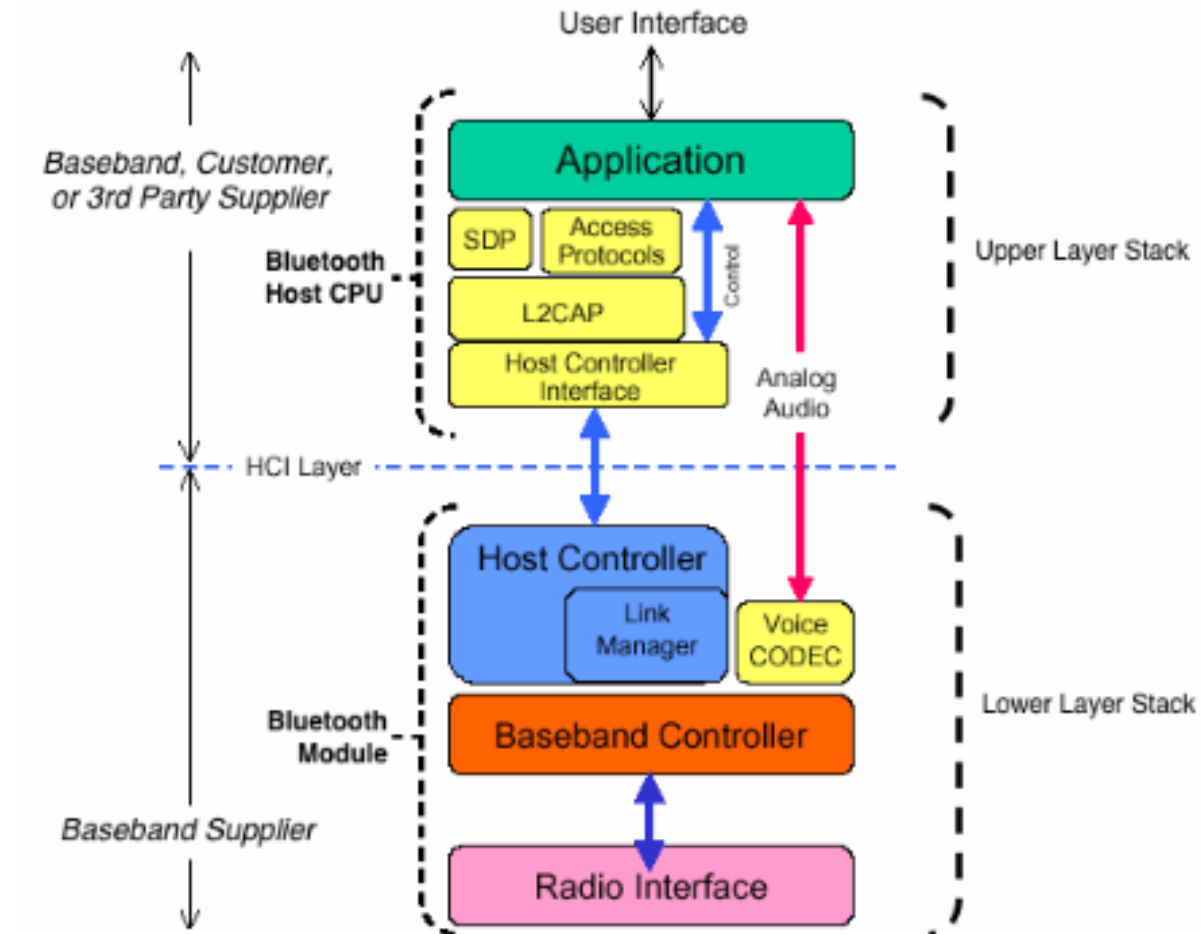
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# • Multiple slaves

# *Features*

- There is no direct connection between the slaves and all the connections are essentially master-to-slave or slave-to-master.

- Slaves are allowed to transmit once these have been polled by the master.

- Transmission starts in the slave-to-master time slot immediately following a polling packet from the master.

- A device can be a member of two or more piconets, jumping from one piconet to another by adjusting the transmission regime-timing and frequency hopping sequence dictated by the master device of the second piconet.

- It can be a slave in one piconet and master in another. It however cannot be a master in more than once piconet.
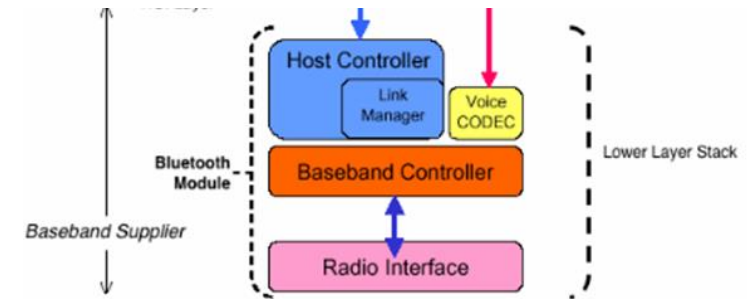
- Spectrum  Bluetooth technology operates in the unlicensed industrial, scientific and medical (ISM) band at 2.4 to 2.485 GHZ, using a spread spectrum hopping, full-duplex signal at a nominal rate of 1600 hops/sec. the 2.4 GHZ ISM band is available and unlicensed in most countries.

- Range  Bluetooth operating range depends on the device Class 3 radios have a range of up to 1 meter or 3 feet Class 2 radios are most commonly found in mobile devices have a range of 10 meters or 30 feet Class 1 radios are used primarily in industrial use cases have a range of 100 meters or 300 feet.

- Data rate  Bluetooth supports 1Mbps data rate for version 1.2 and 3Mbps data rate for Version 2.0 combined with Error Data Rate.

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

# Bluetooth Layers



Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication
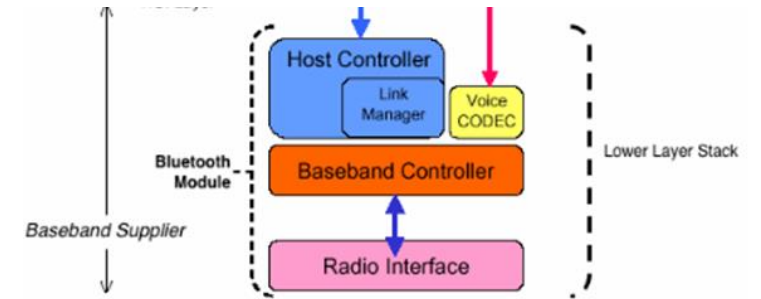
# *Lower Layer Stack*



The lower layers are the *basic core specifications* that describe how Bluetooth works.

- **Radio layer**,
- ✓ responsible for modulation/demodulation of data for transmitting **or** receiving especially it uses a version of FSK called GFSK
- ✓ It splits the transmission band into 79 channels and performs fast frequency hopping (1600 hops/sec) for security.
- ✓ The radio layer moves data from master to slave or vice versa.
- ✓ It is a low power system that uses 2.4 GHz ISM band in a range of 10 meters.

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

- **baseband** and **link controller/link manager protocol (LMP)**.

✓Baseband layer is equivalent to the MAC sublayer in LANs.

✓Bluetooth uses a form of TDMA called TDD-TDMA (time division duplex TDMA).

✓Master and slave stations communicate with each other using time slots.

✓The master in each piconet defines the time slot of 625 µsec.

✓ two types of links can be created between a master and slave.

✓If piconet has more than one slave, the master uses even numbered slots. The slave sends in the next odd-numbered slot if the packet in the previous slot was addressed to it.
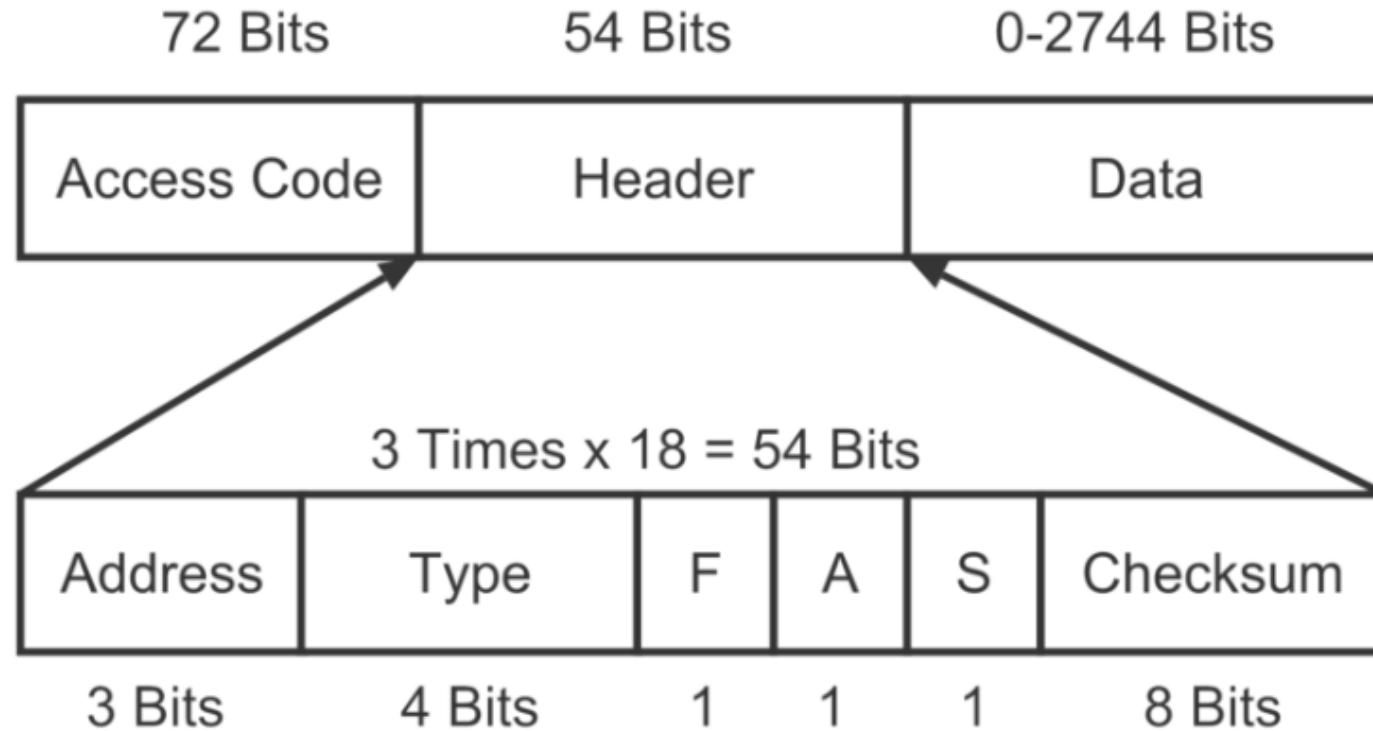
Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

- ***link manager controller***

✓ The *link manager controller* translates the host controller interface (HCI) commands from the upper stack, and establishes and maintains the link. It is responsible for managing the connection, enforcing fairness among slaves in the piconet, and provides for power management.

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

# *Upper Stack Layers*

- **host controller interface** (**HCI**) serves as the interface between the software part of the system and the hardware (i.e., the device driver).

- **L2CAP** (logical link control and adaptation protocol) lays a central role in communication between the upper and lower layers of the Bluetooth stack.

- **service discovery protocol** (**SDP**) is important to mention because it exists independently of other higher-level protocol layers.

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication

# Bluetooth Frame Format



Bluetooth Frame Format

Reference: 1. Ferouzan, Behrouz A., Data Communications and Networking, 2. Stallings William, Data and Computer Communication