
IoT
gadgets
frameworks
Internet
control
utilized
checking
Things
administration
information
system
articles
assembling
connection
items
sensors
security
devices
different
vitality
applications
observing
products
likewise
framework
incorporate
wellbeing
empowers
example
correspondence
help
urban
home
spaces
propelled
RFID
Media

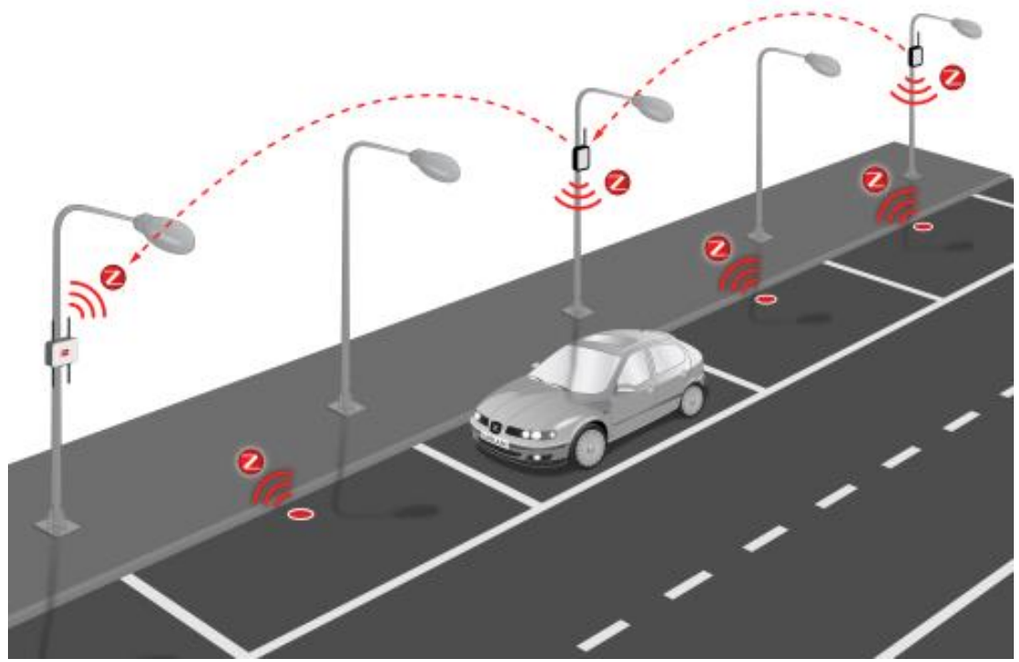
ZIGBEE

ZIGBEE

ZIGBEE

INTRODUCTION

- A wireless mesh networking standard for connecting sensors, instrumentation and control systems.
- Communication - wireless personal area network (WPAN)
- An open, global, packet-based protocol
- A secure, reliable, low power wireless networks.



TECHNICAL SPECIFICATION

FEATURES	DESCRIPTION
Network Protocol	Zigbee PRO 2015 (or newer)
Network Topology	MESH Networking
Network Device Types	Coordinator, Router, End Device
Frequency Band / Channels	2.4 GHz (ISM band) 16-channels (2 MHz wide)
Data Rate	20bits - 250 Kbits/sec
Communication Range (Average)	Up to 300+ meters (line of sight) Up to 75-100 meters indoor
Low Power Support	Sleeping End Devices
Logical device support	up to 240 end-points

FEATURES

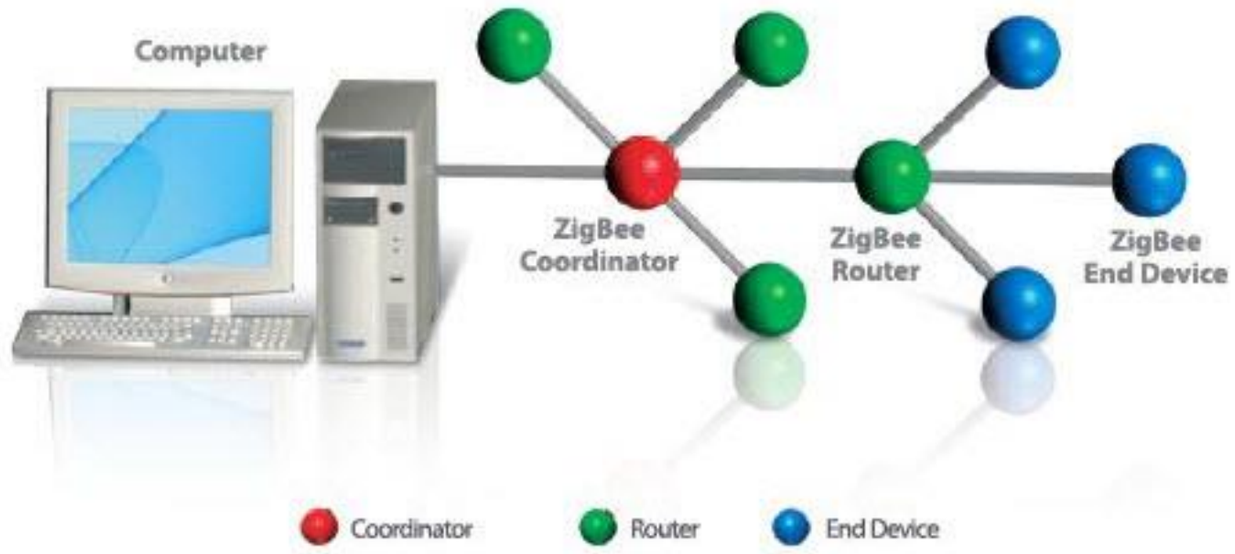
- Low battery consumption
- Low cost
- Low data rate
- Easy to implement
- Supports up to 65,000 nodes
- Automatically establish its network

HARDWARE DETAILS

ZIGBEE SMT GROVE DEVELOPMENT BOARD

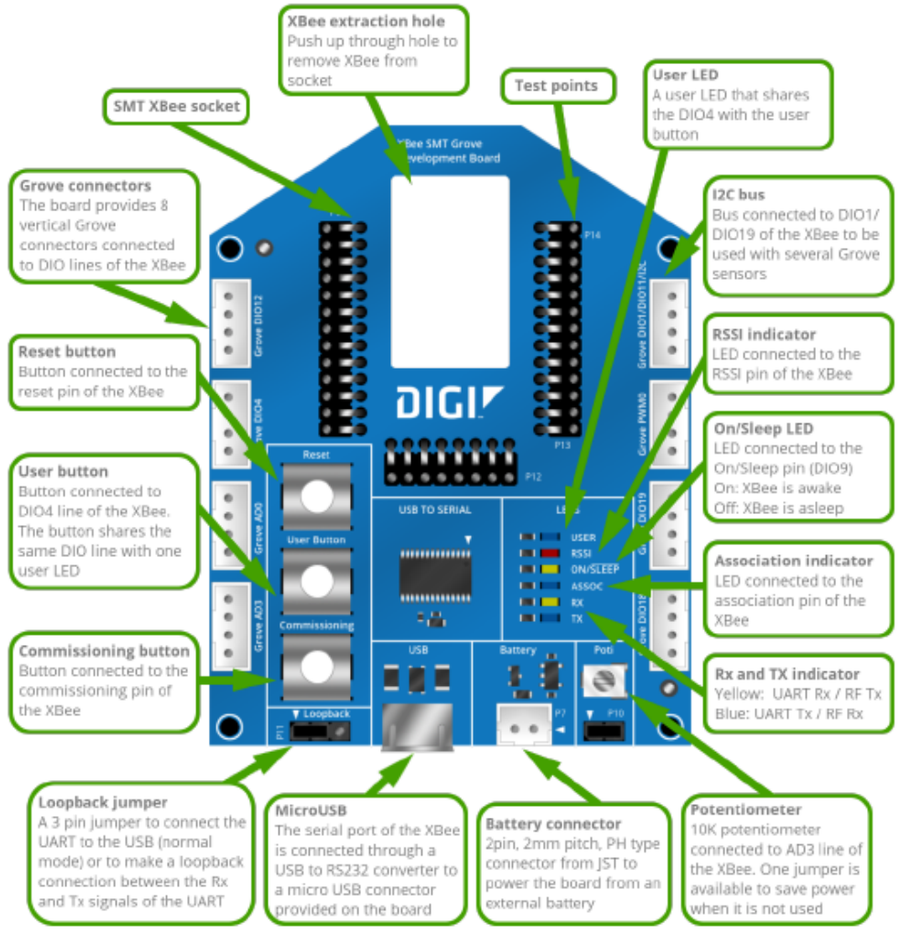
TYPES

- Router
- Co-ordinator
- End device

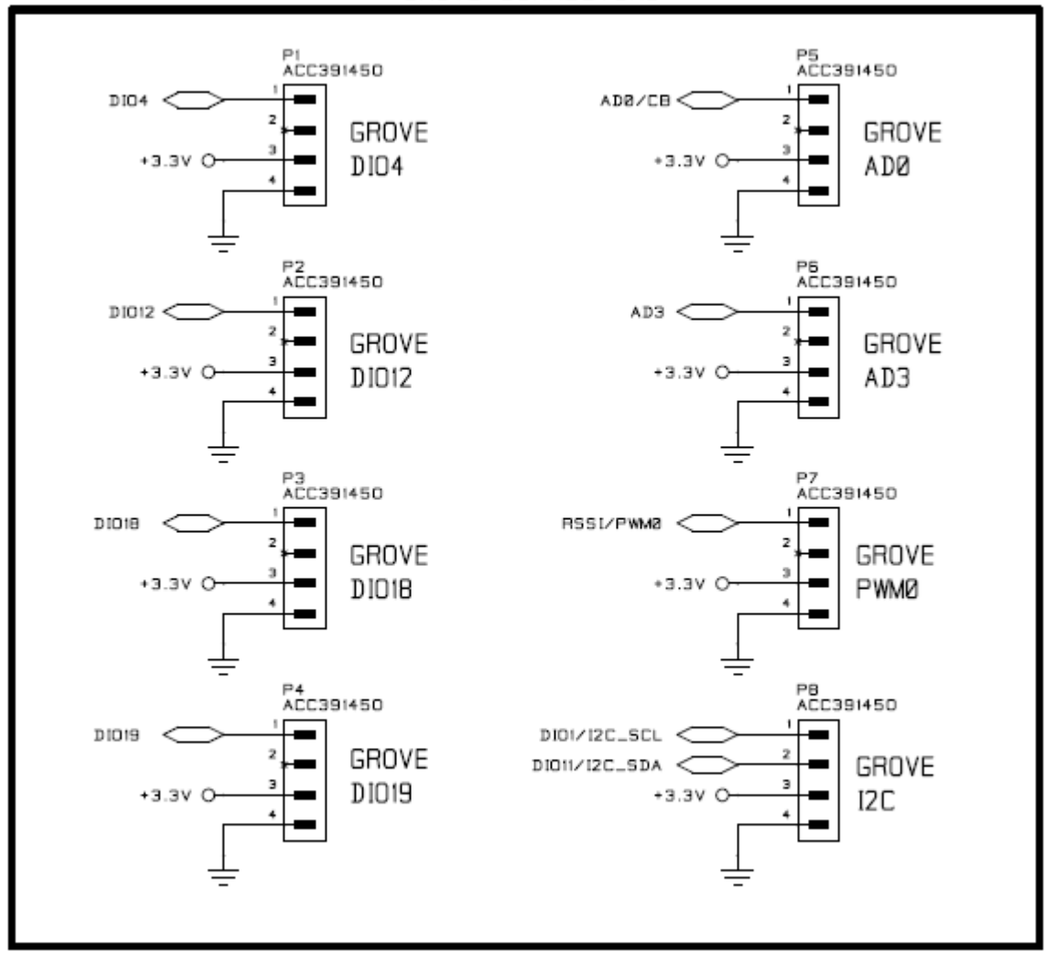


PIN DETAILS

XBee SMT Grove Development Board



GROVE CONNECTORS



ROUTER

- Performs similar to coordinator except establishing a network
- Used in tree and mesh topologies (expand n/w coverage)
- Function - finds the best route to the destination for message transfer

CO-ORDINATOR

- Starts the network
- Assigns how addresses are allocated to nodes or routers
- Permits other devices to join or leave the network
- Holds a list of neighbours and routers
- Transfers application packets

END DEVICE

- End device (child) can be connected to a router or coordinator (parent).
- Operates at low power (consumes power only while transmitting information)
- End device transmission time is short
- Functions
  - Joins or leaves a network
  - Transfers application packets

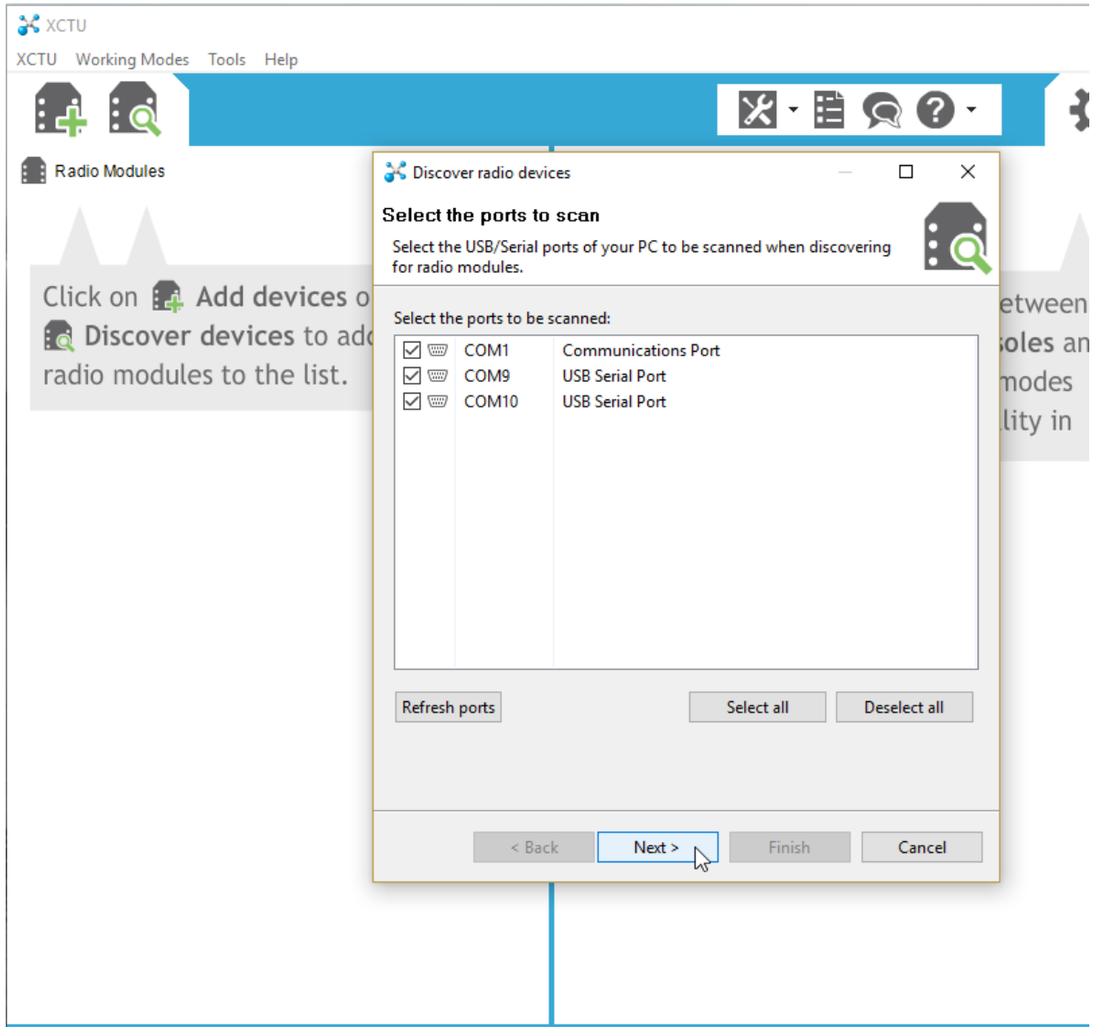
ZIGBEE STACK LAYERS

- Built on the Physical (PHY) layer & Medium Access Control (MAC) sub-layer
- Standard – IEEE 802.15.4
- Function - low-level network operations (addressing and
- message transmission/reception)
- Network layer (NWK) - network structure, routing, and security
- Application layer consists of
  - Application Support sub-layer (APS)
  - Zigbee Device Objects (ZDO)
  - user-defined applications

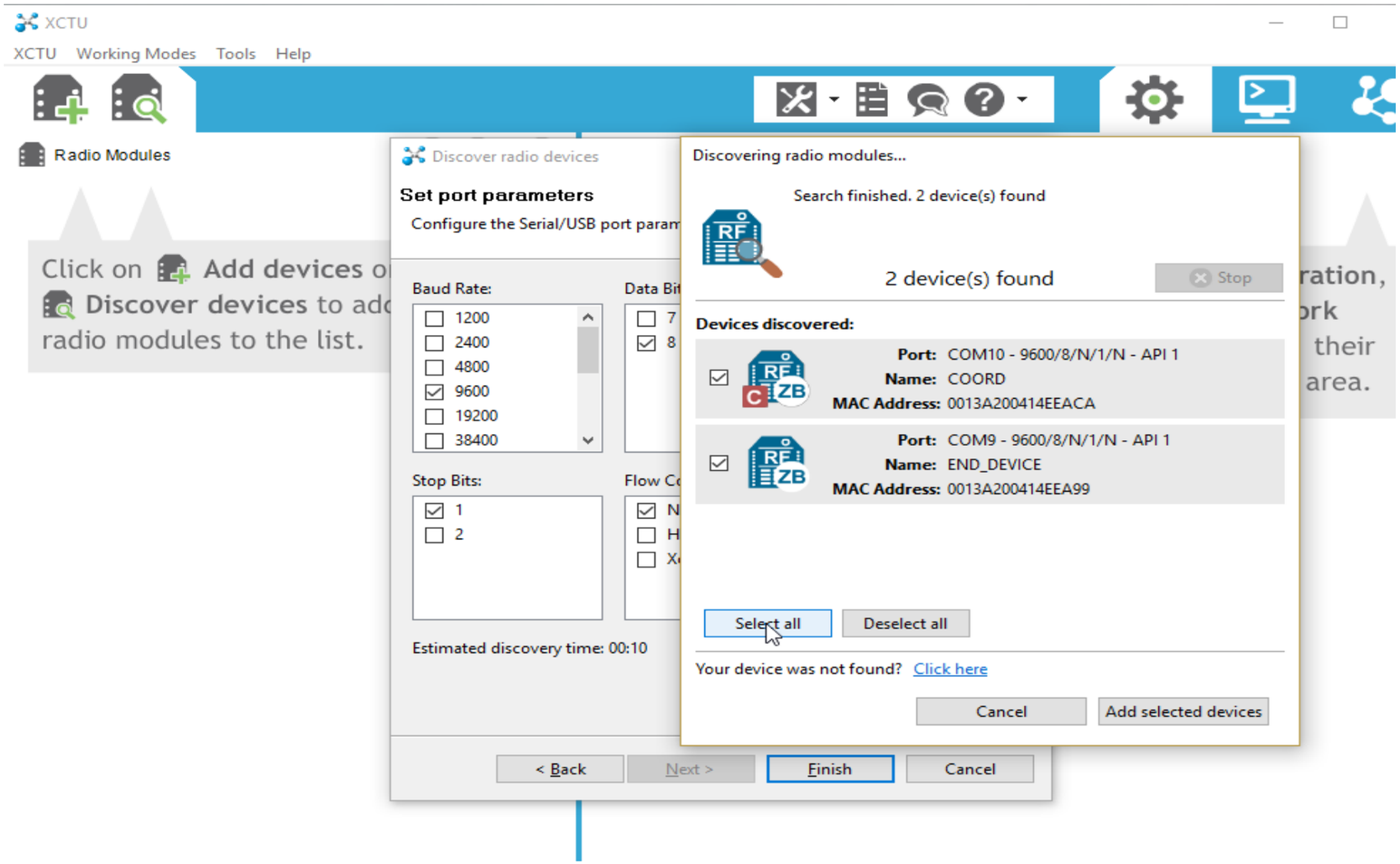
- Click the Discover radio nodes in the same network button of the first radio module.

Discover Radio Node Button

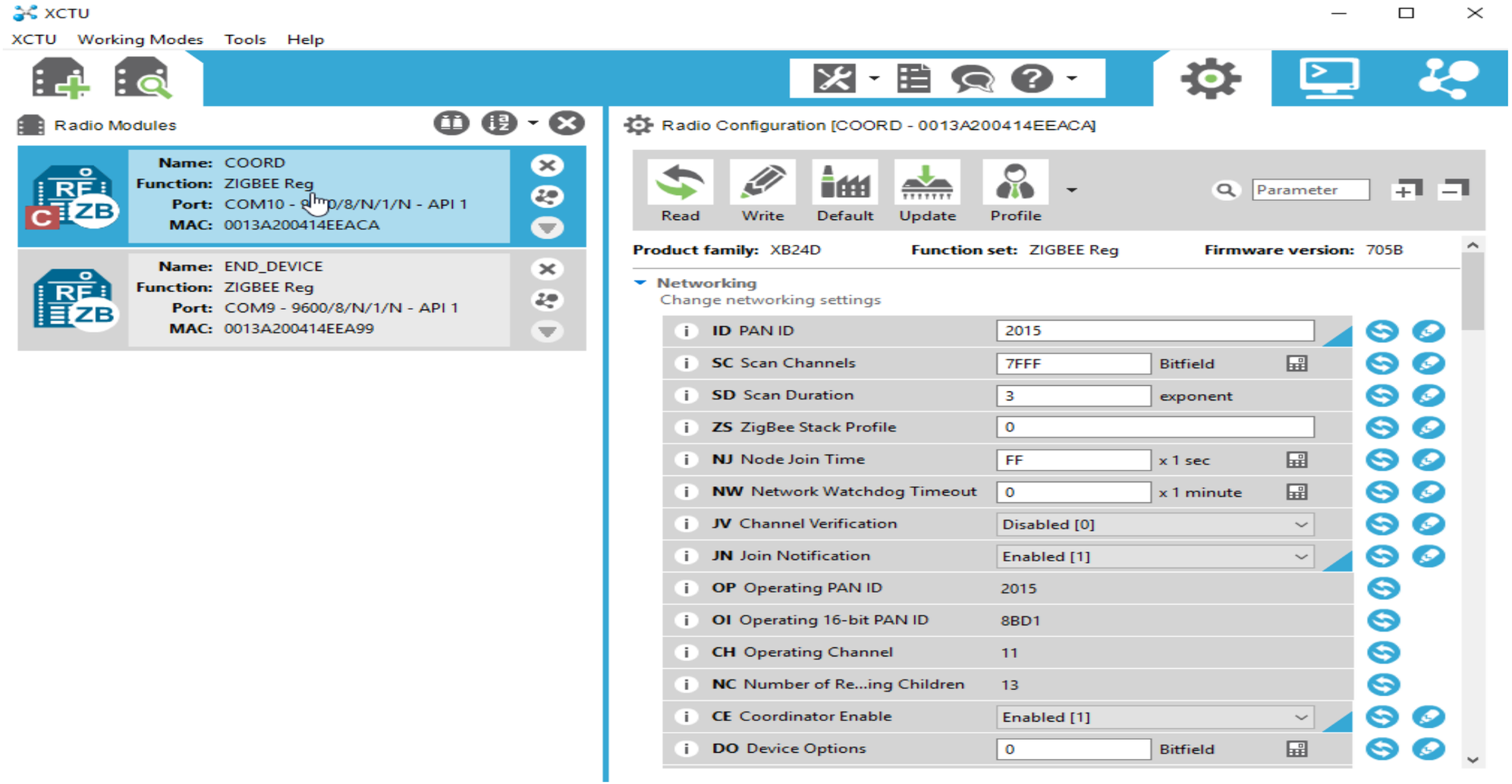
- Select the scanned ports and click NEXT
- Then click FINISH



- Select all the listed devices and click add selected devices



- Click the device that needs to be configured and change the parameters as per the user guide



Step 4: Configure the XBee modules

To transmit data wirelessly between your XBee modules, you must configure them to be in the same network. Remember that in Zigbee one device must be the coordinator, and the rest can be routers or end devices. In this case, you will have one router and one end device configured to send data to the coordinator.

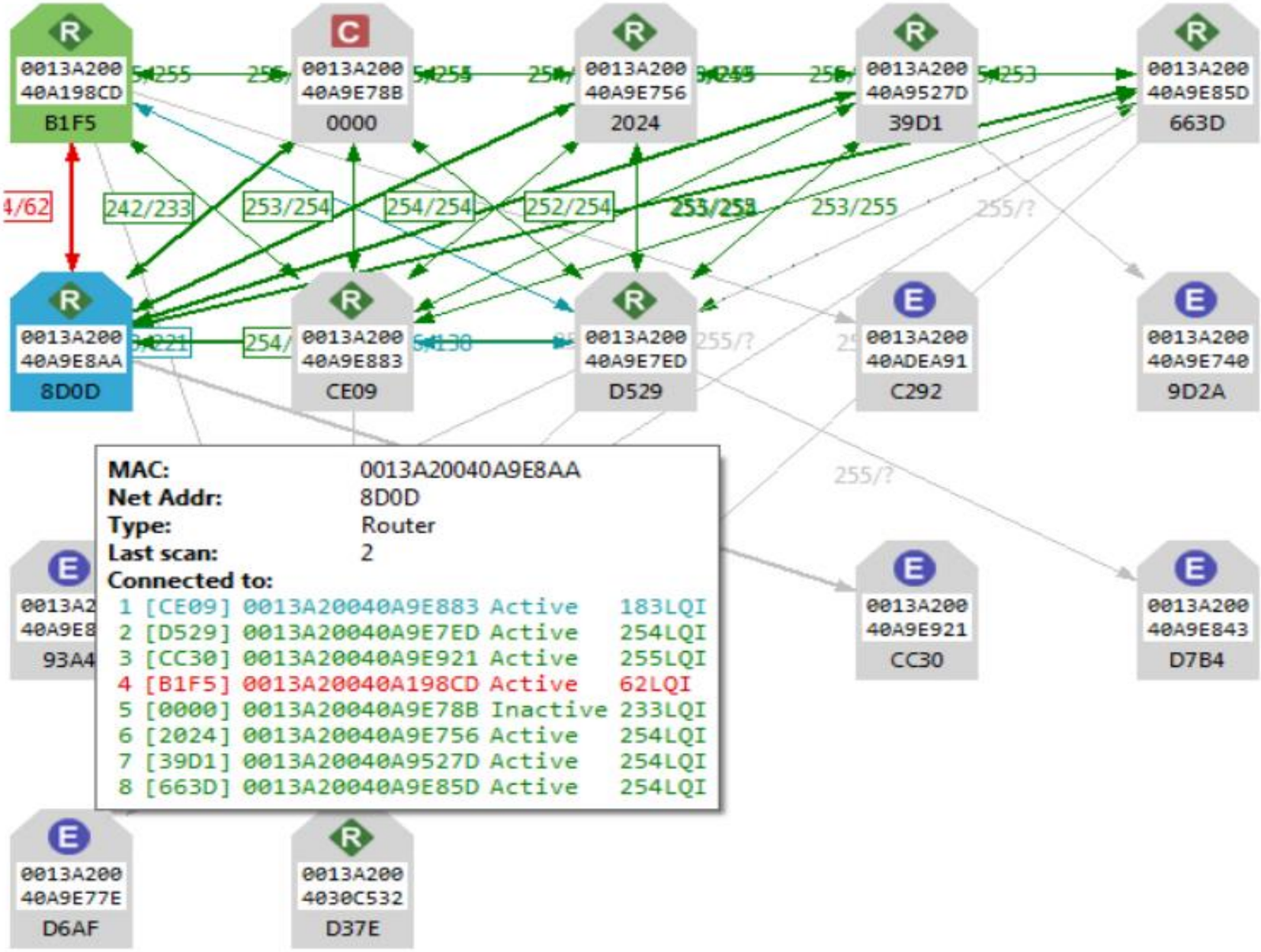
1. Restore the default settings of all XBee modules with the **Load default firmware settings** button at the top of the Radio Configuration section.
2. Use XCTU to configure the following parameters:

Param	XBee A	XBee B	XBee C	Effect
ID	2015	2015	2015	Defines the network that a radio will attach to. This must be the same for all radios in your network.
JV	—	Enabled [1]	Enabled [1]	Verifies if a coordinator exists on the same channel to join the network or to leave if it cannot be found.
CE	Enabled [1]	—	—	Sets the device as coordinator.
DH	—	0	0	Defines the destination address (high part) to transmit the data to.
DL	—	0	0	Defines the destination address (low part) to transmit the data to. The address 0000000000000000 can be used to address the coordinator.
NI	COORD	ROUTER	END_DEVICE	Defines the node identifier, a human-friendly name for the module. The default NI value is a blank space. Make sure to delete the space when you change the value.
SP	1F4	1F4	1F4	Defines the duration of time spent sleeping. 1F4 (hexadecimal) = 500 (decimal) x 10 ms = 5 seconds.
SM	—	—	Cyclic sleep [4]	Enables cyclic sleep mode in the end device.
SO	—	—	2	Keeps the module awake during the entire period.

Discovery:

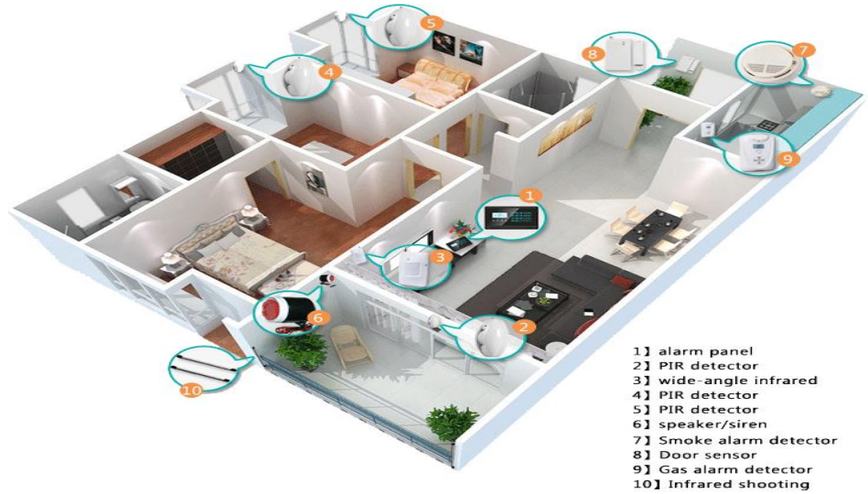
The remainder of the options are specific to 802.15.4, DigiMesh, and ZigBee network types:

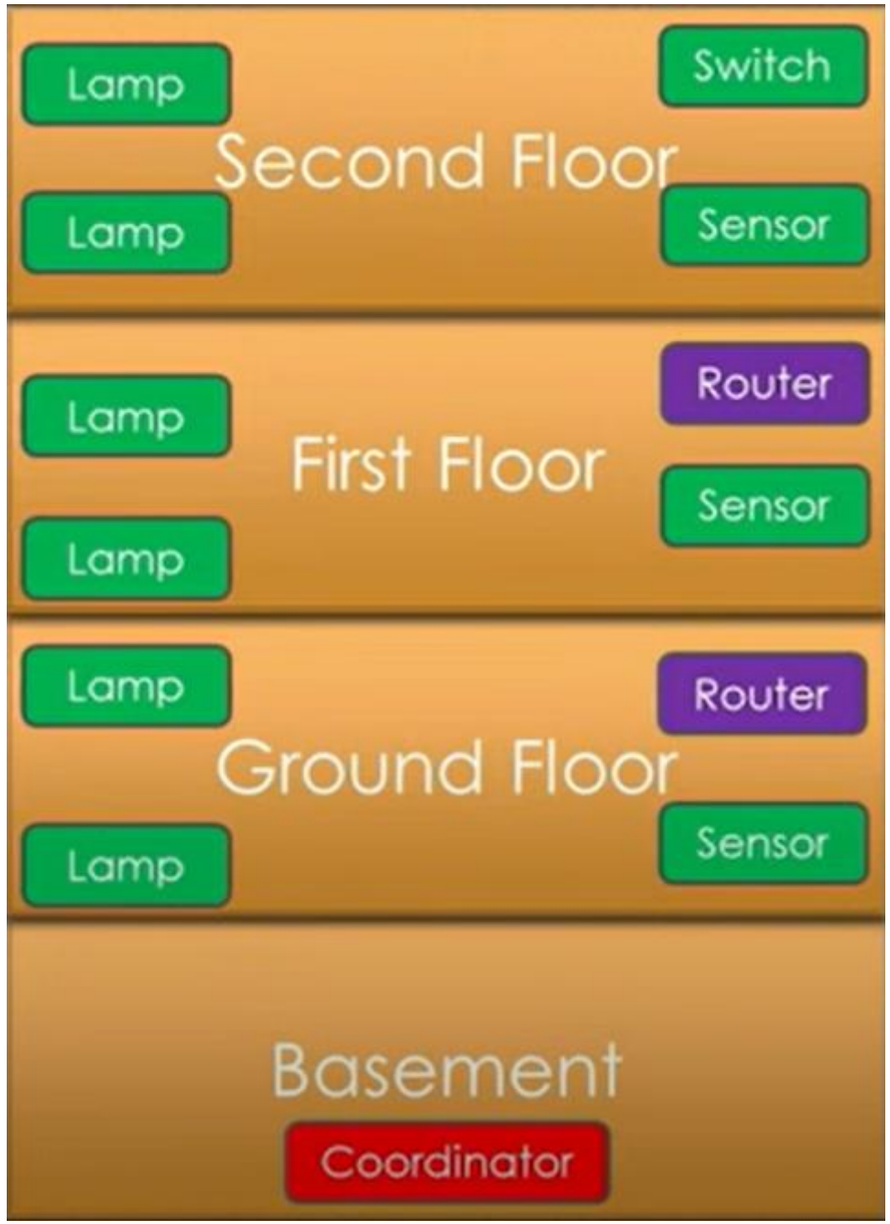
Field	Description
Discovery mode	Sets the method used by the network discovery process. ■ Flood: The neighbor discovery process is performed for every node at the moment it is found. Several discovery processes may be running at the same time. This method may be faster, but it may also generate a lot of traffic and saturate the network. ■ Cascade: The neighbor discovery process is performed for every node as soon as the discovery process finishes. Only one discovery process runs at a time. This method may be slower, but it is likely to generate less traffic.
Neighbor discovery timeout	Sets the maximum duration, in seconds, the discovery process should spend finding neighbors of a module. Value must be between 5 and 1800 seconds (30 minutes). This timeout is highly dependent on the nature of the network. For DigiMesh, the value should be greater than the highest NT (Node Discover Timeout) and include enough time to let the message propagate, depending on the sleep cycle of your devices.
Time between requests	Sets the wait time between node neighbor requests. The value must be between 0 and 300 seconds (5 minutes). For the Cascade method, this is the number of seconds to wait after completion of the neighbor discovery process of the previous node. For the Flood method, this is the minimum time to wait between each radio module's neighbor requests.

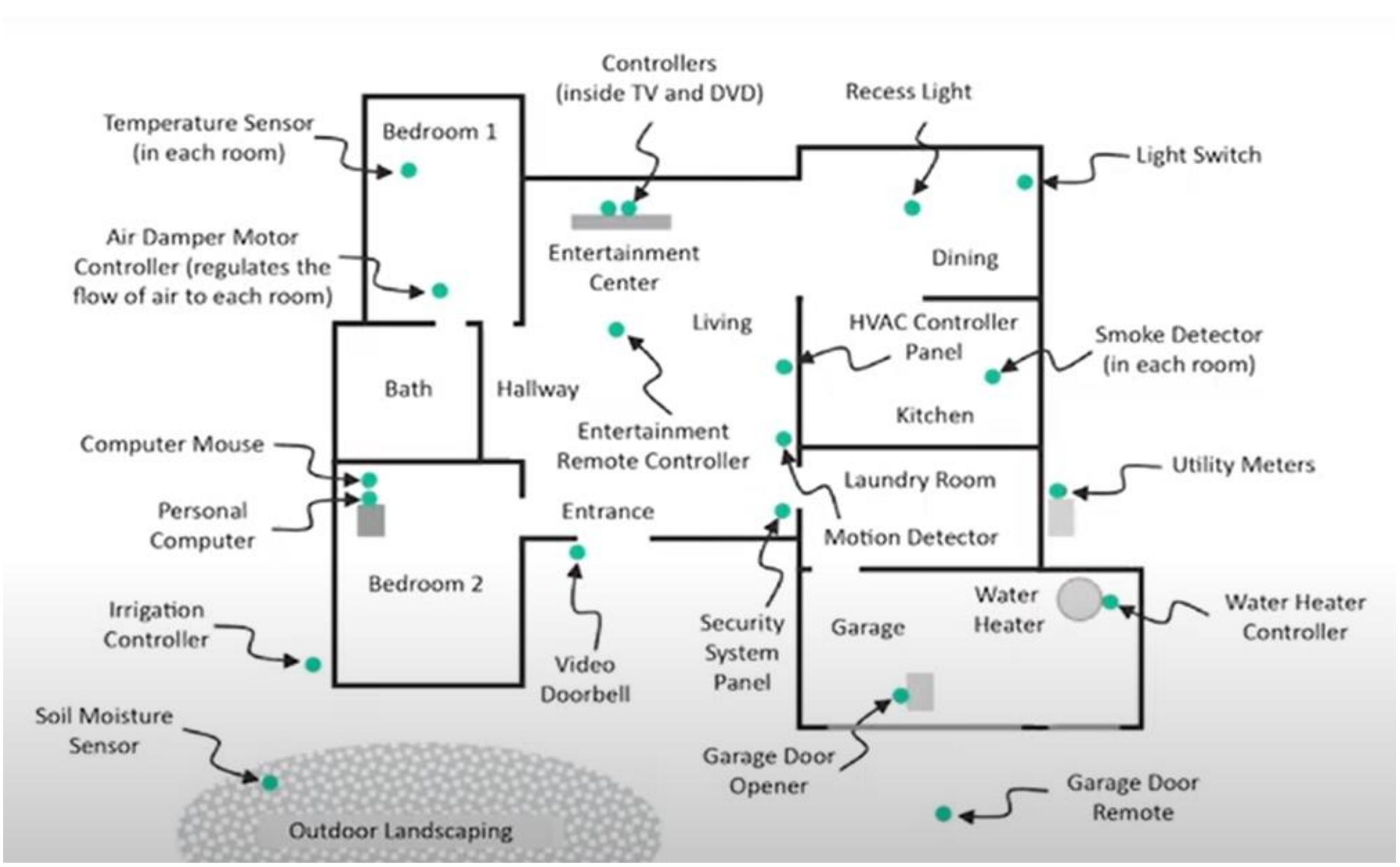

0013A200
40A198CD
B1F5
0013A200
40A9E78B
0000
0013A200
40A9E756
2024
0013A200
40A9527D
39D1
0013A200
40A9E85D
663D
4/62
242/233
253/254
254/254
252/254
253/255
0013A200
40A9E8AA
8D0D
0013A200
40A9E883
CE09
0013A200
40A9E7ED
D529
0013A200
40ADEA91
C292
0013A200
40A9E740
9D2A
255/?
MAC: 0013A20040A9E8AA
Net Addr: 8D0D
Type: Router
Last scan: 2
Connected to:
1 [CE09] 0013A20040A9E883 Active 183LQI
2 [D529] 0013A20040A9E7ED Active 254LQI
3 [CC30] 0013A20040A9E921 Active 255LQI
4 [B1F5] 0013A20040A198CD Active 62LQI
5 [0000] 0013A20040A9E78B Inactive 233LQI
6 [2024] 0013A20040A9E756 Active 254LQI
7 [39D1] 0013A20040A9527D Active 254LQI
8 [663D] 0013A20040A9E85D Active 254LQI
0013A200
40A9E921
CC30
0013A200
40A9E843
D7B4
0013A200
40A9E77E
D6AF
0013A200
4030C532
D37E

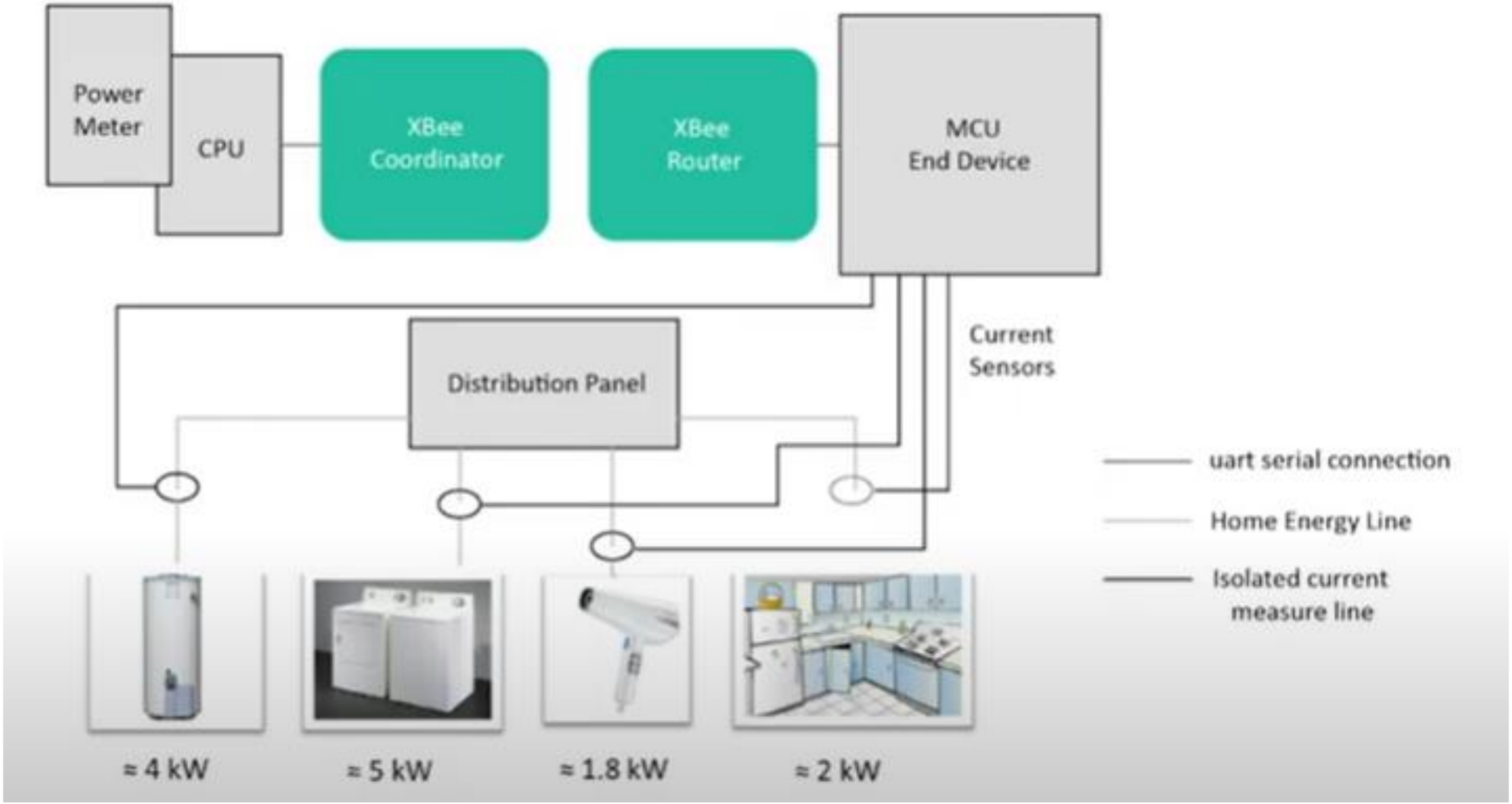
APPLICATIONS

- Smart home monitoring
- Healthcare devices
- Food safety monitoring
- Security monitoring
- controlling home applications from remote locations
- Automatic doors, windows enabled with motion sensors




Lamp
Switch
Second Floor
Lamp
Sensor
Lamp
Router
First Floor
Sensor
Lamp
Lamp
Router
Ground Floor
Sensor
Lamp
Basement
Coordinator


Controllers
(inside TV and DVD)
Recess Light
Temperature Sensor
(in each room)
Bedroom 1
Light Switch
Air Damper Motor
Controller (regulates the
flow of air to each room)
Entertainment
Center
Dining
Living
HVAC Controller
Panel
Smoke Detector
(in each room)
Bath
Hallway
Kitchen
Entertainment
Remote Controller
Computer Mouse
Laundry Room
Utility Meters
Personal
Computer
Entrance
Motion Detector
Bedroom 2
Water
Heater
Water Heater
Controller
Irrigation
Controller
Security
System
Panel
Garage
Video
Doorbell
Soil Moisture
Sensor
Garage Door
Opener
Garage Door
Remote
Outdoor Landscaping


Power Meter
CPU
XBee Coordinator
XBee Router
MCU End Device
Distribution Panel
Current Sensors
uart serial connection
Home Energy Line
Isolated current measure line
≈ 4 kW
≈ 5 kW
≈ 1.8 kW
≈ 2 kW

Bluetooth	Zigbee
The frequency range of Bluetooth ranges from 2.4 GHz – 2.483 GHz	The frequency range of Zigbee is 2.4 GHz
It has 79 RF channels	It has 16 RF channels
The modulation technique used in Bluetooth is GFSK	Zigbee uses different modulation techniques like BPSK, QPSK & GFSK.
Bluetooth includes 8-cell nodes	Zigbee includes above 6500 cell nodes
Bluetooth uses IEEE 802.15.1 specification	Zigbee uses IEEE 802.15.4 specification
Bluetooth covers the radio signal upto 10meters	Zigbee covers the radio signal upto 100 meters
Bluetooth takes 3 seconds to join a network	Zigbee takes 3 Seconds to join a network
The network range of Bluetooth ranges from 1-100 meters based on radio class.	The network range of Zigbee is up to 70 meters

Bluetooth	Zigbee
Bluetooth requires less bandwidth	As compared with Bluetooth, it needs high bandwidth
The TX Power of Bluetooth is 4 dBm	The TX Power of Zigbee is 18 dBm
The frequency of Bluetooth is 2400 MHz	The frequency of Zigbee is 2400 MHz
Tx antenna gain of Bluetooth is 0dB whereas the RX -6dB	Tx antenna gain of Zigbee is 0dB whereas the RX -6dB
Sensitivity is -93 dB	Sensitivity is -102 dB
The margin of Bluetooth is 20 dB	Margin of zigbee is 20 dB
Bluetooth range is 77 meters	The Zigbee range is 291 meters

LoRa	Zigbee
The frequency bands of LoRa ranges from 863-870 MHz, 902-928 MHz &779-787 MHz	The frequency bands of Zigbee are 868MHz, 915 MHz, 2450 MHz
LoRa covers the distance in urban areas like 2 to 5kms whereas in rural areas 15kms	Zigbee covers the distance from 10-100meters
The power utilization of LoRa is low as compared to Zigbee	Power utilization is low
The modulation technique used in LoRa is FSK otherwise GFSK	The modulation technique used in Zigbee is OQPSK & BPSK, It uses the DSSS method to change bits to chips.
The data rate of LoRa is 0.3 to 22 Kbps for LoRa modulation & 100 Kbps for GFSK	The data rate of Zigbee is 20 kbps for 868 frequency band, 40Kbps for 915 frequency band, and 250 kbps for 2450 frequency band)
The network architecture of LoRa includes servers, LoRa Gateway & end devices.	The network architecture of Zigbee routers, coordinator & end devices.
The protocol stack of LoRa includes PHY, RF, MAC & application layers	The protocol stack of Zigbee includes PHY, RF, MAC, network security & application layers.
The Physical Layer of LoRa mainly uses a	Zigbee includes two physical layers like 868/915 Mhz

Applications of Zigbee Technology

The applications of ZigBee technology include the following.

Industrial Automation: In manufacturing and production industries, a communication link continually monitors various parameters and critical equipment. Hence Zigbee considerably reduces this communication cost as well as optimizes the control process for greater reliability.

Home Automation: Zigbee is perfectly suited for controlling home appliances remotely as a lighting system control, appliance control, heating, and cooling system control, safety equipment operations and control, surveillance, and so on.

Smart Metering: Zigbee remote operations in smart metering include energy consumption response, pricing support, security over power theft, etc.

Smart Grid monitoring: Zigbee operations in this smart grid involve remote temperature monitoring, fault locating, reactive power management, and so on.

ZigBee technology is used to build engineering projects like wireless fingerprint attendance system and home automation.