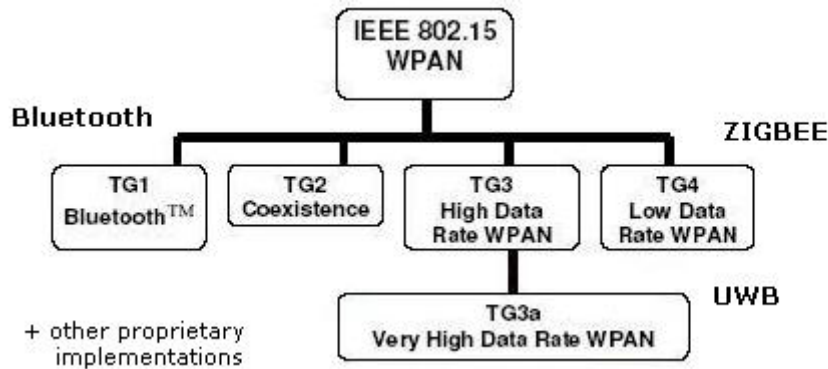


Wireless Personal Area Network Technologies & Applications

Wireless technologies and applications are of great interest in recent times and here is a short summary of various Wireless Personal Area Network technologies and possible application developments.

IEEE standards for Wireless Personal Area networking technologies:



Emerging WPAN (Wireless Personal Area Networking) standards (IEEE 802.15 standards) are focused in general to provide cost effective and innovative smart wireless applications such as

- Wireless Sensor Networking
- RFID Applications
- Mobile Ad Hoc Networks (MANETs)

Wireless sensor networking is one of the most exciting technology markets today and market for such smart wireless solutions are growing at an exponential rate. Main advantages of such wireless sensor networking are

- Low Installation
- Easier maintenance with handheld wireless devices
- New markets for wireless applications

RFID applications are catching up fast replacing barcodes and optical scanner based tracking applications and mainly used for

- Asset Tracking
- People Tracking
- Inventory Tracking

Mobile Ad Hoc Networks (MANETs) are of great interest to researchers and system integrators to develop cost effective wireless application networks using mix of Wireless PAN Standards and proprietary technologies

Most popular WPAN Standards are

- Bluetooth IEEE 802.15.1
- Zigbee IEEE 802.15.4
- UWB (Ultra Wide Band) IEEE 802.15.3a
- Proprietary standards based on Embedded Wireless Chips

For larger networks and special applications even IEEE 802.11 WLAN WiFi standard can be used for designing smart wireless solutions.

This means different smart wireless applications can be designed for **both training of students and real life development projects by entrepreneurs** by using mix of available WPAN and WLAN standards.

For example,

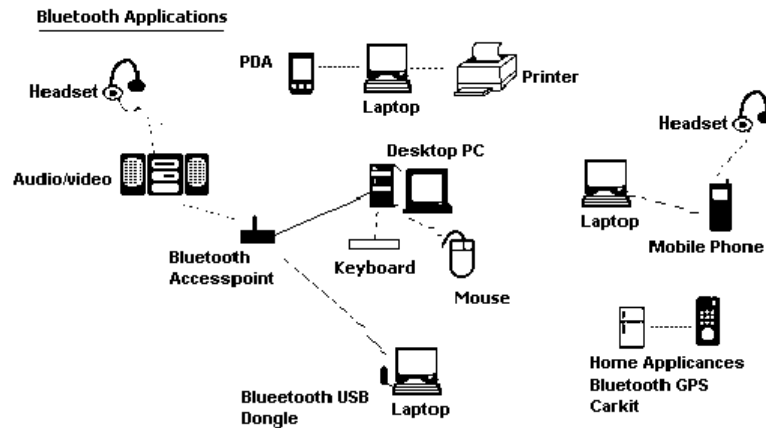
- Home automation using **Bluetooth or Zigbee or Proprietary** solutions
- Industrial automation using **Zigbee or proprietary or mix** of solutions
- RFID applications **using proprietary solutions or integrating with WiFi**
- Smart wireless applications using **standard based or proprietary** solutions

Following Development Kit are suggested for Training and Development Projects:

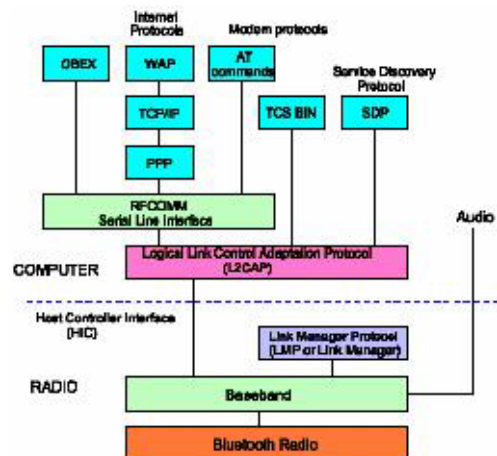
- A. Bluetooth Development Kit BT2001 and/or BT 1000 (2.4 Ghz)
- B. PICDEM™ Z ZigBee™ Technology Development Kit (2.4 Ghz)
- C. RFID Development Kit (13 MHz)
- D. ChipWeb WiFi-PIC Development kit (2.4 Ghz)
- E. Keeloq Evaluation Kit II

A. Bluetooth IEEE 802.15.1

It is the very popular WPAN technology for connecting mobile devices, handheld devices and wireless peripherals. There are numerous Bluetooth applications that can be developed for interfacing mobile, office equipment.



Bluetooth Protocol stack



Possible Training Projects

- ☒ Study of Bluetooth stack and various interfaces (USB, UART, SPI)
- ☒ FTP File Transfer and chatting applications
- ☒ I/O Port controls, LED control, Sound Control
- ☒ Bluetooth based voice transfer (audio gateway)

Possible Development Projects

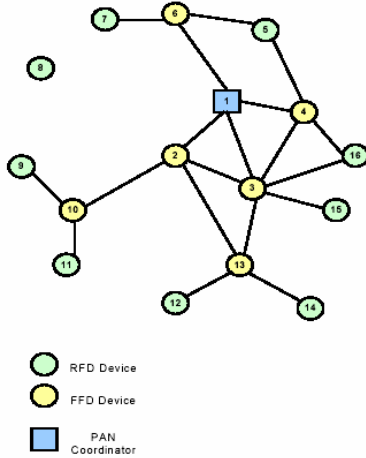
- ☒ Inbuilt Bluetooth Data communication between shared devices – printers, faxes, PCs
- ☒ Automatic wireless interface between PCs and remotely monitored equipment
- ☒ Cost effective Serial port/USB Bluetooth dongles
- ☒ Bluetooth enabled Pico nets, dialup networks, voice activated Bluetooth devices for customized applications with various interfaces – AT, WAP, TCP/IP, SDP
- ☒ Bluetooth Sync applications

Suggested Development Kit:

Bluetooth Development Kit BT2001 and/or BT 1000 (2.4 Ghz)

B. ZIGBEE IEEE 802.15.4

It is the emerging WPAN technology ideally suited for wireless sensor networks in mesh configuration and is characterized by lowest power consumption supporting many devices.



Zigbee™/802.15.4 Specifications by Band

	868 MHz	902-928 MHz	2.450 GHz
Data Rate	20 kbps	40 kbps	250kbps
# channels	1	10	16
TX Power	-3dBm	-3dBm	-3dBm
RX Sensitivity	-92dBm	-92dBm	-85dBm
Link Budget	89dB	89dB	82dB
Adjacent channel rejection	0dB	0dB	0dB
Alternate channel rejection	30dB	30dB	30dB

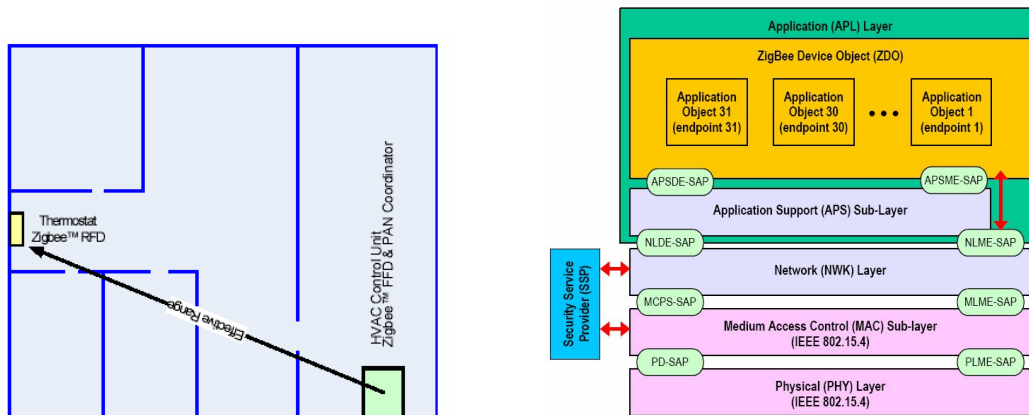
Possible Training Projects

- Study of WPAN networks based on Zigbee
- Study of low power characteristics of Zigbee standard
- Study of Zigbee protocols and how to realize mobile ad hoc networks

Possible Development Projects

- Remote Keyless Entry (Transmitters)
- Wireless Security Systems
- Home Appliances Control (Lighting Control, Ceiling Fans)
- Radio Remote Control (Hobby, Toys)
- Garage Door Openers
- Wireless PC Peripherals (Keyboard, Mouse)
- Telemetry (Tire Pressure, Utility Meter, Asset Tracking)

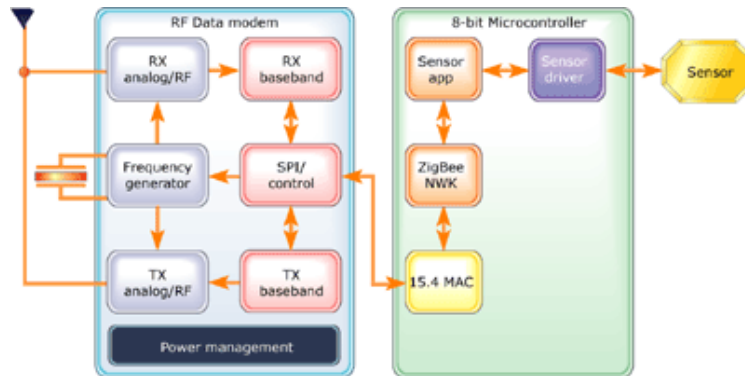
Typical Example: A thermostat interfaced to Zigbee device for telemetry



Suggested Development Kit:

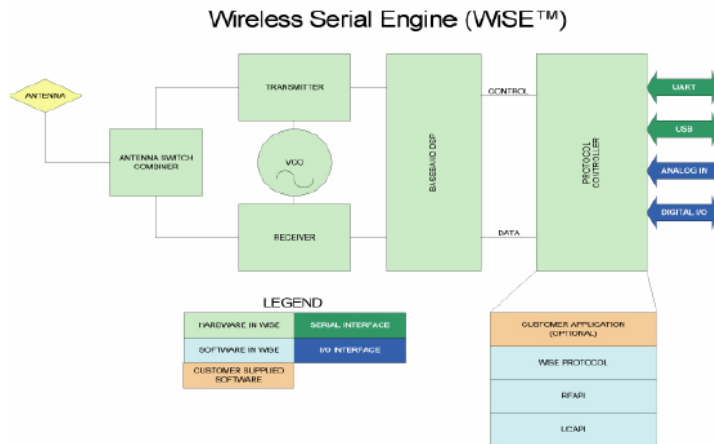
PICDEM™ Z ZigBee™ Technology Development Kit (2.4 GHz) supporting 250 kbps

Note: Advanced Wireless Applications in line with Zigbee (for entrepreneurs)



Based on Zigbee experience one can even try other emerging Zigbee like smart wireless applications such as wireless serial engine™ (WiSE™).

It is essentially Zigbee high performance protocol stack in a small IC-style package. WiSE modules are programmed with a unique 48-bit MAC address and supports applications using TCP/IP and ARP.



Possible applications by Entrepreneurs using WiSE™

- Wi232DTS(EUR)™
 - Wire Replacement Applications, Home Automation, Building Automation
 - Mobile AMR, Wireless RS-232/422/485 applications
- Wi232FHSS(EURHP)™
 - Same as above but with longer range
- Wi.MESH™
 - Same as above but for Mesh type applications (MANETs – Mobile Ad Hoc Networks)
 - Particularly suited for
 - Fixed automated meter reading
 - Container security/tracking

These chips can be procured from vendors based on project requirement and application under consideration.

C. RFID Development Kit (13 MHz) – An application that can use mix of WPAN or proprietary wireless technologies

There is a tremendous market growth for RFID applications and it can be implemented for variety of customized applications in different ISM (Industrial Scientific Medicine) bands. 13 MHz band is ideal for training and development for RFID applications.



Frequency ranges for RFID-Systems		
Frequency range	Remarks	Allowed Tx Power
< 135 kHz	low frequency, inductive coupling	72 dBμA/m
6.765 - 6.795 MHz	MF Band (ISM), inductive coupling	42 dBμA/m
7.400 – 8.800 MHz	MF Band, used for EAS (electronic article surveillance) only	9 dBμA/m
13.553 -13.567 MHz	Medium frequency (13.56 MHz, ISM), inductive coupling, wide spread usage for contact less smartcards (ISO 14443, MIFARE, LEGIC, smart labels (ISO 15693, Tag-It, I-Code) and item management (ISO 18000-3).	42 dBμA/m
26.957- 27.283 MHz	MF Band (ISM), inductive coupling, special applications only	42 dBμA/m
433 MHz	UHF (ISM), backscatter coupling, rarely used for RFID as there are more ISM devices working	10 - 100 mW
868 - 870 MHz	UHF (SRD), backscatter coupling	500 mW(Europe)
902 - 928 MHz	UHF (SRD), backscatter coupling	4 W - spread spectrum, (USA/Canada)
2.400 - 2.483 GHz	SHF (ISM), backscatter coupling, several systems, (vehicle identification: 2.446- 2.454 GHz)	4 W - spread spectrum, (USA/Canada), 500 mW (Europe)
5.725 - 5.875 GHz	SHF (ISM), backscatter coupling, rarely used for RFID	4 W USA/Canada, 500 mW Europe

Possible Training Projects

- Simple RFID applications using active and passive RFID tags
- Interfacing RFID reader with back office applications – (eg. Tracking costly test equipment in lab)
- Understanding and testing of various RFID tags – active, passive

Possible Development Projects

- Asset tracking – Industrial test equipments, valuable items.....
- People tracking – Personal Security, staff movement management.....
- Vehicle tracking – Location based applications, automobile workshops, auto garage openers....
- Inventory tracking – library books, arms in military, police premises.....

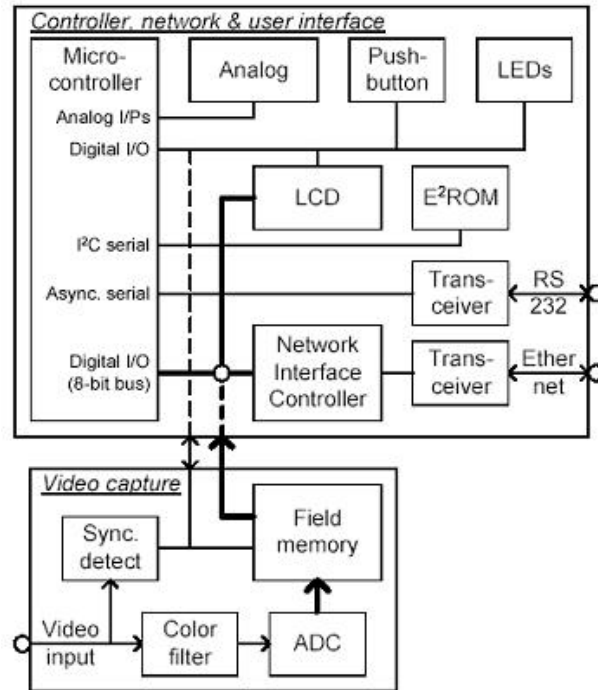
Suggested Development Kit:

RFID Development Kit (13 MHz)

(Development projects depend upon requirement and frequency selection accordingly)

D. ChipWeb WiFi-PIC Development kit (2.4 GHz)

Wireless sensor networks can also be integrated with existing WiFi networks working in 2.4 GHz. ChipWeb is one such development kit that can communicate to WiFi network using a special PIC microcontroller board. This Microchip PICDEM with Ethernet Interface kit provides even video capture ability and can communicate with WiFi networks using PCMCIA wireless LAN card.



Possible Training Projects

- Study interfacing PIC Microcontroller devices with WiFi Networks
- Simple serial port applications for remote monitoring using existing WiFi networks
- Industrial automation examples for controlling sensors using WiFi

Possible Development Projects

- Wireless sensors integration with WiFi – pressure, temperature, humidity, speed control
- Remote monitoring applications using Web and VPN over a WiFi WLAN

Suggested Development Kit:

ChipWeb WiFi-PIC Development kit (2.4 GHz)

E. Keeloq Evaluation Kit II

This kit can be used in conjunction with other smart wireless applications or standalone for Wireless security and remote monitoring applications. The 8-bit Flash PIC16F639 microcontroller had a 3-channel, transponder analog front end and an integrated KEELOQ® cryptographic peripheral. The combination of this new transponder analog front end, KEELOQ peripheral and low power consumption via nanoWatt Technology provides a total solution for passive-keyless-entry (PKE) and other wireless authentication applications.



Additional PIC12F635/PIC16F636 Features:

- 8 MHz internal oscillator with software clock switching
- Ultra Low Power Wakeup (ULPW)
- Up to 3.5K bytes of Flash program memory, and up to 256 bytes of EEPROM data memory
- Up to 128 bytes of RAM
- Up to 2 Analog Comparators

Typical Applications:

- Remotely Security Control, including remote keyless entry (RKE) and passive keyless entry (PKE)
- Property and Identity Authentication
- Security Systems – remote sensors and their intercommunication
- Pseudo Random Number Generation, such as electronic toy dice

Possible Training Projects

- Study wireless to serial interfacing for remote RF applications
- Design of simple RF security solutions for home automation

Possible Development Projects

- Remote control automation applications