SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT312 – EMBEDDED SYSTEM DESIGN

III YEAR/ VI SEMESTER

UNIT 2 :**DEVICES AND EMERGING BUS STANDARDS**

TOPIC 2.8 & 9 - Bluetooth & Zigbee

BLUETOOTH

- Radio band: 2.4-2.48 GHz
- Average 1 Mbps - Up to 3 Mbps
- Supports point-to-point and point-to-multipoint
  - Creates personal area networks (PANs/Piconets)
  - Connects up to 8 devices simultaneously
- Minimal interference between devices
  - **Devices alter frequencies arbitrarily after packet exchanges -up to 1600 times/second - frequency**

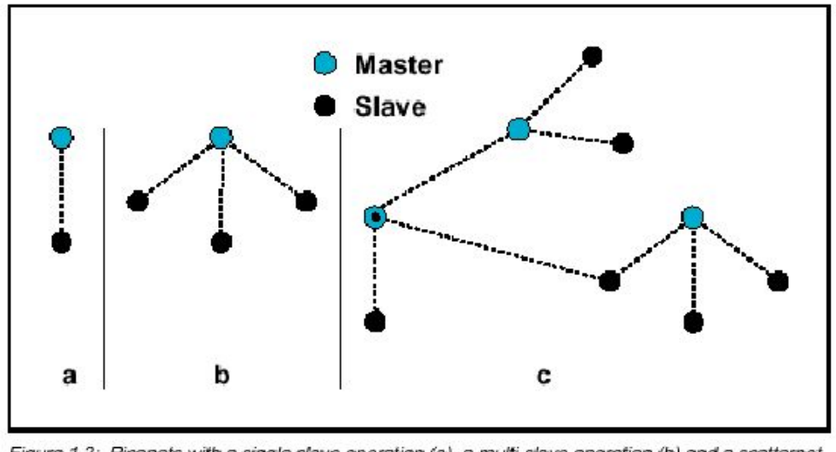


Figure 1.2: Piconets with a single slave operation (a), a multi-slave operation (b) and a scatternet operation (c).

Class	Maximum Power	Operating Range
Class 1	100mW (20dBm)	100 meters
Class 2	2.5mW (4dBm)	10 meters
Class 3	1mW (0dBm)	1 meter

BLUETOOTH

- Alternatives to cables
- IEEE 802.15.1 standard (2002)
- “Short range” and “Mobile products”
- POS of 10m radius, with mobility
- Ad-hoc connections between devices

- Network topology
- # of devices
- Scalability / Extendibility
- Flexibility
- Resilience / Reliability

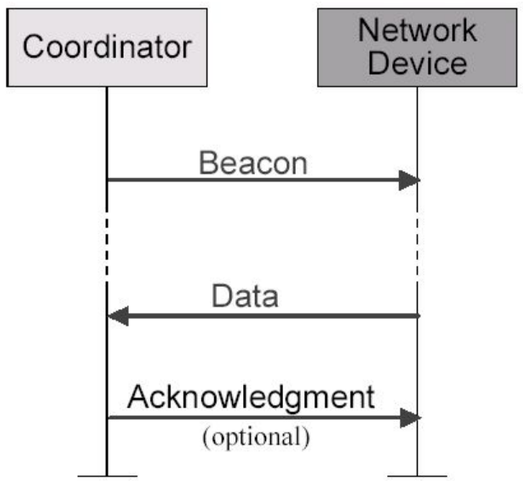
BLUETOOTH

- Wireless communication between devices
  - Mobile phones, laptops, cameras, gaming controllers, computer peripherals, etc
- Short range sensor transmission
- Share multimedia - pictures, video, music
- A2DP - Advanced Audio Distri
  - Stream audio wirelessly

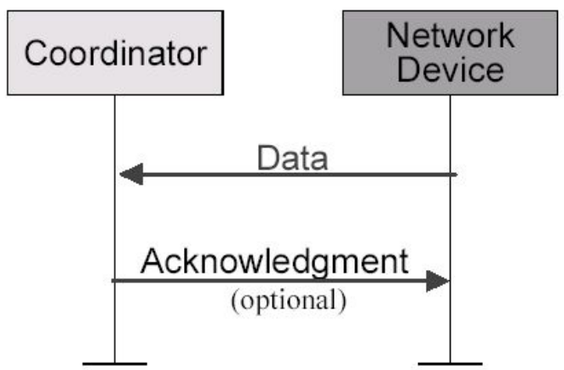
DATA TRANSFER MODEL

Data transferred from device to coordinator

- **In a beacon-enable network, device finds the beacon to synchronize to the super-frame structure. Then using slotted CSMA/CA to transmit its data.**
- **In a non beacon-enable network, device simply transmits its data using un-slotted CSMA/CA**



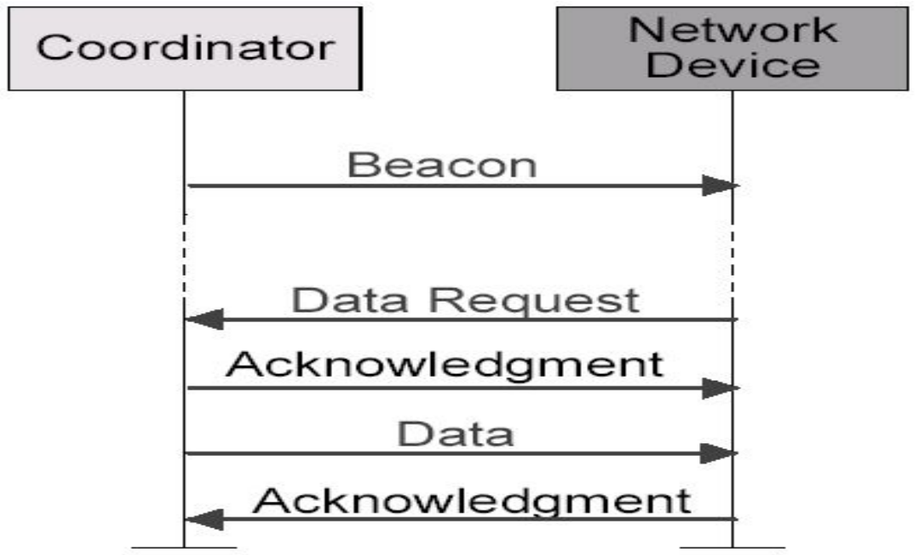
Communication to a coordinator
In a beacon-enabled network



Communication to a coordinator
In a non beacon-enabled network

DATA TRANSFER MODEL

- Data transferred from coordinator to device
  - In a beacon-enable network, the coordinator indicates in the beacon that "data is pending."
  - Device periodically listens to the beacon and transmits a MAC command request using slotted CSMA/CA if necessary.



Communication from a coordinator
In a beacon-enabled network

COMPARISON WITH PEER TECHNOLOGIES!

Feature(s)	IEEE 802.11b	Bluetooth	ZigBee
Power Profile	Hours	Days	Years
Complexity	Very Complex	Complex	Simple
Nodes/Master	32	7	64000
Latency	Enumeration upto 3 seconds	Enumeration upto 10 seconds	Enumeration 30ms
Range	100 m	10m	70m-300m
Extendability	Roaming possible	No	YES
Data Rate	11Mbps	1Mbps	250Kbps
Security	Authentication Service Set ID (SSID)	64 bit, 128 bit	128 bit AES and Application Layer user defined

Bluetooth is Best

For :

- Ad-hoc networks between capable devices
- Handsfree audio
- Screen graphics, pictures…
- File transfer

But ZigBee is Better

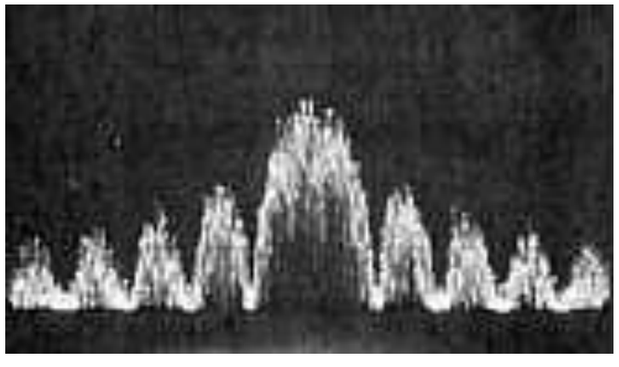
If :

- The Network is static
- Lots of devices
- Infrequently used
- Small Data Packets

AIR INTERFACE

ZigBee
DSSS
11 chips/ symbol
62.5 K symbols/s
4 Bits/ symbol

Peak Information Rate
~128 Kbit/second



Bluetooth
FHSS
1 M Symbol / second

Peak Information Rate
~720 Kbit/second

TIMING CONSIDERATIONS

ZigBee:

- New slave enumeration = 30ms typically
- Sleeping slave changing to active = 15ms typically
- Active slave channel access time = 15ms typically

Bluetooth:

- New slave enumeration = >3s
- Sleeping slave changing to active = 3s typically
- Active slave channel access time = 2ms typically

ZigBee protocol is optimized for timing critical applications

INITIAL ENUMERATION

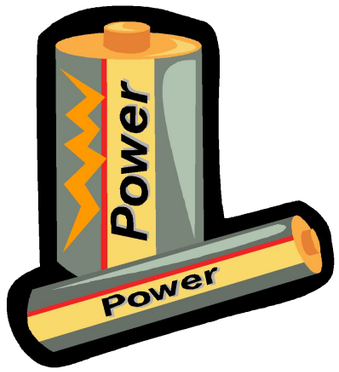
ZigBee

Coordinator

Bluetooth

Coordinator

POWER CONSIDERATIONS



ZigBee

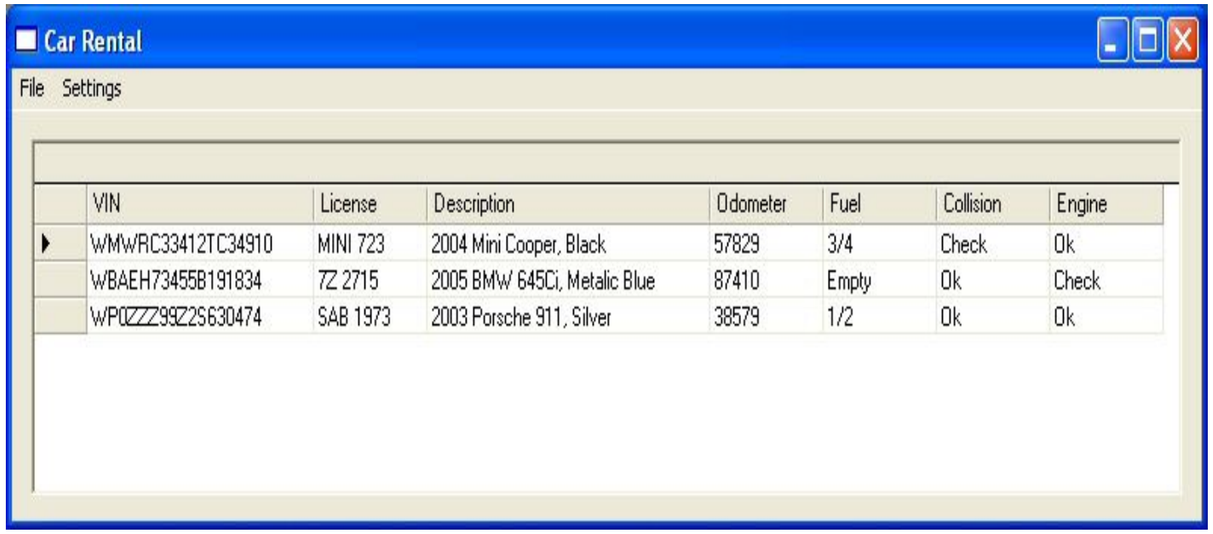
- 2+ years from 'normal' batteries
- Designed to optimise slave power requirements

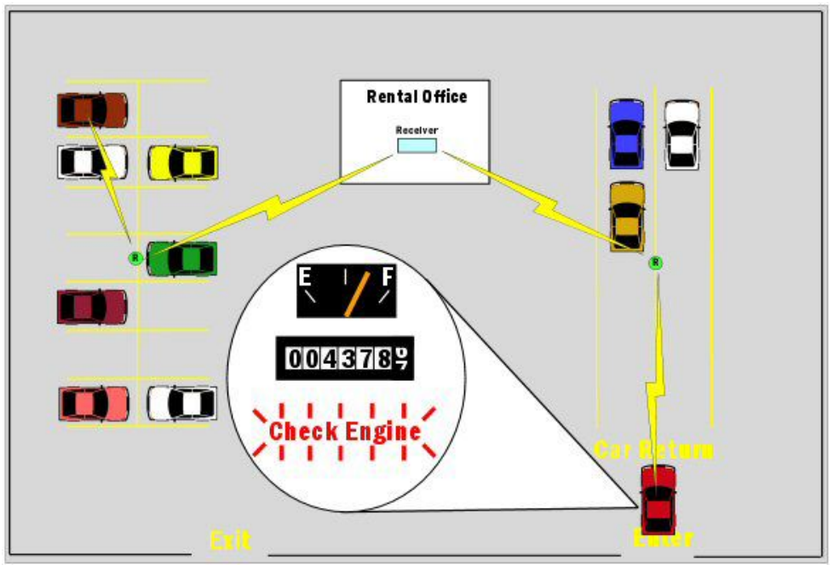
Bluetooth

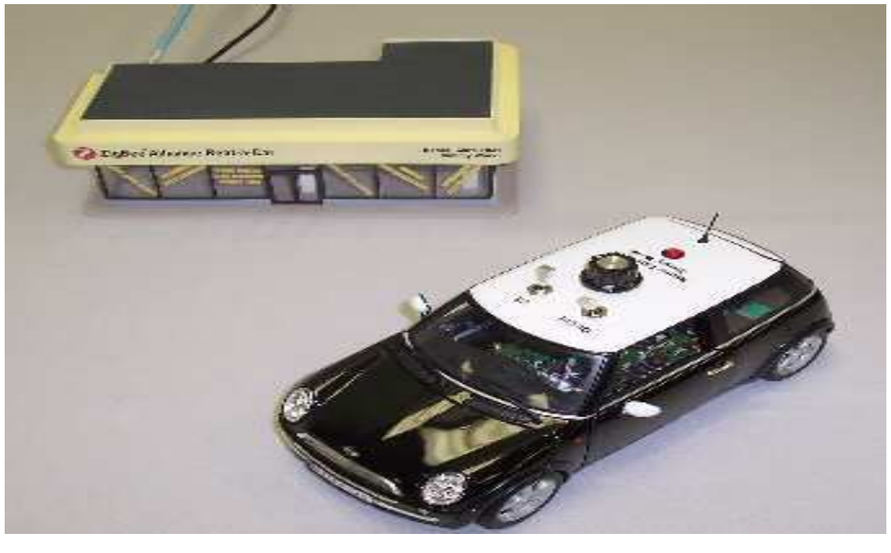
- **Power model as a mobile phone (regular charging)**
- **Designed to maximise ad-hoc functionality**

Application example of a light switch with respect to latency and power consumption …...

AUTOMATED RENTAL CAR RETURN*







FROM SOFTWARE TECHNOLOGIES GROUP

Assessment

1.What is Bluetooth?
2.Compare Bluetooth with ZigBee

THANK YOU