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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Wireless Personal Area Networks (WPAN)-Bluetooth

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WPAN- IEEE DEFINITION

Wireless personal area networks (WPANs) are used to convey information over short distances among a private, intimate group of participant devices.

Unlike a wireless local area network (WLAN), a connection made through a WPAN involves little or no infrastructure or direct connectivity to the world outside the link. This allows small, power-efficient, inexpensive solutions to be implemented for a wide range of devices.

WPAN

1. Bluetooth
2. Zigbee
3. Ultra Wide Band (UWB)

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BLUETOOTH

- A **cable-replacement** technology that can be used to connect almost any device to any other device

- Radio interface enabling electronic devices to communicate wirelessly via short range (10 meters) ad-hoc radio connections

- a standard for a **small , cheap radio chip to be plugged into computers, printers, mobile phones, etc**

PRODUCTS

- Notebook PCs & desktop computers
- Printers
- PDAs
- Other handheld devices
- Cell phones
- Wireless periperals:
  - Headsets
  - Cameras
- Access Points

- CD Player
- TV/VCR/DVD
- Telephone Answering Devices
- Cordless Phones
- Cars

What is Bluetooth

- Uses the radio range of 2.45 GHz
- Theoretical maximum bandwidth is 1 Mb/s
- Several Bluetooth devices can form an ad hoc network called a "piconet"
  - In a piconet one device acts as a master (sets frequency hopping behavior) and the others as slaves
  - Example: A conference room with many laptops wishing to communicate with each other

History

- Harald Bluetooth : 10th century Danish King, managed to unite Denmark and Norway

- Bluetooth SIG (Special Interest Group) :
  - Founded in 1998 by : Ericsson, Intel, IBM, Toshiba and Nokia
  - Currently more than 2500 adopter companies
  - Created in order to promote, shape an define the specification and position Bluetooth in the market place : Bluetooth 2.1

Bluetooth Architecture

- Piconet
  - Each piconet has one master and up to 7 simultaneous slaves
    - **Master** : device that initiates a data exchange.
    - **Slave** : device that responds to the master
- Scatternet
  - Linking of multiple piconets through the master or slave devices
  - Bluetooth devices have point-to-multipoint capability to engage in Scatternet communication.
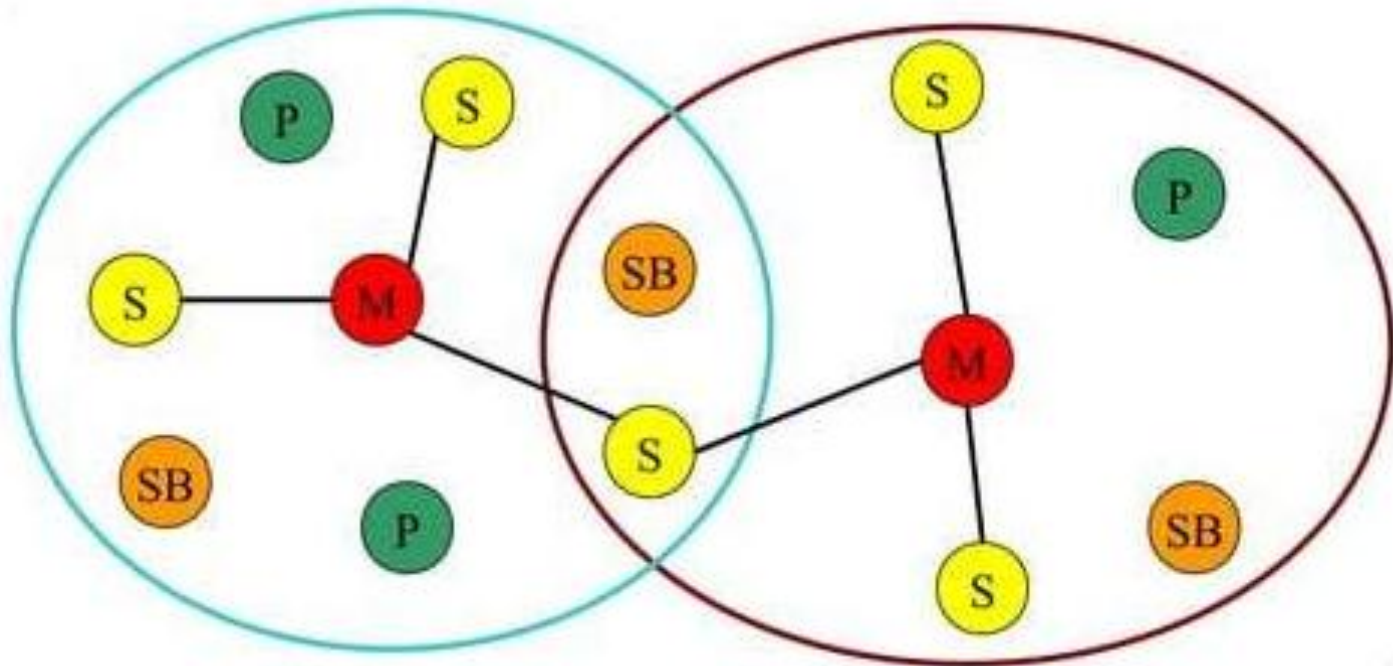
Piconet

- All devices in a piconet hop together
  - Master gives slaves its clock and device ID
- Non-piconet devices are in standby
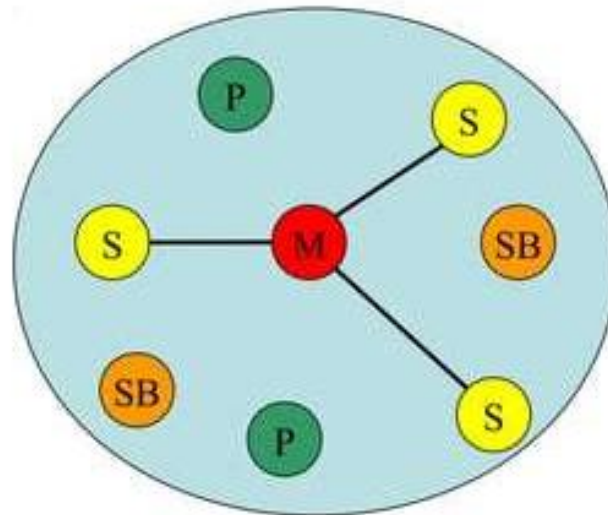
M=Master   P=Parked
S=Slave   SB=Standby

Scatternet

- Devices can be slave in one piconet and master of another

Physical Links

- Between master and slave(s), different types of links can be established. Two link types have been defined:
  - Synchronous Connection-Oriented (SCO) link
 - Asynchronous Connection-Less (ACL) link

Physical Links

- Synchronous Connection Oriented (SCO)
  - Support symmetrical, circuit-switched, point-to-point connections
  - Typically used for voice traffic.
  - Data rate is 64 kbit/s.
- Asynchronous Connection-Less (ACL)
  - Support symmetrical and asymmetrical, packet-switched, point-to-multipoint connections.
  - Typically used for data transmission .
  - Up to 433.9 kbit/s in symmetric or 723.2/57.6 kbit/s in asymmetric

Bluetooth Protocol Stack

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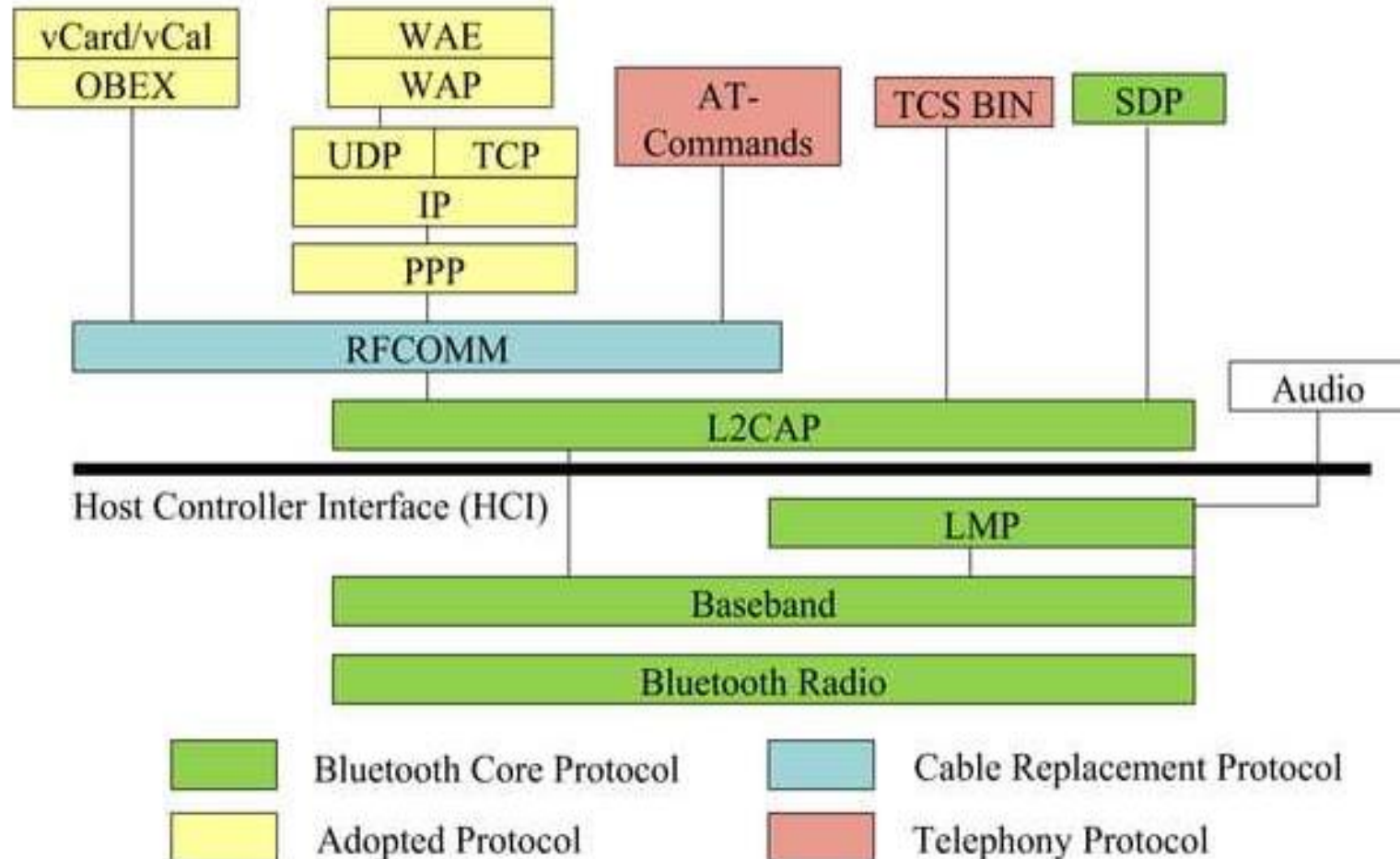
Bluetooth Protocol Stack

- **Bluetooth Radio** : specifics details of the air interface, including frequency, frequency hopping, modulation scheme, and transmission power.

- **Baseband**: concerned with connection establishment within a piconet, addressing, packet format, timing and power control.

- **Link manager protocol (LMP)**: establishes the link setup between Bluetooth devices and manages ongoing links, including security aspects (e.g. authentication and encryption), and control and negotiation of baseband packet size

Bluetooth Protocol Stack

- **Logical link control and adaptation protocol (L2CAP):** adapts upper layer protocols to the baseband layer. Provides both connectionless and connection-oriented services.

- **Service discovery protocol (SDP):** handles device information, services, and queries for service characteristics between two or more Bluetooth devices.

- **Host Controller Interface (HCI):** provides an interface method for accessing the Bluetooth hardware capabilities. It contains a command interface, which acts between the Baseband controller and link manager

Bluetooth Protocol Stack

- **TCS BIN (Telephony Control Service)**: bit-oriented protocol that defines the call control signaling for the establishment of voice and data calls between Bluetooth devices.

- **OBEX(OBject EXchange)** : Session-layer protocol for the exchange of objects, providing a model for object and operation representation

- **RFCOMM**: a reliable transport protocol, which provides emulation of RS232 serial ports over the L2CAP protocol

- **WAE/WAP**: Bluetooth incorporates the wireless application environment and the wireless application protocol into its architecture.

Connection Establishment States

- **Standby**
  - State in which Bluetooth device is inactive, radio not switched on, enable low power operation.

- **Page**
  - Master enters page state and starts transmitting paging messages to Slave using earlier gained access code and timing information.

- **Page Scan**
  - Device periodically enters page state to allow paging devices to establish connections.
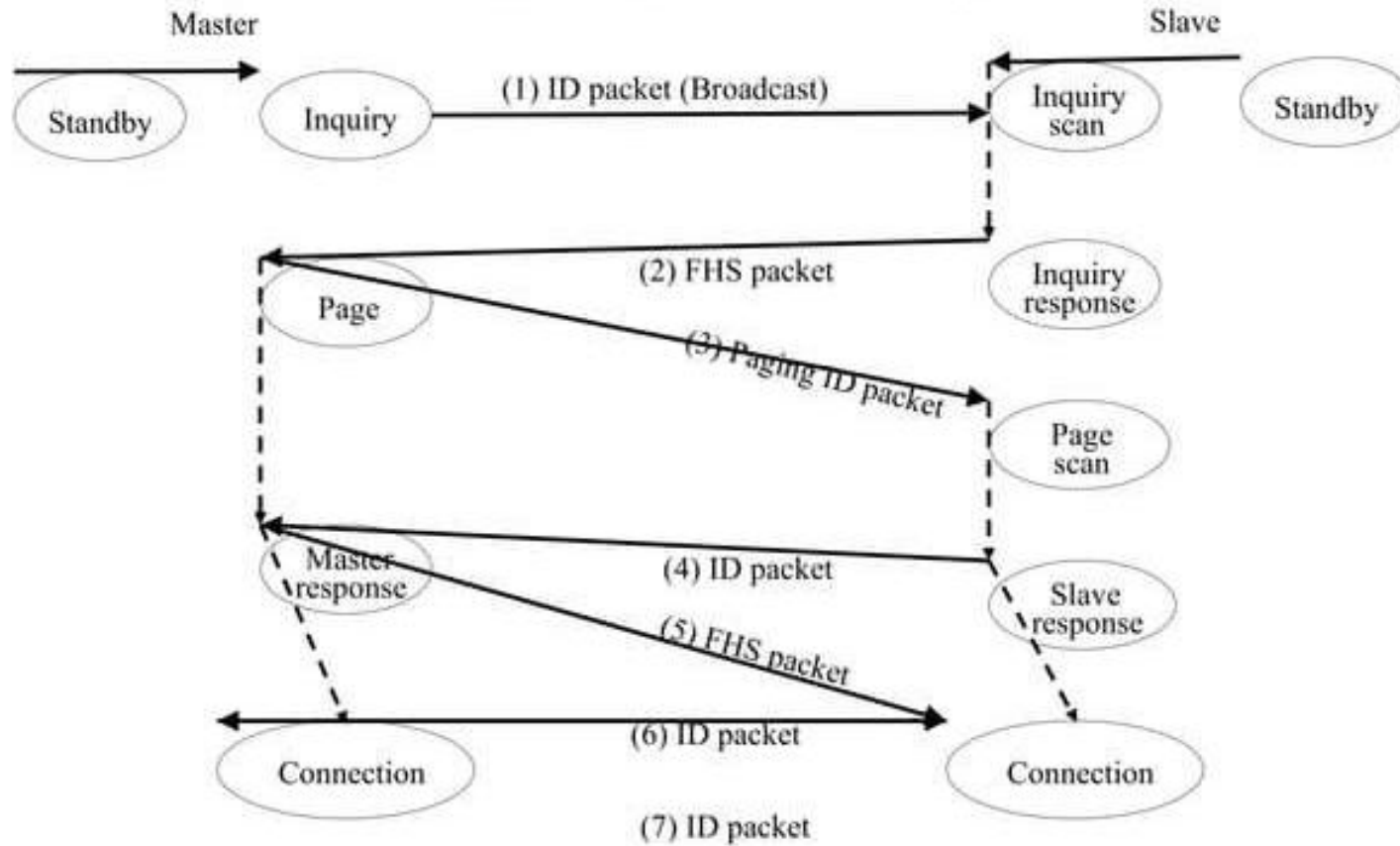
Connection Establishment States

- **Inquiry**
  - State in which device tries to discover all Bluetooth enabled devices in the close vicinity.

- **Inquiry scan**
  - Most devices periodically enter the inquiry scan state to make themselves available to inquiring devices.

Inquiry and Page

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Bluetooth Security

- The following are the three basic security services specified in the Bluetooth standard:

  - **Authentication**
    - verifying the identity of communicating devices. User authentication is not provided natively by Bluetooth.

  - **Confidentiality**
    - preventing information compromise caused by eavesdropping by ensuring that only authorized devices can access and view data.

  - **Authorization**
    - allowing the control of resources by ensuring that a device is authorized to use a service before permitting it to do so.