Bluetooth

Introduction

- ✓ Bluetooth wireless technology is a short range communications technology.
- ✓ Intended for replacing cables connecting portable units
- ✓ Maintains high levels of security.
- ✓ Bluetooth technology is based on **Ad-hoc technology** also known as **Ad-hoc Piconets.**

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

Features

- ✓ Bluetooth technology operates in the unlicensed industrial, scientific and medical (ISM) band at 2.4 to 2.485 GHZ.
- ✓ Uses spread spectrum hopping, full-duplex signal at a nominal rate of 1600 hops/sec.
- ✓ Bluetooth supports 1Mbps data rate for version 1.2 and 3Mbps data rate for Version 2.0 combined with Error Data Rate.

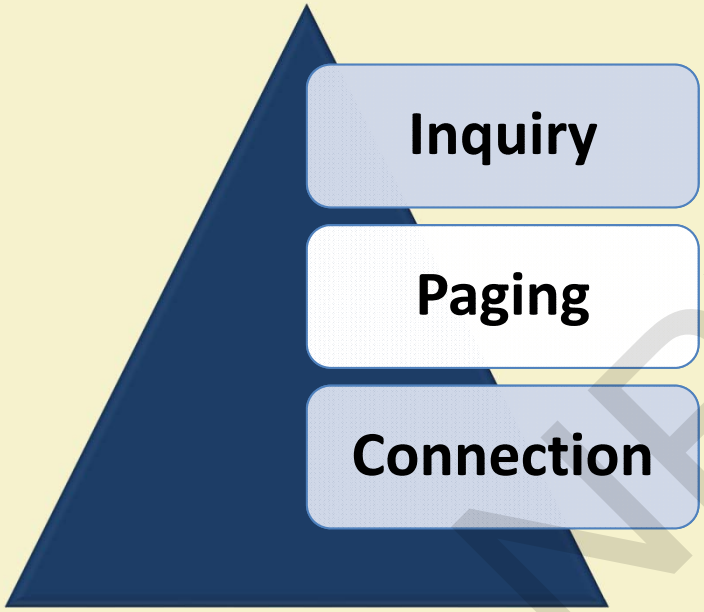
Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

Features

- ✓ 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.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

Connection Establishment



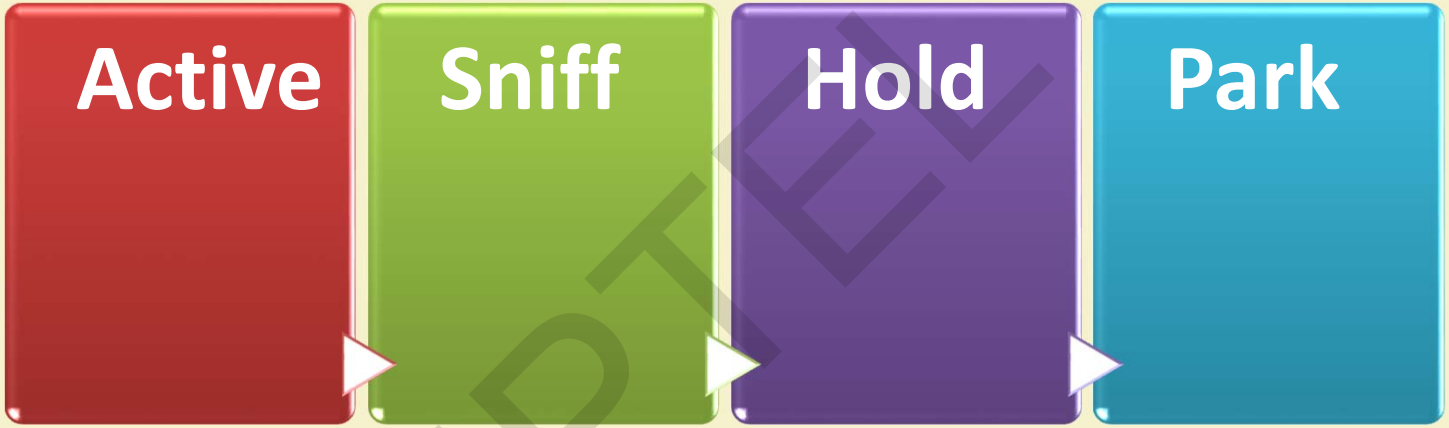
Inquiry run by one Bluetooth device to try to **discover other devices near it.**

Process of **forming a connection** between two Bluetooth devices.

A device either actively **participates** in the network or enters a low-power sleep mode.

Source: "Bluetooth Basics", Tutorials, Sparkfun.com (Online)

Modes



Actively transmitting or receiving data.

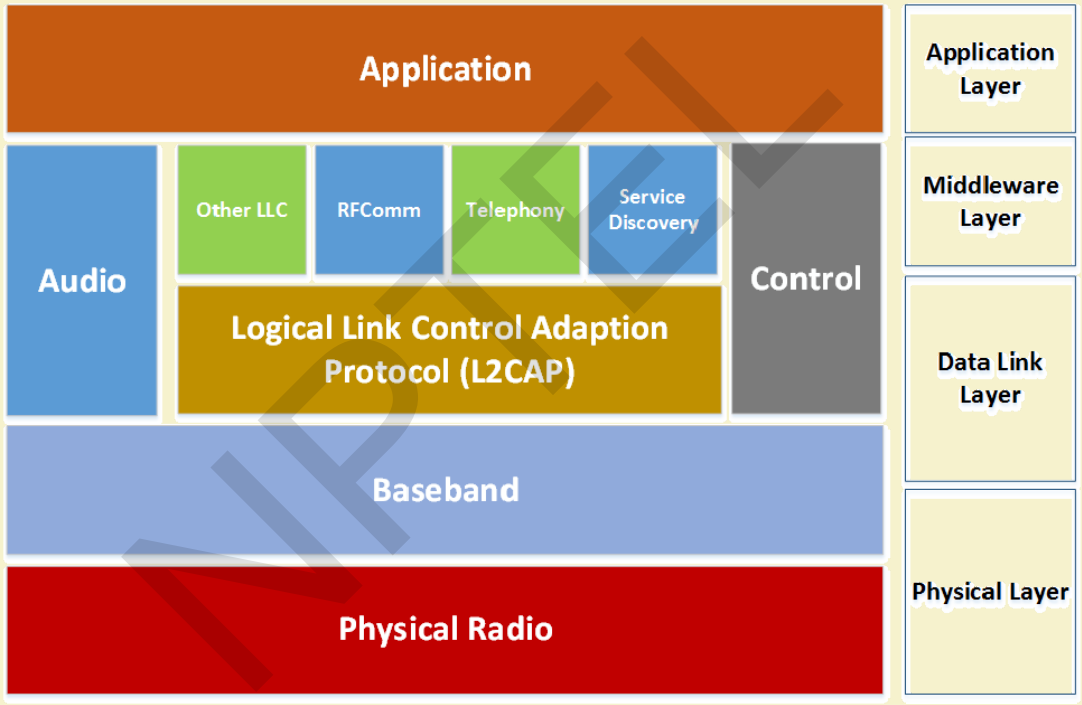
Sleeps and only listens for transmissions at a set interval .

Power-saving mode where a device sleeps for a defined period and then returns back to active mode .

Slave will become inactive until the master tells it to wake back up.

Source: "Bluetooth Basics", Tutorials, Sparkfun.com (Online)

Protocol Stack



Baseband

- ✓ Physical layer of the Bluetooth.
- ✓ Manages physical channels and links.
- ✓ Other services include:
  - Error correction
  - Data whitening
  - Hop selection
  - Bluetooth security
- ✓ Manages asynchronous and synchronous links.
- ✓ Handles packets, paging and inquiry.

Source: "Bluetooth", Wikipedia (Online)

L2CAP

- ✓ The Logical Link Control and Adaptation Protocol (L2CAP).
- ✓ Layered over the Baseband Protocol and resides in the data link layer.
- ✓ Used to multiplex multiple logical connections between two devices.
- ✓ Provides connection-oriented and connectionless data services to upper layer protocols.
- ✓ Provides:
  - Protocol multiplexing capability
  - Segmentation and reassembly operation
  - Group abstractions

Source: "Bluetooth", Wikipedia (Online)

RFComm

- ✓ Radio Frequency Communications (RFCOMM).
- ✓ It is a cable replacement protocol used for generating a virtual serial data stream.
- ✓ RFCOMM provides for binary data transport .
- ✓ Emulates EIA-232 (formerly RS-232) control signals over the Bluetooth baseband layer, i.e. it is a serial port emulation.
- ✓ RFCOMM provides a simple reliable data stream to the user, similar to TCP.
- ✓ Supports up to 60 simultaneous connections between two BT devices.

Source: "Bluetooth", Wikipedia (Online)

Service Discovery Protocol (SDP)

- ✓ Enables applications to discover available services and their features.
- ✓ Addresses the unique characteristics of the Bluetooth environment such as, dynamic changes in the quality of services in RF proximity of devices in motion.
- ✓ Can function over a reliable packet transfer protocol.
- ✓ Uses a request/response model.

Source: "Bluetooth", Wikipedia (Online)

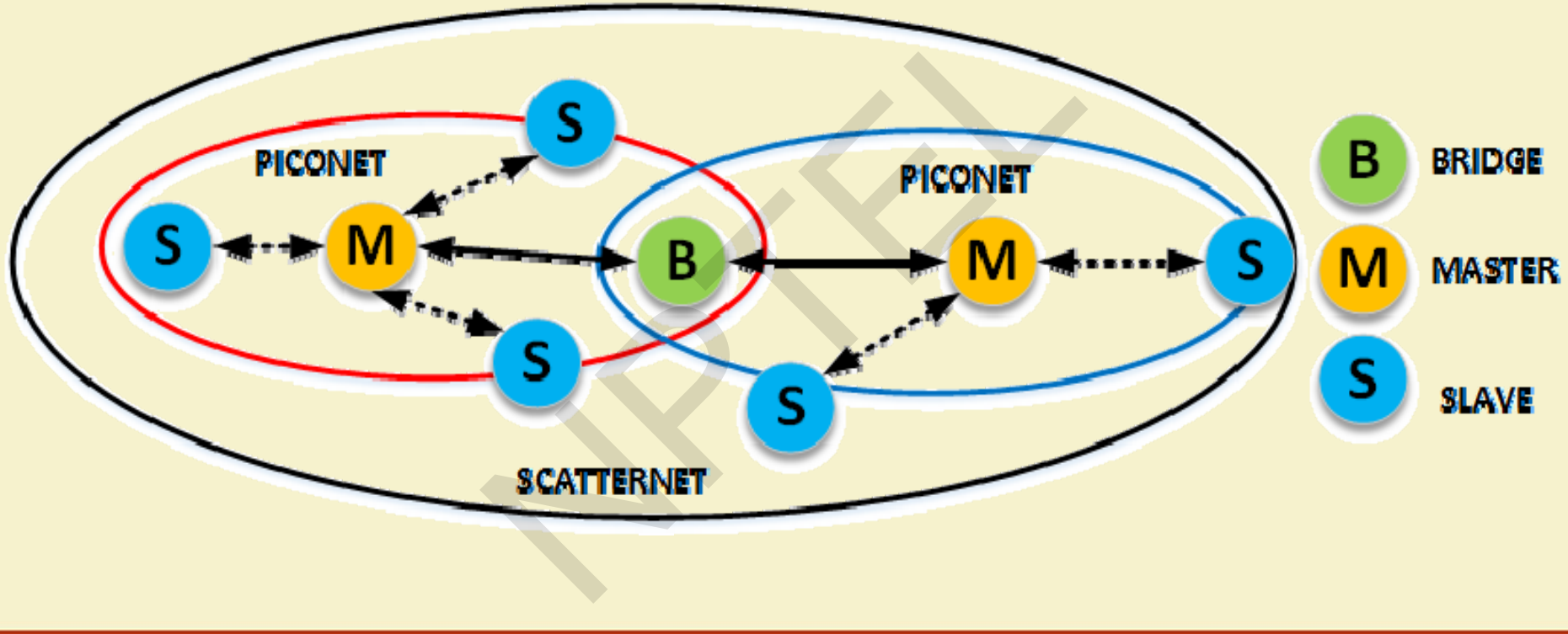
Piconets

- ✓ Bluetooth enabled electronic devices connect and communicate wirelessly through short range networks known as **Piconets**.
- ✓ Bluetooth devices exist in small ad-hoc configurations with the ability to act either as master or slave.
- ✓ Provisions are in place, which allow for a **master** and a **slave** to switch their roles.
- ✓ The simplest configuration is a point to point configuration with one master and one slave.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

- ✓ When more than two Bluetooth devices communicate with one another, it is called a **PICONET**.
- ✓ A Piconet can contain up to seven slaves clustered around a single master.
- ✓ The device that initializes establishment of the Piconet becomes the **master**.
- ✓ The master is responsible for transmission control by dividing the network into a series of time slots amongst the network members, as a part of **time division multiplexing** scheme.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)


PICONET
PICONET
S
S
M
B
M
S
S
S
SCATTERNET
B
BRIDGE
M
MASTER
S
SLAVE

Features of Piconet

- ✓ Within a Piconet, the clock and unique **48-bit address** of master determines the timing of various devices and the frequency hopping sequence of individual devices.
- ✓ Each Piconet device supports 7 simultaneous connections to other devices.
- ✓ Each device can communicate with several piconets simultaneously.
- ✓ Piconets are established dynamically and automatically as Bluetooth enabled devices enter and leave piconets.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

- ✓ There is no direct connection between the slaves.
- ✓ All connections are either 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.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

- ✓ A device can be a slave in one Piconet and master in another. It however cannot be a master in more than once Piconets.
- ✓ Devices 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**.

Source: "Wireless Communication - Bluetooth", Tutorials Point (Online)

Applications

- ✓ Audio players
- ✓ Home automation
- ✓ Smartphones
- ✓ Toys
- ✓ Hands free headphones
- ✓ Sensor networks

Thank You!!