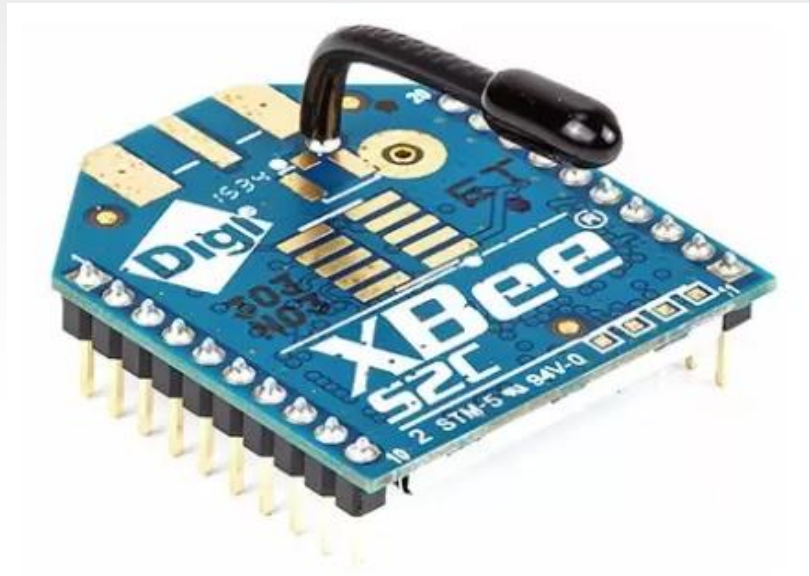


# ZigBee RF Module



# ZigBee

- ZigBee is a technology standard to design for control and sensor network
- Based on IEEE 802.15.4 standard
- Ad-hoc and Mesh network creation
- Routing (pass messages on) and Self-healing
- Example of WPAN Technology
- Created by ZigBee Alliance
  - Global standards for reliable, cost-effective, low power wireless applications



# Radio Communication

- Electromagnetic Waves
- No medium required
- Modulation
- Wireless/Airwaves
- Inverse Square Law

$$\rho \propto \frac{1}{r^2}$$

r = distance,  $\rho$  = power.



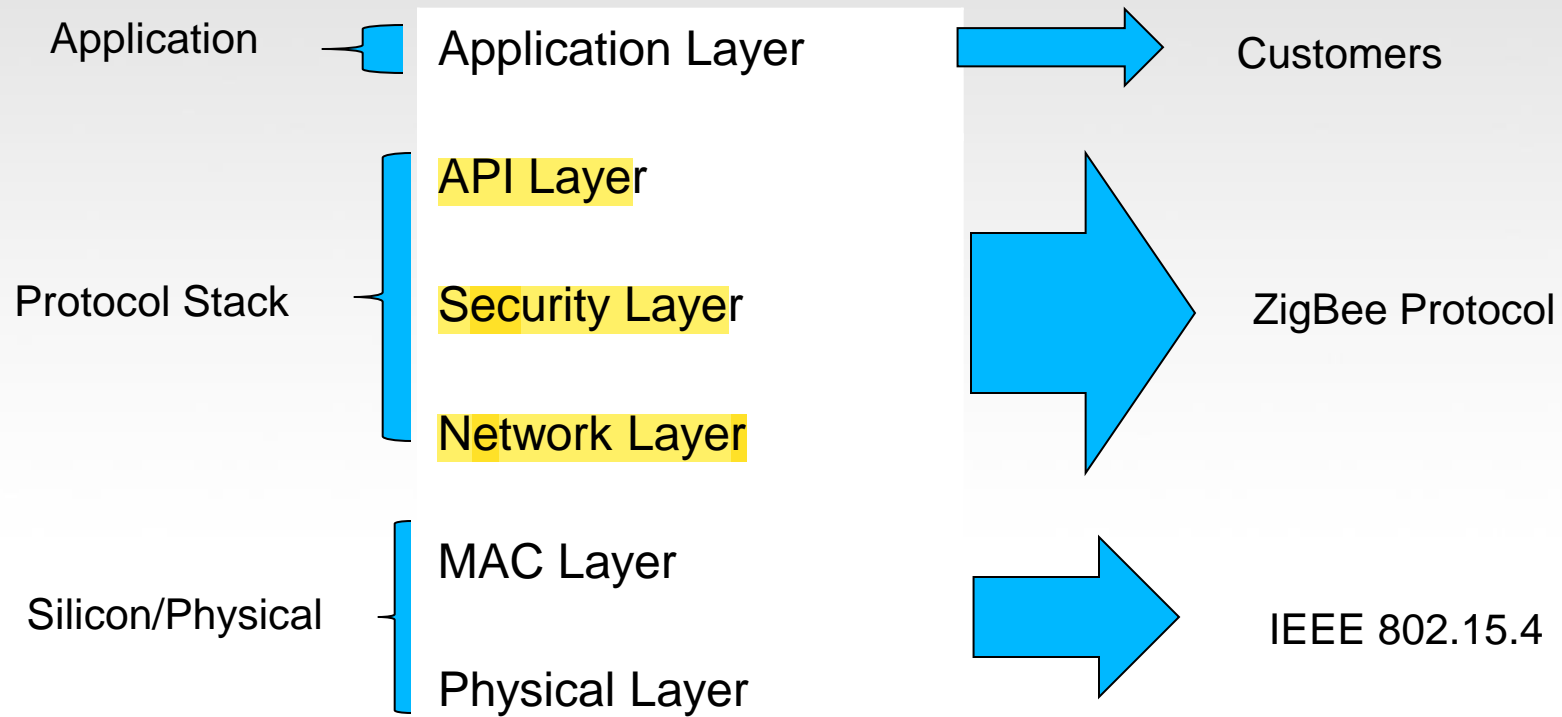
# Need of ZigBee?

- Development started 1998, when many engineers realized that Wi-Fi and Bluetooth were going to be unsuitable for many applications as
- Direct /indirect communication between multiple machines
- Non standardized IoT devices
- Low power and small size devices
- Cost effective and security.

# IEEE 802.15.4

- Low Power consumption
- Low bandwidth
- Affordable
- Small
- Standardized
- Popular

# Layering Architecture of ZigBee

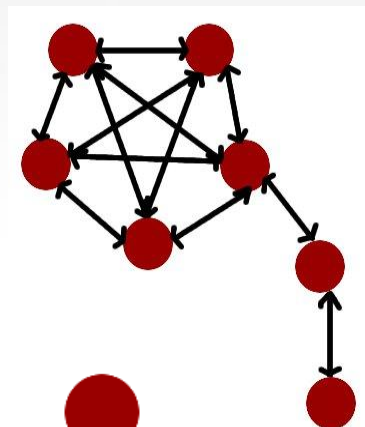


# IEEE 802.15.4 Configurations

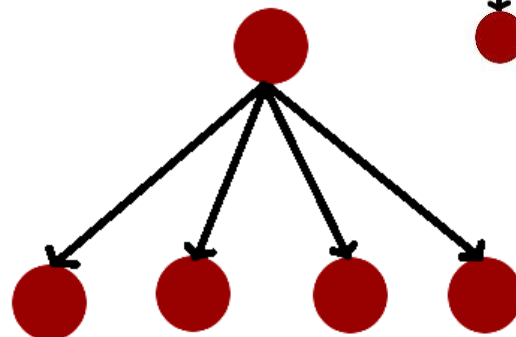
- Single Peer



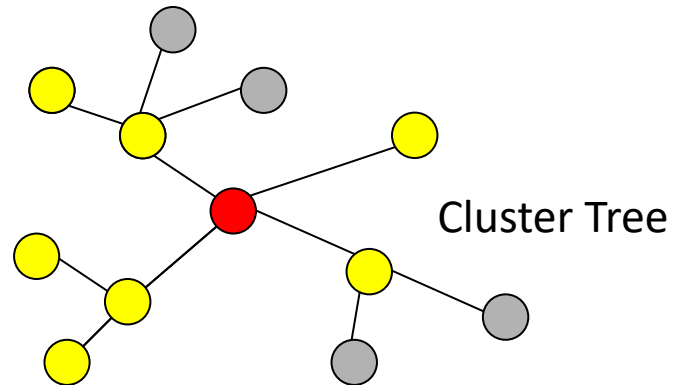
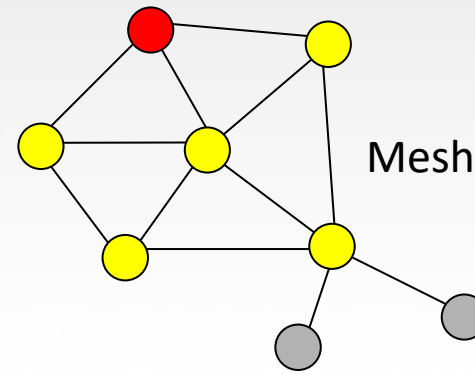
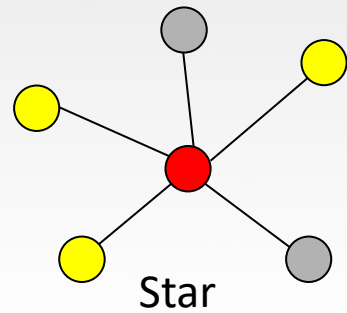
- Multi Peer






- Broadcast



# ZigBee Network Topologies

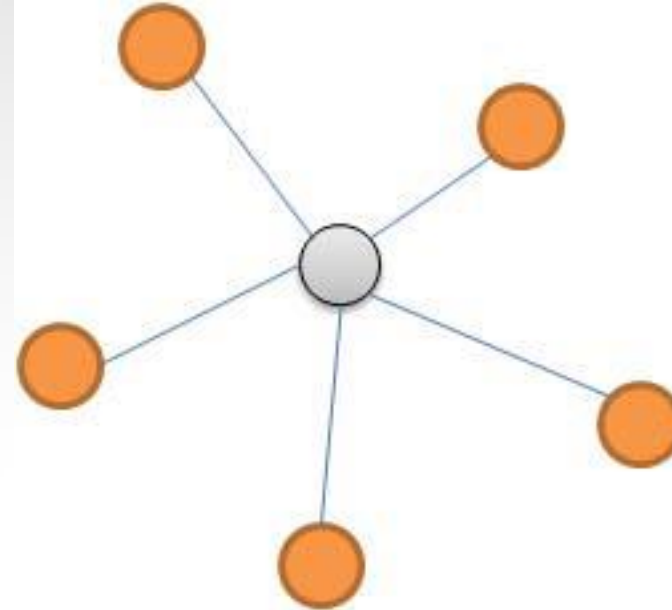


-  PAN coordinator
-  Full Function Device
-  Reduced Function Device



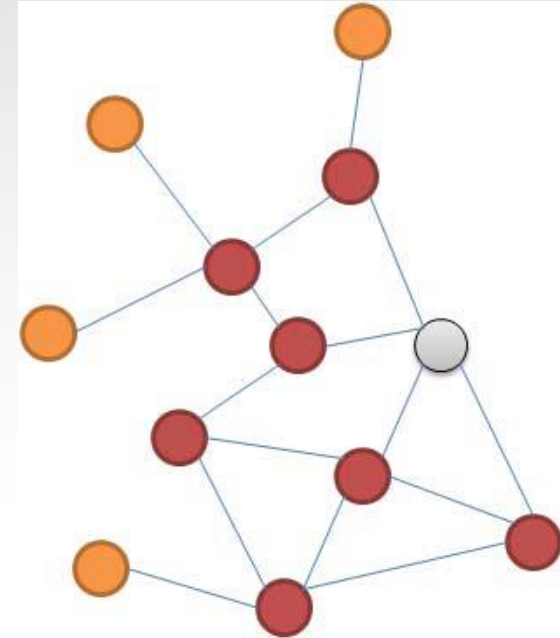
# ZigBee Network Topologies

- Star Topology
  - Advantage
    - Easy to synchronize
    - Low latency
  - Disadvantage
    - Small scale



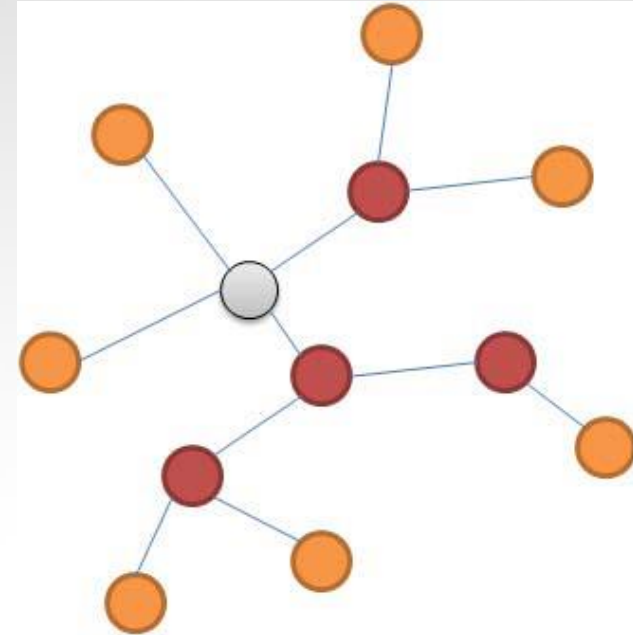
# ZigBee Network Topologies

- Mesh Topology
  - Advantage
    - Robust multi-hop communication
    - Network is more flexible
    - Lower latency
  - Disadvantage
    - Route discovery is costly
    - Needs storage for routing table



# ZigBee Network Topologies

- Cluster Tree
  - Advantage
    - Low routing cost
    - Allow multihop communication
  - Disadvantage
    - Route reconstruction is costly
    - Latency may be quite long

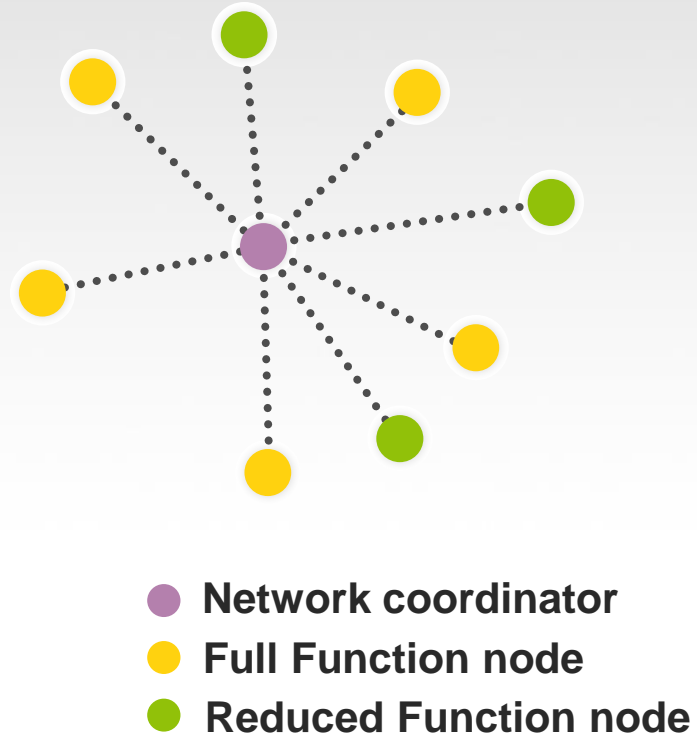


# Sensor/Control Network Requirements

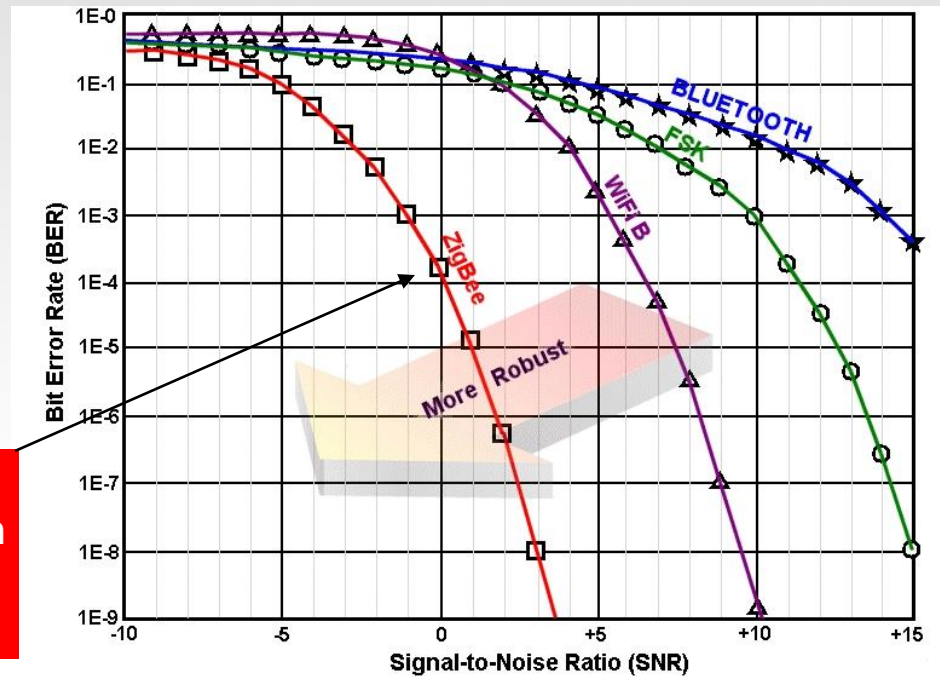
- Networks form by themselves, scale to large sizes and operate for years without manual intervention
- Extremely long battery life (years on AA cell),
  - low infrastructure cost (low device & setup costs)
  - low complexity and small size
- Low device data rate and QoS (Quality-of-Service)
- Standardized protocols allow multiple vendors to interoperate.

# Basic Network Characteristics

- 65,536 network (client) nodes
- 27 channels over 2 bands
- 250Kbps data rate
- Optimized for time-critical applications and power management
- Full mesh networking support



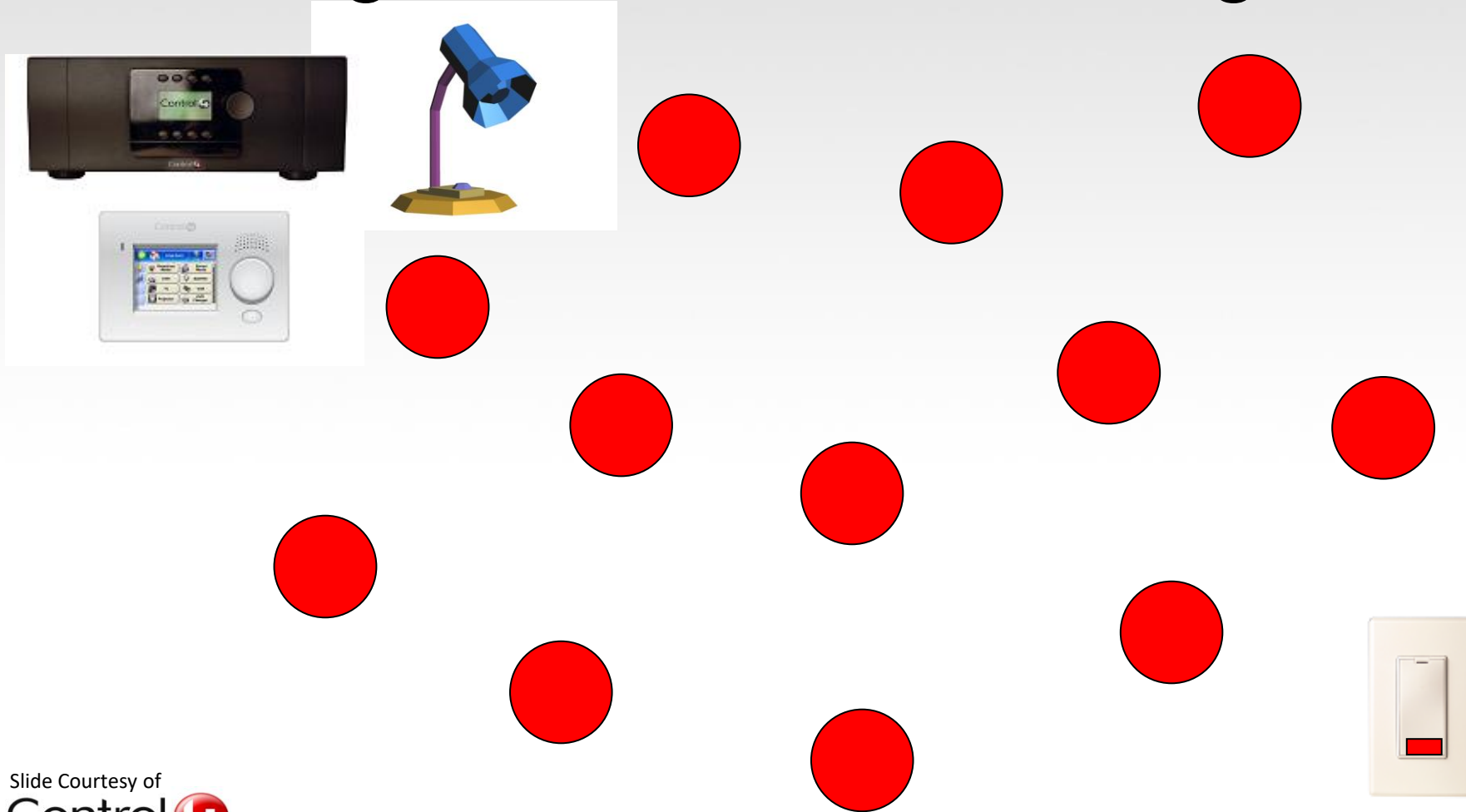
# Basic Radio Characteristics



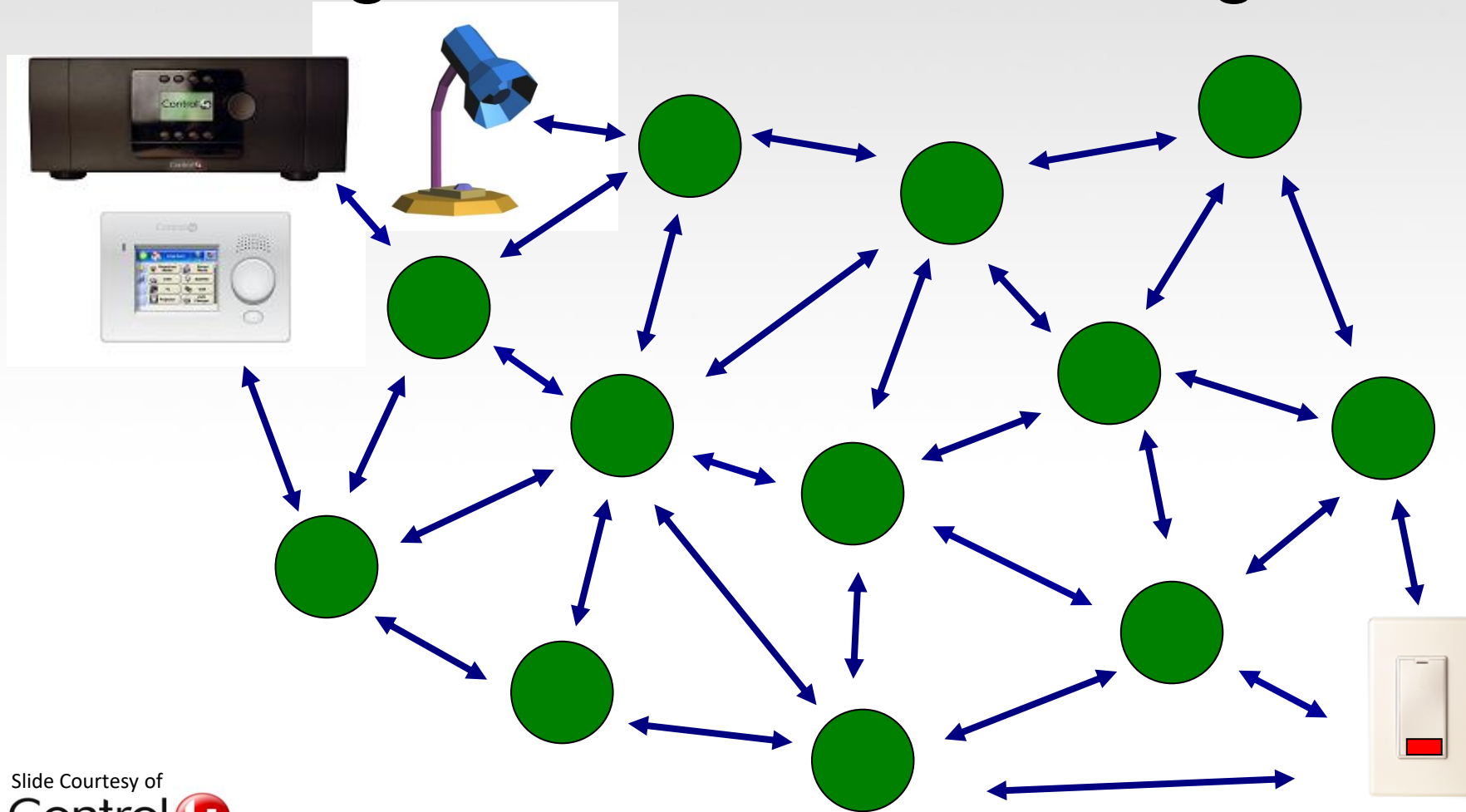
ZigBee technology relies upon IEEE 802.15.4, which has excellent performance in low SNR environments

Frequency Band	License Required?	Geographic Region	Data Rate	Channel Number(s)
868.3 MHz	No	Europe	20kbps	0
902-928 MHz	No	Americas	40kbps	1-10
2405-2480 MHz	No	Worldwide	250kbps	11-26

# ZigBee Mesh Networking

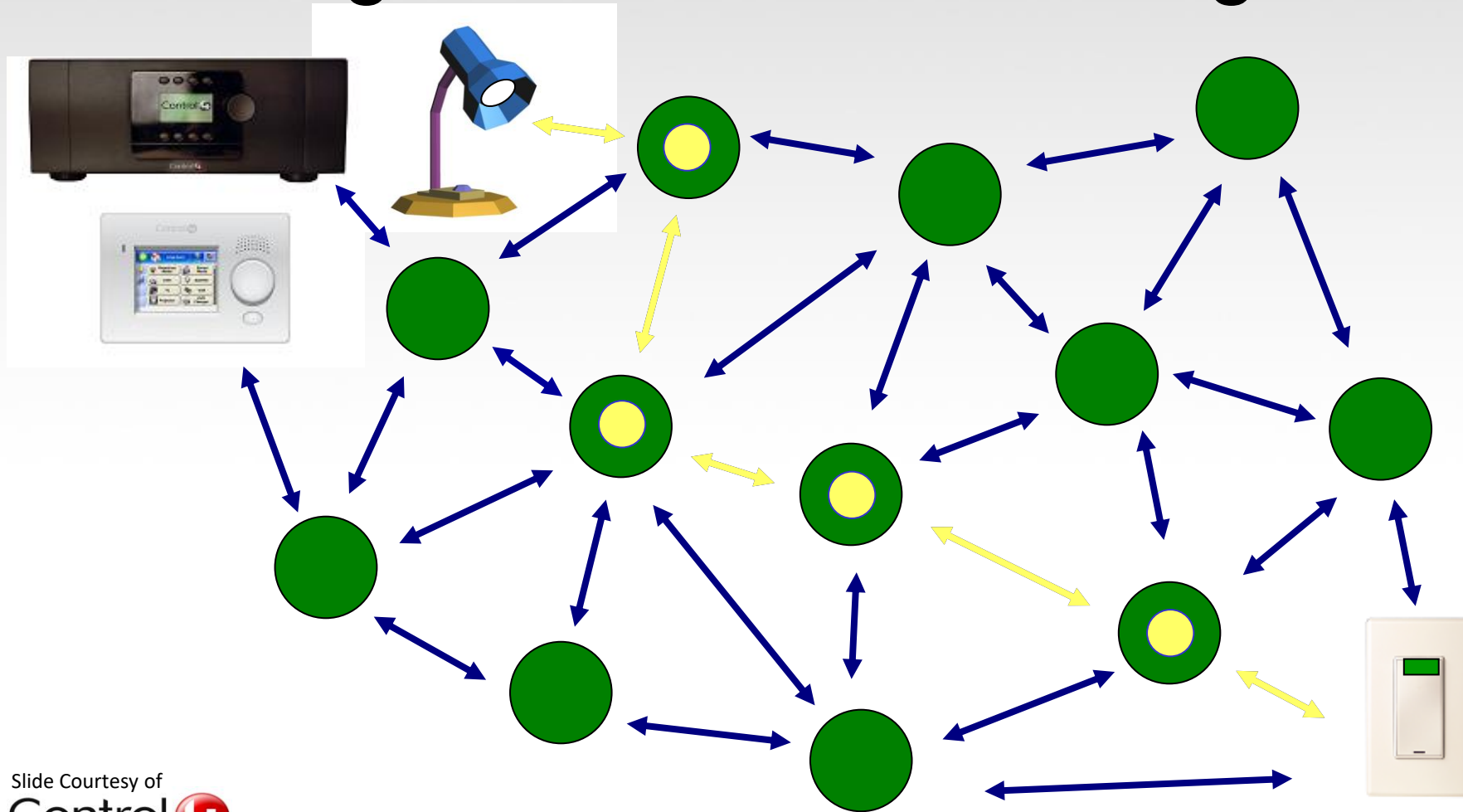


# ZigBee Mesh Networking

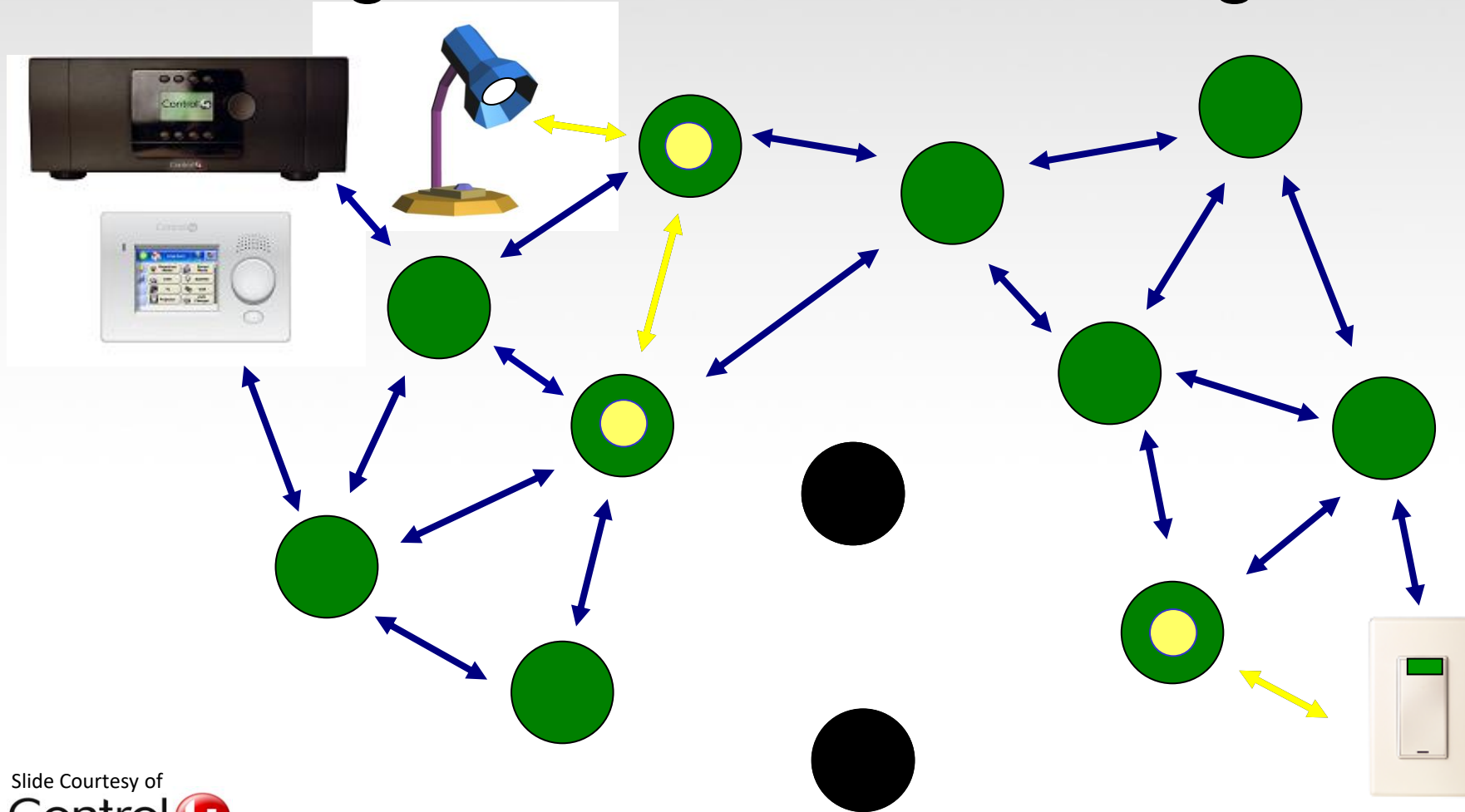




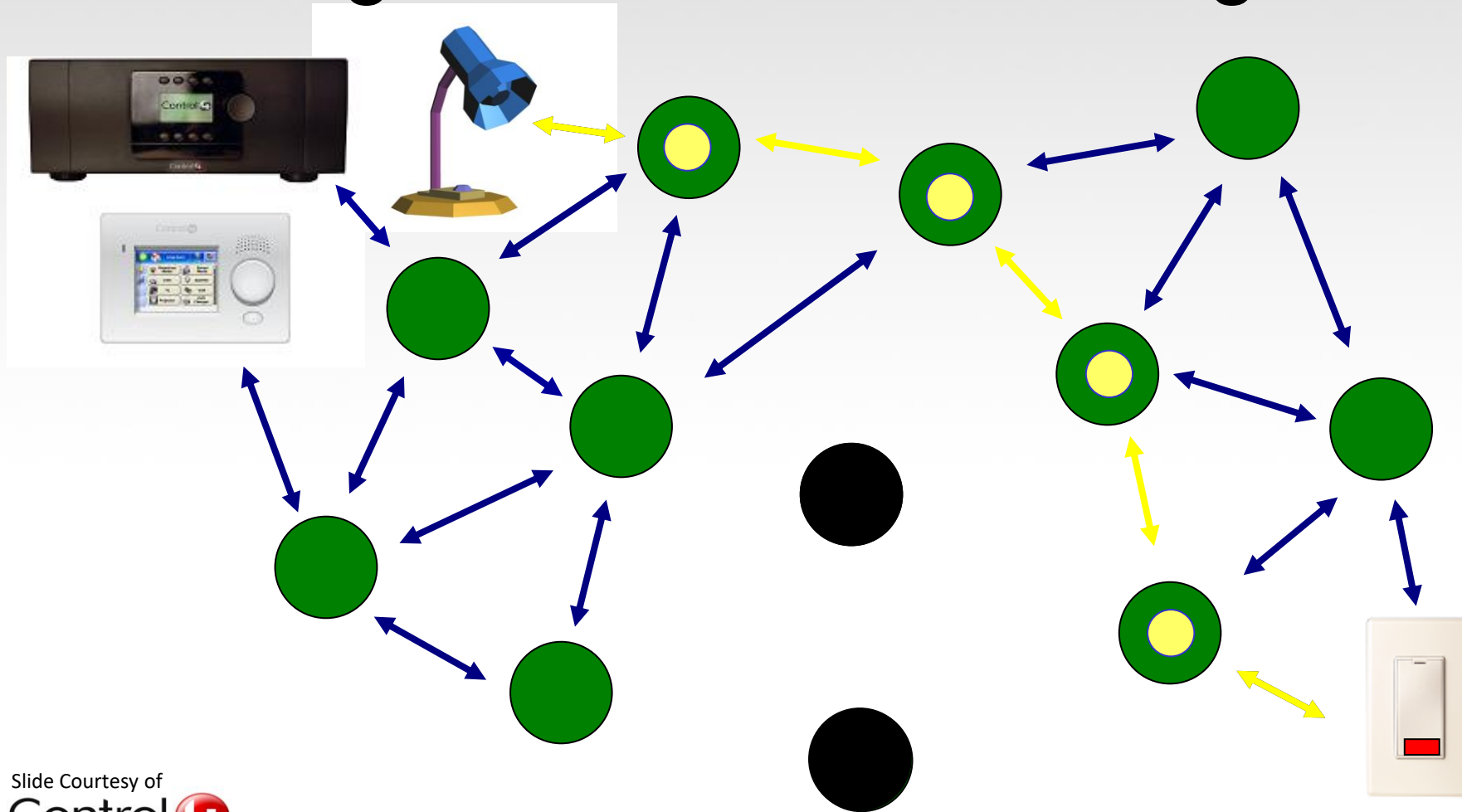
# ZigBee Mesh Networking







# ZigBee Mesh Networking



# ZigBee Mesh Networking



Wireless Connectivity Comparison				
Category	BLE	Bluetooth Classic	ZIG-BEE	Wi-Fi
				
IEEE Standard	802.15.1	802.15.1	802.15.4	802.11 (a, b, g, n)
Frequency (GHz)	2.4	2.4	0.8, 0.9, 2.4	2.4 to 5
Bandwidth (Mbps)	Low ( 1 )	Medium ( 1 to 3)	Very low (0.25)	High (54-a, 11-b, 54-g, 600-n)
Power Consumption	Very Low	Medium	Very low	High
Battery Life	Months to Years	Days	Months to Years	Hours
Network Size	Undefined	7	64,000 +	255
Range	Short to Medium	Short	Medium	Medium to Long
Ease of use	Simple to use	Fairly simple to use	Fairly simple to use, but not yet adopted in mobiles and computers	It is more complex and requires configuration of Hardware and Software
Adaptability	High	High	Low	High
Primary Applications	Wearables, Mobile phones	Mobile Phones, mouse, keyboards, office and industrial automation devices	Industrial Automation, Home Automation, Smart metering	Notebook computers, desktop computers, servers.

# XBee as a Coordinator

- Each network has 1 coordinator
- Coordinator selects channel and Create PAN ID
- Other devices then join the PAN ID
- Usually powered by something stable
- 16-bit network address is always 0
- Assigns 16-bit address for the router and end devices

# XBee as a Routers

- Router as Optional
- Often powered by something stable
- Can have as many as you want
- Issues a request on start to find a coordinator/network so it can join
- Can talk to any device
- Coordinator can act as a “super router”

# XBee as End Devices

- End devices as Optional
- Usually, battery powered
- Can have as many as you want
- Issues a request on start to find a network, it can join a parent device (router or coordinator)
- Can only communicate with its parent

# XBee ZB S1 Vs XBee ZB S2 Vs XBee s2c

Specification	XBee ZB S1	XBee ZB S2	XBee ZB S2C
Indoor/Urban range	up to 100 ft. (30m)	up to 133 ft. (40m)	up to 200 ft (60 m)
Outdoor RF line-of-sight range	up to 300 ft. (100m)	up to 400 ft. (120m)	up to 4000 ft (1200m)
Transmit Power Output	1 mW (0dbm)	2 mW (+3dbm)	6.3mW (+8dBm) Boost mode
			3.1mW (+ddBm) Normal mode
RF Data Rate	250 Kbps	250 Kbps	250 Kbps
Receiver Sensitivity	-92dBm (1% PER)	-98dBm (1% PER)	-102dBm (1% PER) Boost mode
			-100dBm (1% PER) Normal Mode



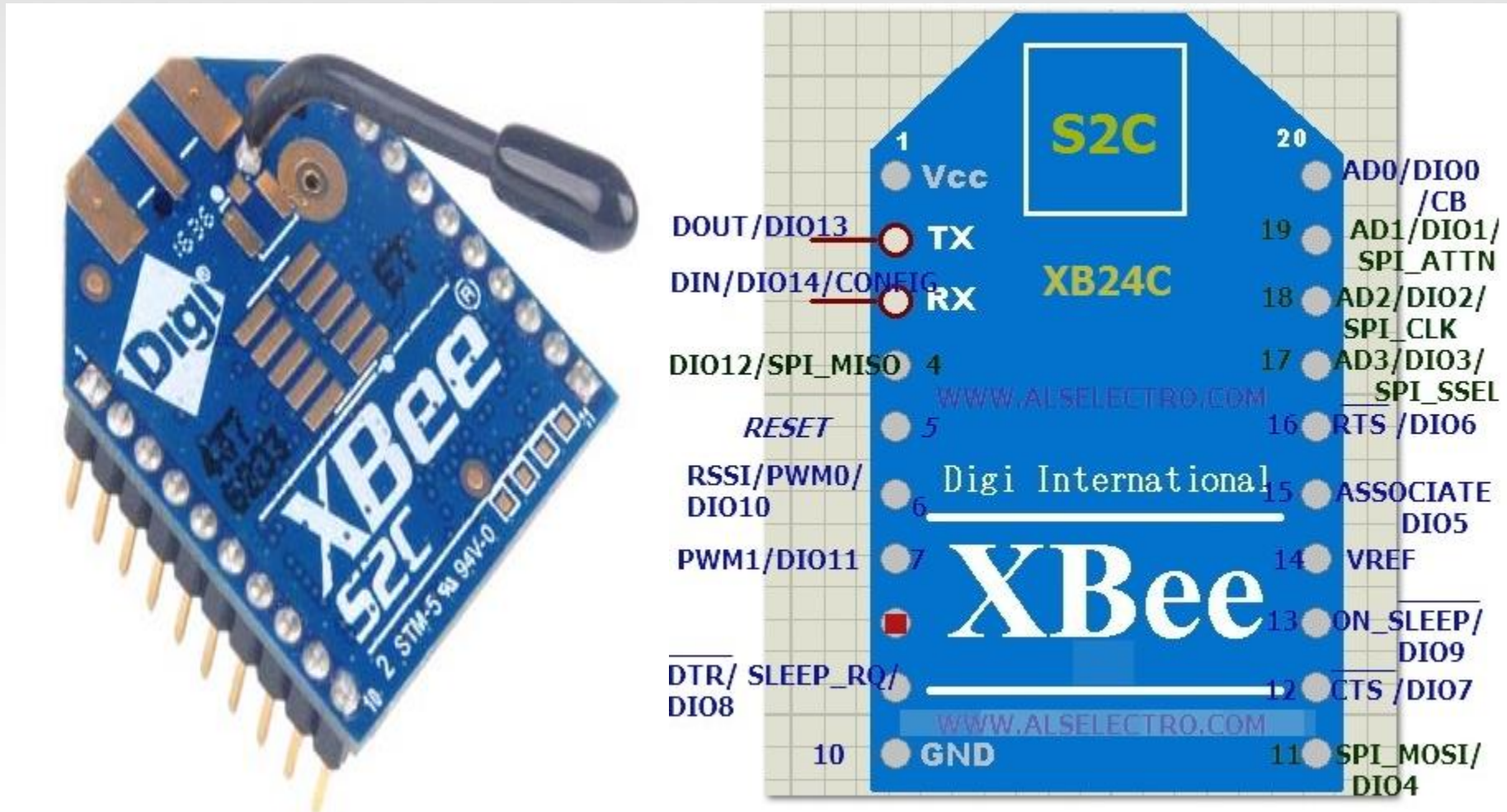
# XBee ZB S1 Vs XBee ZB S2 Vs XBee s2c

Supply Voltage	2.8 - 3.4 V	2.8 - 3.6 V	2.1 - 3.6V
Transmit Current (typical)	45 mA (@ 3.3 V)	40 mA (@ 3.3 V)	45 mA (+8dBm) Boost Mode
			33 mA (+5dBm) Normal Mode
Idle/Receive Current (typical)	50 mA (@ 3.3 V)	40 mA (@ 3.3 V)	31 mA (+8dBm) Boost Mode
			28 mA (+5dBm) Normal Mode
Power-down Current	10 uA	1 uA	<1uA
Frequency	ISM 2.4 GHz	ISM 2.4 GHz	ISM 2.4 GHz

# XBee ZB S1 Vs XBee ZB S2 Vs XBee s2c

Network Topologies	Point to point, Star, Mesh (with DigiMesh firmware)	Point to point, Star, Mesh	Point to point, Star, Mesh
Number of Channels	16 Direct Sequence Channels	16 Direct Sequence Channels	16 Direct Sequence Channels
Filtration Options	PAN ID, Channel & Source/Destination	PAN ID, Channel & Source/Destination	PAN ID, Channel & Source/Destination

# XBee s2c Pin out Diagram



# Pin signals for XBee s2c

Pin	Name	Direction	Description
1	VCC		Power supply
2	DOUT	Output	UART data out
3	DIN/CONFIG	Input	UART data In
4	DIO12/SPI_MISO	Both	Digital I/O 12 / Serial Peripheral Interface (SPI) Data Out
5	RESET	Input	Module reset (reset pulse must be at least 200 ns). This must be driven as an open drain/collector. The device drives this line low when a reset occurs. Never drive this line high.
6	DIO10/PWM0/RSSI PWM	Both	Digital I/O 10 / PWM output 0 / RX signal strength indicator
7	DIO11/PWM1	Both	Digital I/O 11 / PWM output 1
8	[Reserved] - Do not connect		
9	DIO8/SLEEP_ RQ/DTR	Both	Digital I/O 8 / Pin sleep control line
10	GND		Ground
11	DIO4/SPI_MOSI	Both	Digital I/O 4 / SPI Data In
12	DIO7/CTS	Both	Digital I/O 7 / Clear-to-send flow control
13	ON/SLEEP	Output	Device sleep status indicator
14	VREF		Feature not supported on this device. Used on other XBee devices for analog voltage reference.

# Pin signals for XBee s2c Cont..

Pin	Name	Direction	Description
15	DIO5/ASSOC	Both	Digital I/O 5 / Associated indicator
16	DIO6/RTS	Both	Digital I/O 6 / Request-to-send flow control
17	DIO3/AD3/SPI_ SSEL	Both	Digital I/O 3 / Analog input 3 / SPI select
18	DIO2/AD2/SPI_CLK	Both	Digital I/O 2 / Analog input 2 / SPI clock
19	DIO1/AD1/SPI_ ATTN	Both	Digital I/O 1 / Analog input 1 / SPI Attention
20	DIO0/AD0	Both	Digital I/O 0 / Analog input 0

# Troubleshooting

- Only use 3.3V, more than 5V will release magic smoke
- Use decoupling capacitors with a voltage regulator
- TX->RX
- RX->TX
- Don't overwhelm them, try putting in a small delay

# Firmware

- Must install with X-CTU (on Windows)
- API firmware
- Coordinator, Router, End Device
- Each Firmware has different settings

# Thank You

<https://www.robolab.in/zigbee-xbee-s2c-how-to-configure-as-coordinator-router-end-device/>



# Getting Started With XCTU

# Installation of XCTU

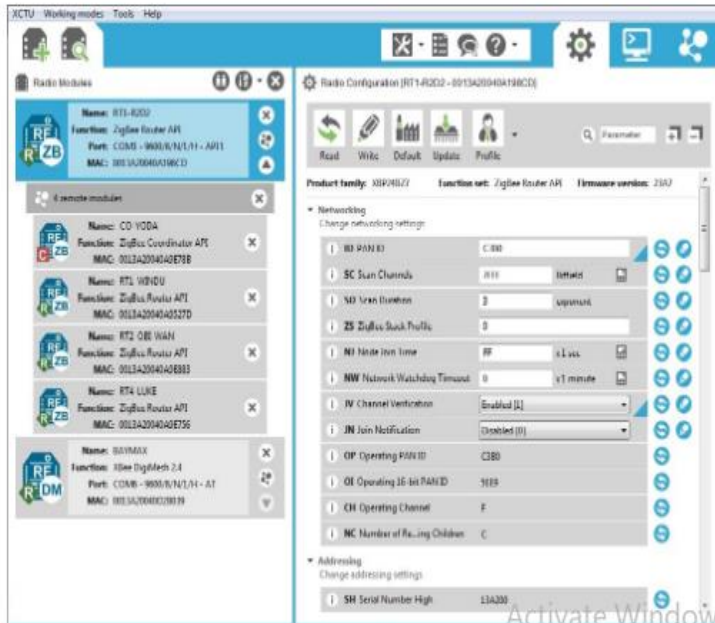
- Step 1: Click on the link :  
<https://www.digi.com/products/embedded-systems/digi-xbee-tools/xctu>
- Click on Download XCTU

# XCTU

## Next Generation Configuration Platform for XBee/RF Solutions

- XCTU is a **free, multi-platform** application compatible with Windows, MacOS and Linux
- **Graphical Network View** for simple wireless network configuration and architecture
- **API Frame Builder** is a simple development tool for quickly building XBee API frames
- **Firmware Release Notes Viewer** allows users to explore and read firmware release notes

[DOWNLOAD XCTU](#)



The screenshot displays the XCTU application window. The 'Radio Configuration' tab is active, showing settings for a ZigBee Router API module (RT1-40C32-0013A20340418BCD). The interface includes a 'Radio Modules' list on the left, a 'Product family' dropdown set to 'XBee/ZigBee', and a 'Function set' dropdown set to 'ZigBee Router API'. The 'Firmware version' is 2.10.1. The 'Networking' section is expanded, showing various settings like 'PAN ID', 'Scan Channels', 'Yan Channels', 'ZS ZigBee Stack Profile', 'NI Node Join Time', 'NW Network Watchdog Timeout', 'RF Channel Verification', 'JN Join Notification', 'OP Operating PAN ID', 'OI Operating 16-bit PAN ID', 'CH Operating Channel', and 'NC Number of Re-joining Children'. The 'Addressing' section is also expanded, showing 'SH Serial Number High' set to 13A203.

# Installation of XCTU Cont..

Step 2: You can download XCTU software for windows x86/x64, Linux x64/x86 and mac os x. Click on XCTUv6.4.3 windows x86/x64.

## UTILITIES

### DOWNLOAD XCTU

- [XCTU v. 6.4.3 Windows x86/x64](#)
- [XCTU v. 6.4.3 MacOS X](#)
- [XCTU v. 6.4.3 Linux x64](#)
- [XCTU v. 6.4.3 Linux x86](#)
- [XCTU License Agreement](#)
- [XCTU v. 6.4.3 Release Notes](#)

### DOWNLOAD LEGACY XCTU

- [XCTU ver. 5.2.8.6 installer](#)  
Last old-gen version of XCTU: Contains features from previous versions, plus adds support for XBee Wi-Fi modules, Compatible with Windows 2000, XP, 2003, Vista, 7. Does not support the Digi XLR PRO.
- [XCTU 32-bit ver. 5.2.8.6 installer release notes](#)
- [XCTU ver. 5.1.0.0 installer](#)  
This older version of X-CTU is required for XStream Ethernet RF modems, as well as XCite RF modules and modems. X-CTU 5.1.0.0 is compatible with Windows 2000, XP, 2003 only.

# Installation of USB driver for XBee Cont..

- Step 1: Click on link

<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

- To download USB drivers-→ Click on Download VCP(23MB)

## Download Software

The CP210x Manufacturing DLL and Runtime DLL have been updated and must be used with v6.0 and later of the CP210x Windows VCP Driver. Application Note Software downloads affected are AN144SW.zip, AN205SW.zip and AN223SW.zip. If you are using a 5.x driver and need support you can download archived [Application Note Software](#).

[Legacy OS software and driver package download links and support information >](#)

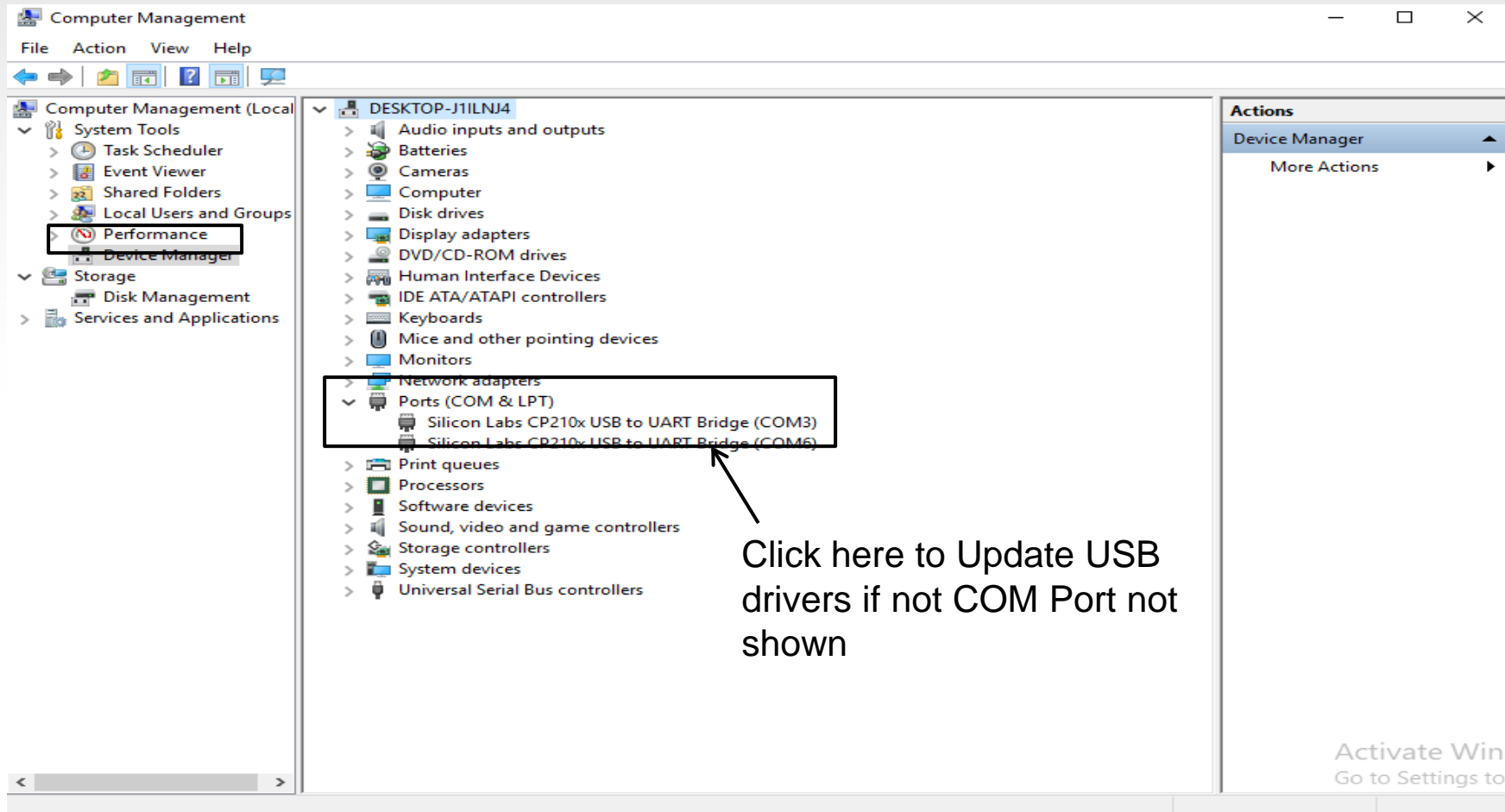
## Download for Windows 10 Universal (v10.1.8)

Note: The latest version of the Universal Driver can be automatically installed from Windows Update.

Platform	Software	Release Notes
 Windows 10 Universal	<a href="#">Download VCP (2.3 MB)</a>	<a href="#">Download VCP Revision History</a>

# Update USB driver for XBee

- Step 2: Check USB drivers for XBee. Go to Right click on My Computer--> open computer Management → click on Device Manager → and check here for USB driver for XBEE i.e. CP210x USB to UART Bridge VCP Drivers



# Communication Between Two XBee's

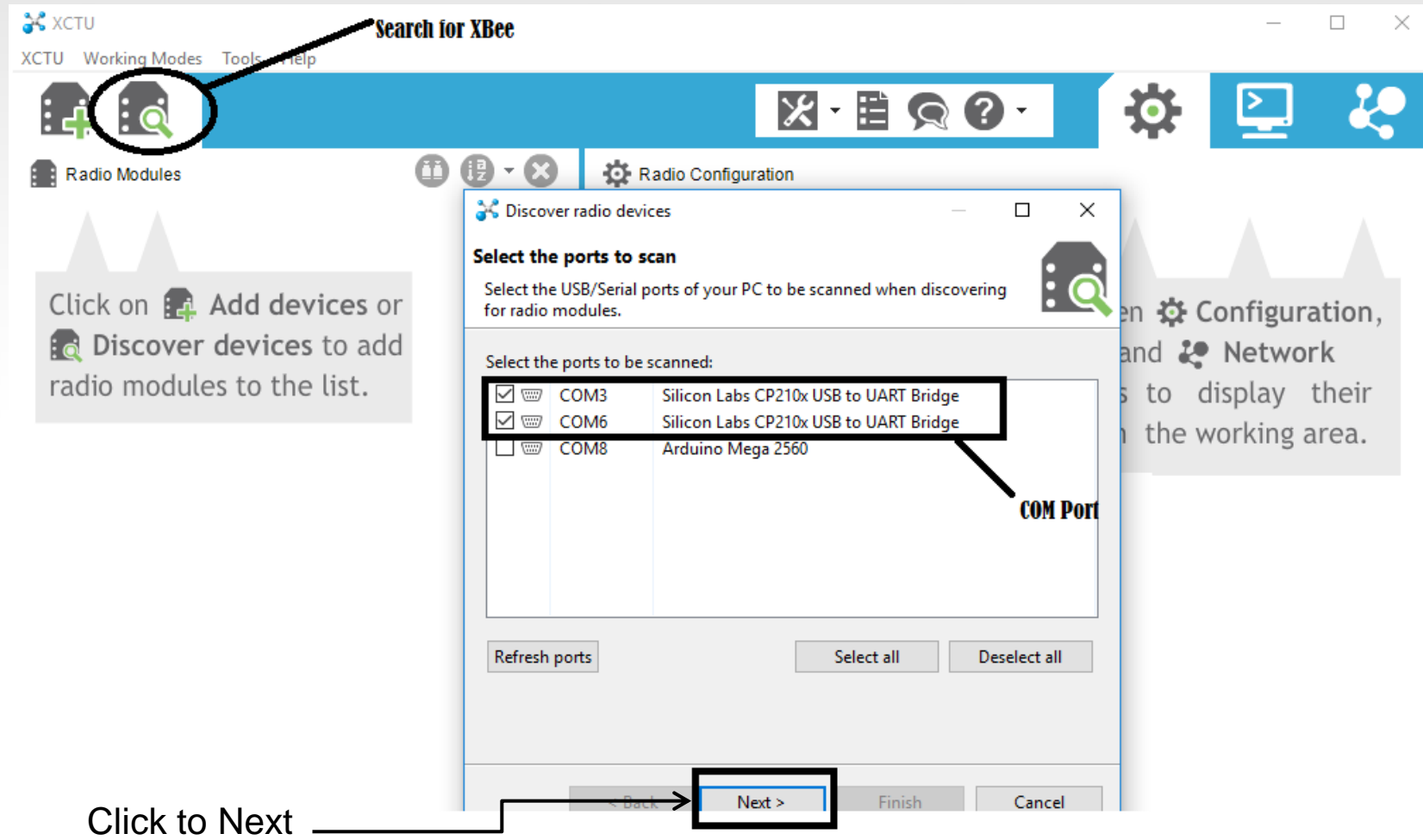
# Components Required

- Two XBee s2c with breakout board
- Two USB cables
- One or Two laptop/computer system

# Configuration for Coordinator XBee

Steps:

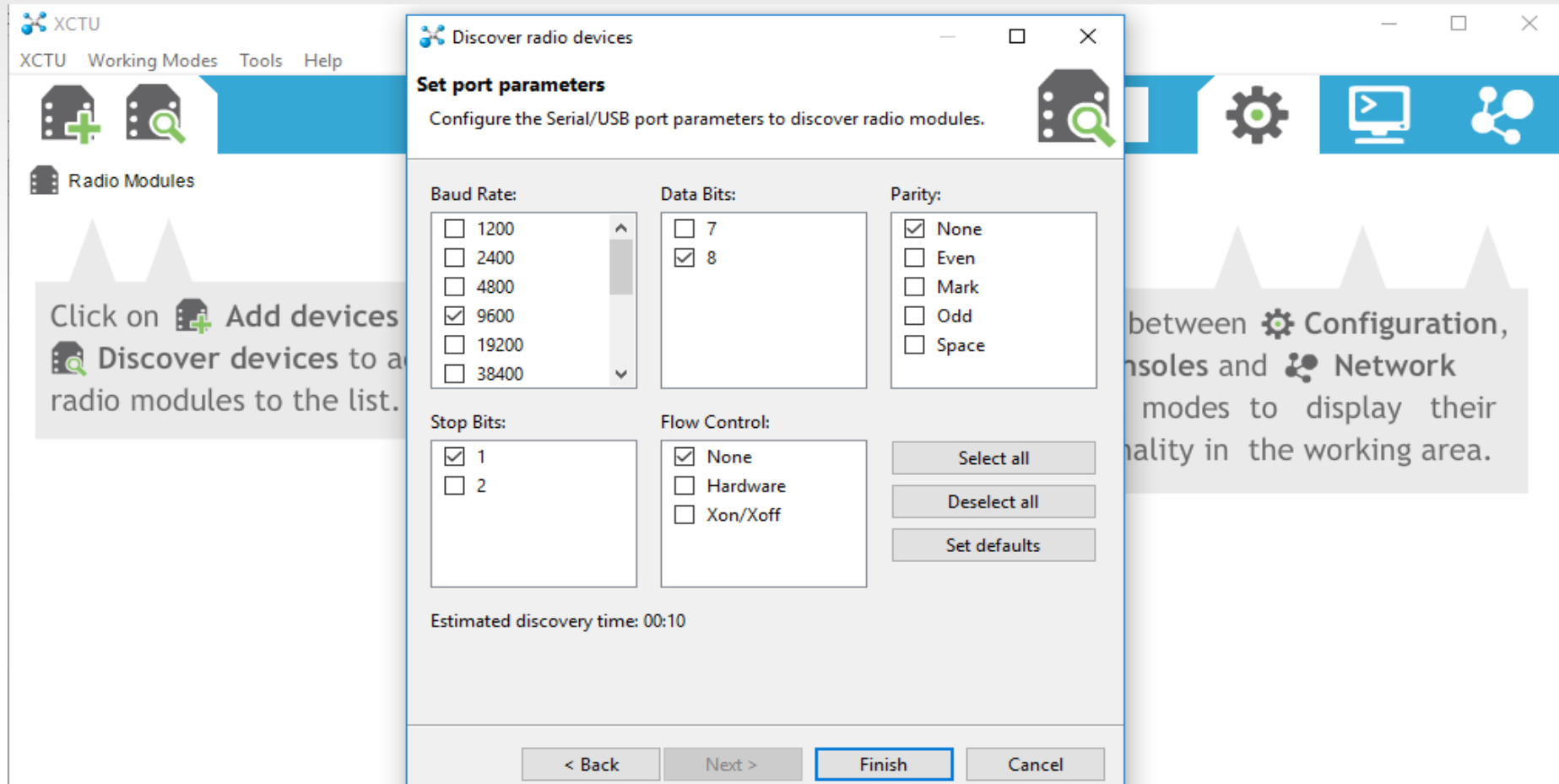
1. Open the XCTU software and Click on the SEARCH icon on top to detect the USB ports.





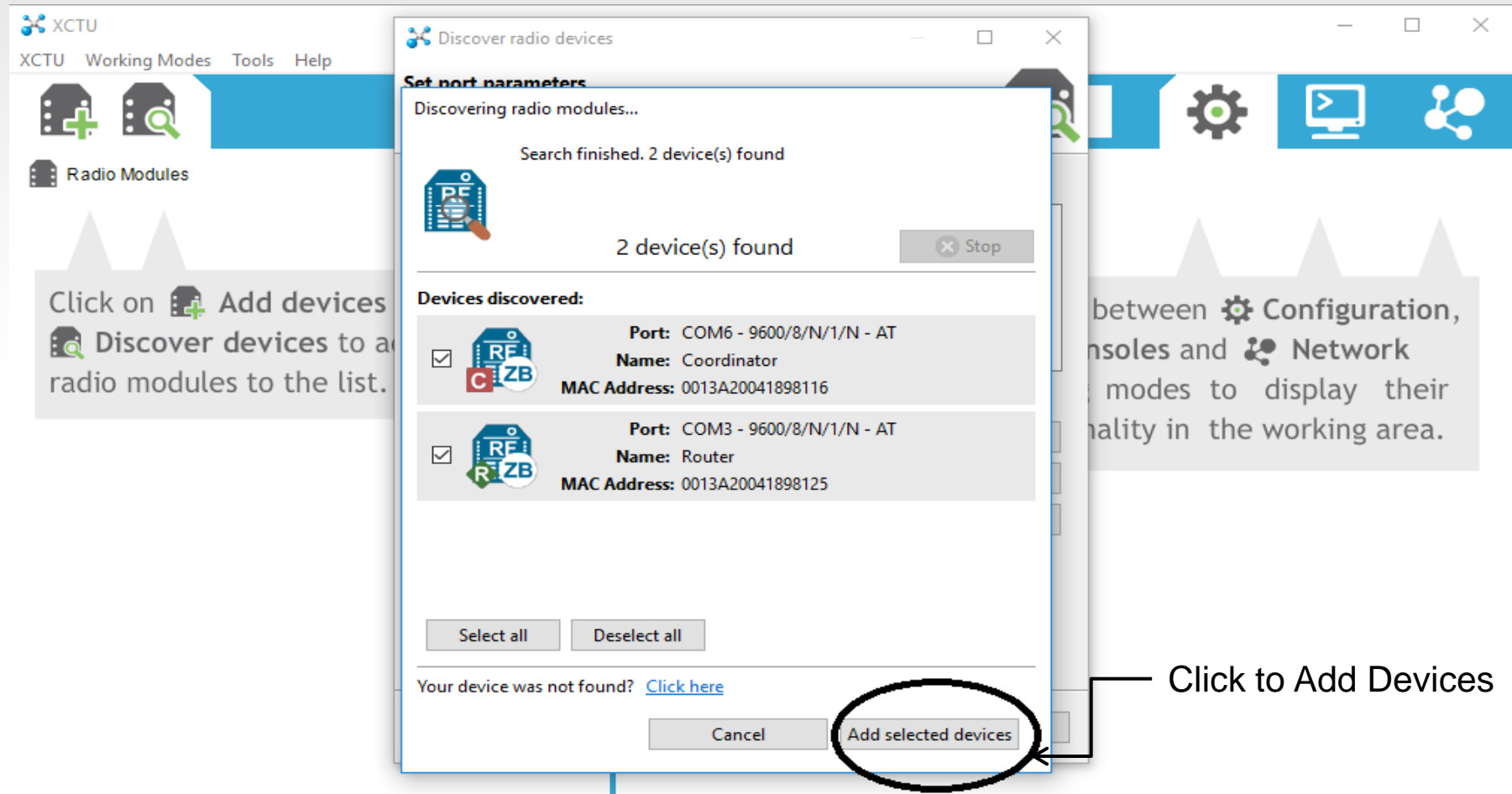
# Configuration for Coordinator XBee Cont..

- Click on NEXT & accept the default PORT PARAMETERS, 9600 is the BAUD RATE, 8 Data Bits, No Parity, Stop bit 1 and Flow Control None. Then Finish.



# Configuration for Coordinator XBee Cont..

3. The XCTU scans the USB ports selected & lists the RADIOs found with their unique 64-bit address and Select both the devices & click ADD SELECTED DEVICES.



# Configuration for Coordinator XBee Cont..

4. Now both the Radios appear on the left pane. Let us configure the RADIO at COM6 as COORDINATOR first and Load the Settings by Clicking on it.

The screenshot displays the XCTU (X-CTU) software interface. On the left, under the 'Radio Modules' section, two modules are listed: 'Router' (COM3) and 'Coordinator' (COM6). The 'Coordinator' module is highlighted with a blue background and a black circle. The right pane shows the 'Radio Configuration [Coordinator - 0013A20041898116]' settings, including buttons for 'Read', 'Write', 'Default', 'Update', and 'Profile'. A modal dialog titled 'Updating user interface...' is open, showing a progress bar and a 'Stop' button. Two callout boxes with arrows point to the interface: one to the left pane and another to the modal dialog.

Both Radio on Left Pane

Loading the settings for Coordinator

# Configuration for Coordinator XBee Cont..

5. 1<sup>st</sup> thing to set PAN ID of the network, this can be from 0 to FFFF Hex. In my case, it is 1111.

**Radio Modules**

Name	Function	Port	MAC
Router	ZIGBEE TH Reg	COM3 - 9600/8/N/1/N - AT	0013A20041898125
Coordinator	ZIGBEE TH Reg	COM6 - 9600/8/N/1/N - AT	0013A20041898116

**Radio Configuration [Coordinator - 0013A20041898116]**

Read Write Default Update Profile

Parameter

**Product family: XB24C**

**Function set: ZIGBEE TH Reg**

**Firmware version: 4060**

**Networking**

Change networking settings

Parameter	Value	Unit
ID PAN ID	1111	
SC Scan Channels	7FFF	Bitfield
SD Scan Duration	3	exponent
ZS ZigBee Stack Profile	0	
NJ Node Join Time	FF	x 1 sec
NW Network Watchdog Timeout	0	x 1 minute
JV Channel Verification	Disabled [0]	
JN Join Notification	Disabled [0]	

Product Family → XB24C

Function Set → ZIGBEE TH Reg.

Firmware Version → 4060

Set PAN ID → 1111

# Configuration for Coordinator XBee Cont..

The screenshot displays the XBee configuration interface. On the left, the 'Radio Modules' list shows two modules: a Router (MAC: 0013A20041898125) and a Coordinator (MAC: 0013A20041898116). The Coordinator is selected. On the right, the 'Radio Configuration' settings for the Coordinator are shown. The 'CE Coordinator Enable' dropdown is set to 'Enabled [1]'. The 'DO Device Options' and 'DC Device Controls' are both set to 0. The 'Addressing' section is expanded, showing the following settings: SH Serial Number High (13A200), SL Serial Number Low (41898116), MY 16-bit Network Address (0), MP 16-bit Parent Address (FFFE), DH Destination Address High (0), DL Destination Address Low (FFFF), and NI Node Identifier (Coordinator). Arrows from the text labels on the left point to the corresponding values in the configuration interface.

**Radio Modules**

- Name:** Router  
**Function:** ZIGBEE TH Reg  
**Port:** COM3 - 9600/8/N/1/N - AT  
**MAC:** 0013A20041898125
- Name:** Coordinator  
**Function:** ZIGBEE TH Reg  
**Port:** COM6 - 9600/8/N/1/N - AT  
**MAC:** 0013A20041898116

**Radio Configuration [Coordinator - 0013A20041898116]**

**Save All Settings**

**Read Write Default Update Profile**

**CE Coordinator Enable** Enabled [1]

**DO Device Options** 0 Bitfield

**DC Device Controls** 0 Bitfield

**Addressing**  
Change addressing settings

<b>SH</b> Serial Number High	13A200
<b>SL</b> Serial Number Low	41898116
<b>MY</b> 16-bit Network Address	0
<b>MP</b> 16-bit Parent Address	FFFE
<b>DH</b> Destination Address High	0
<b>DL</b> Destination Address Low	FFFF
<b>NI</b> Node Identifier	Coordinator

CE → Enables[1]

DH → 0

DL → FFFF

NI → Coordinator

# Configuration for Router XBee

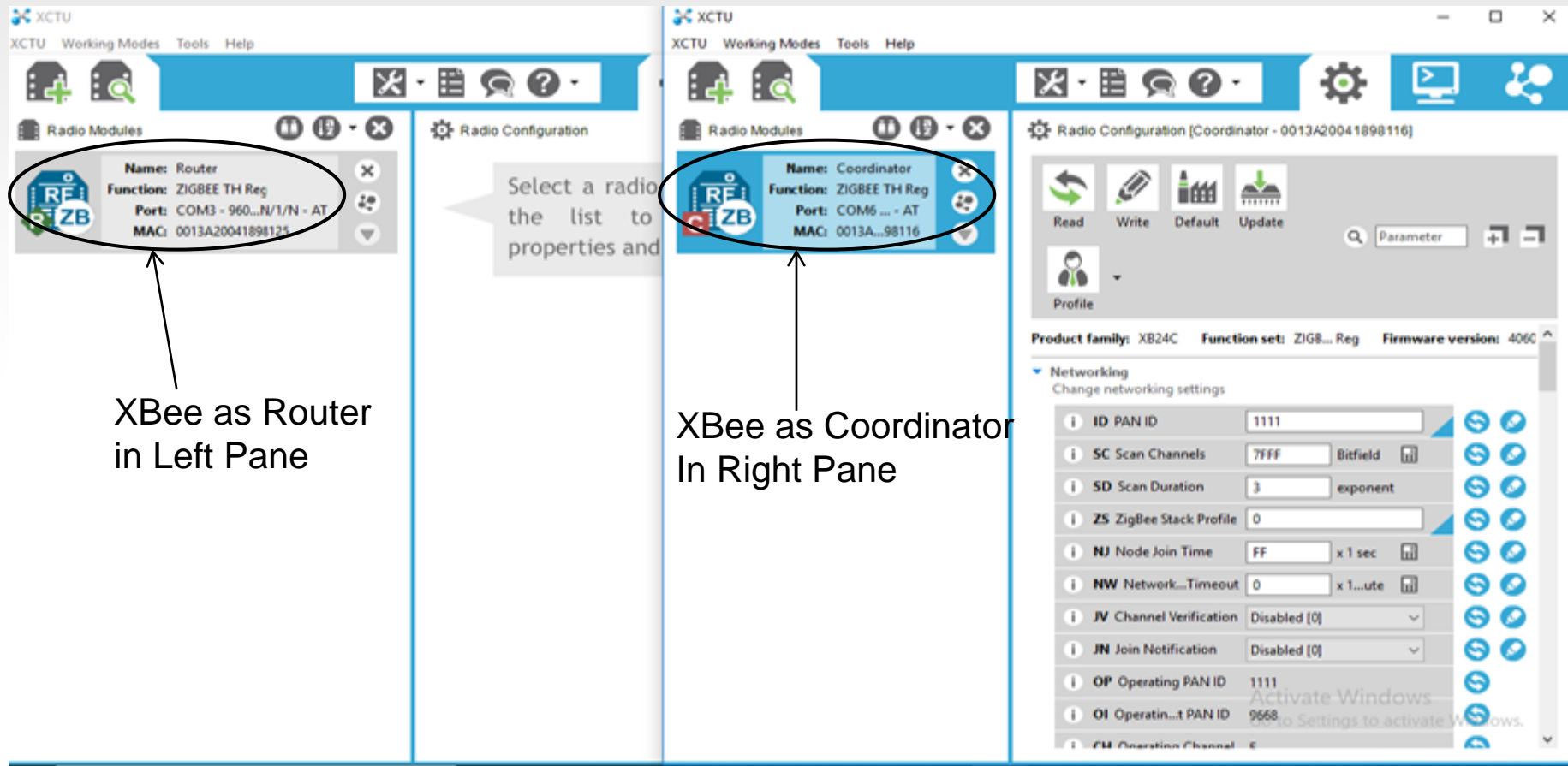
Click on the 2<sup>nd</sup> radio on the left pane to load the setting and then Enter the PANID as 1111 , same as that of Coordinator. JV CHANNEL VERIFICATION is Enabled, CE Coordinator is DISABLED, Destination Address DL is left to default 0, and NI (Node Identifier) as “ ROUTER”. Now Click on WRITE button to save the changes made

The screenshot displays the XCTU software interface for configuring a Router XBee module. The left pane shows two radio modules: 'Router' (selected) and 'Coordinator'. The 'Router' module has the following details: Name: Router, Function: ZIGBEE TH Reg, Port: COM3 - 9600/8/N/1/N - AT, and MAC: 0013A20041898125. The main configuration area is titled 'Radio Configuration [Router - 0013A20041898125]'. It includes a toolbar with buttons for Read, Write, Default, Update, and Profile. The 'Write' button is circled and labeled 'Save All Settings'. Below the toolbar, the configuration is organized into sections: Product family (XB24C), Function set (ZIGBEE TH Reg), and Firmware version (4060). The 'Networking' section is expanded, showing various settings. The 'ID PAN ID' is set to 1111. The 'JV Channel Verification' is set to Enabled [1]. The 'CE Coordinator Enable' is set to Disabled [0]. Other settings include SC Scan Channels (7FFF), SD Scan Duration (3), ZS ZigBee Stack Profile (0), NJ Node Join Time (FF), NW Network Watchdog Timeout (0), OP Operating PAN ID (1111), OI Operating 16-bit PAN ID (9668), CH Operating Channel (E), and NC Number of Remaining Children (14). Annotations with arrows point to the 'ID PAN ID', 'JV Channel Verification', and 'CE Coordinator Enable' settings, with labels: 'Set PAN ID → 11111(Same as Coordinator)', 'V Channel → Enabled[1]', and 'CE → Disabled[0]'. The bottom right corner of the window shows an 'Activate Windows' watermark.

Setting	Value
ID PAN ID	1111
SC Scan Channels	7FFF
SD Scan Duration	3
ZS ZigBee Stack Profile	0
NJ Node Join Time	FF x 1 sec
NW Network Watchdog Timeout	0 x 1 minute
JV Channel Verification	Enabled [1]
JN Join Notification	Disabled [0]
OP Operating PAN ID	1111
OI Operating 16-bit PAN ID	9668
CH Operating Channel	E
NC Number of Remaining Children	14
CE Coordinator Enable	Disabled [0]

# Communication Between Coordinator and Router

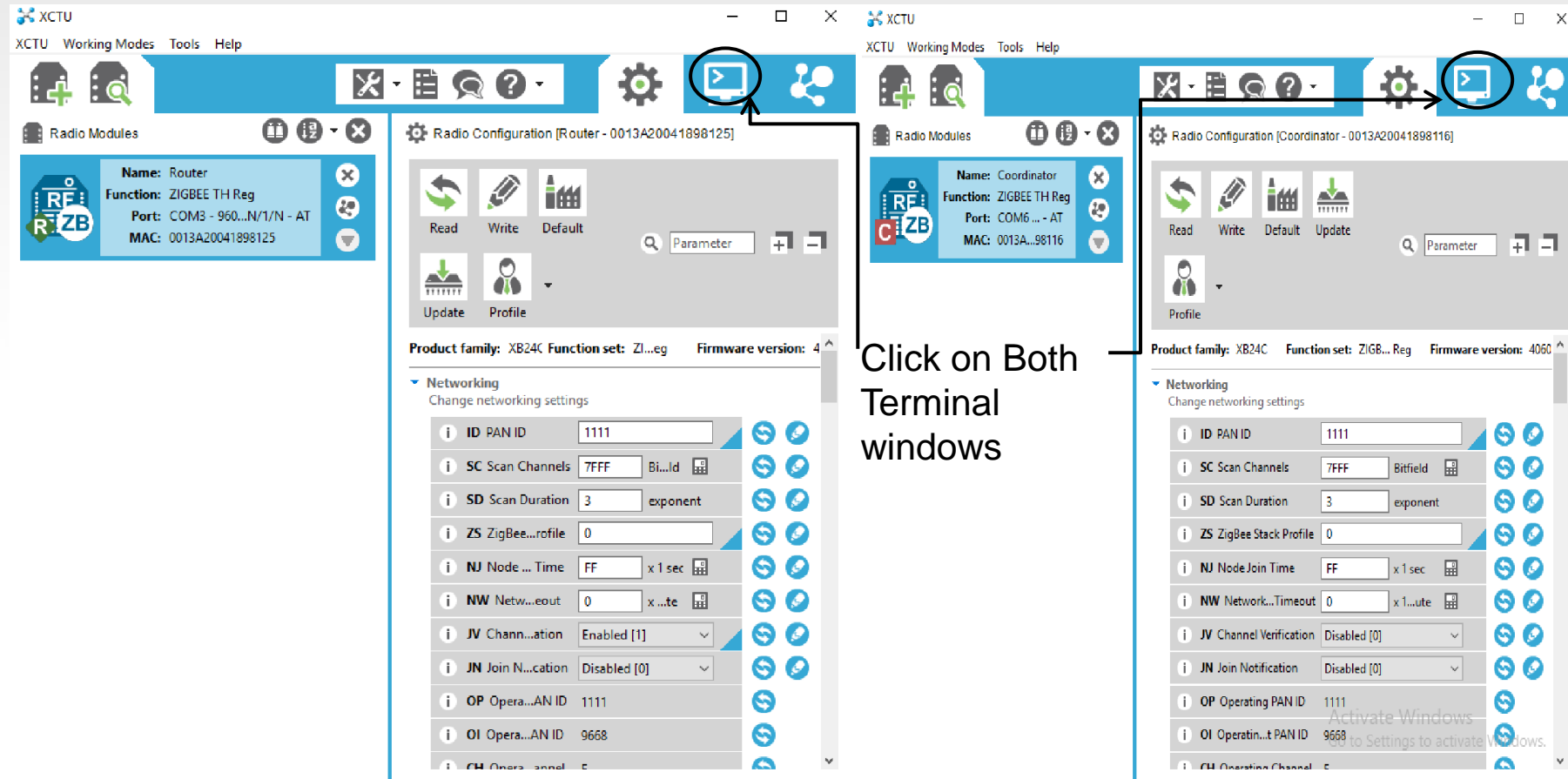
1. The modules are paired and ready for communication. Now let us test the communication on the XCTU window delete the second Radio. Click on the first Radio to load the settings.





# Communication Between Coordinator and Router

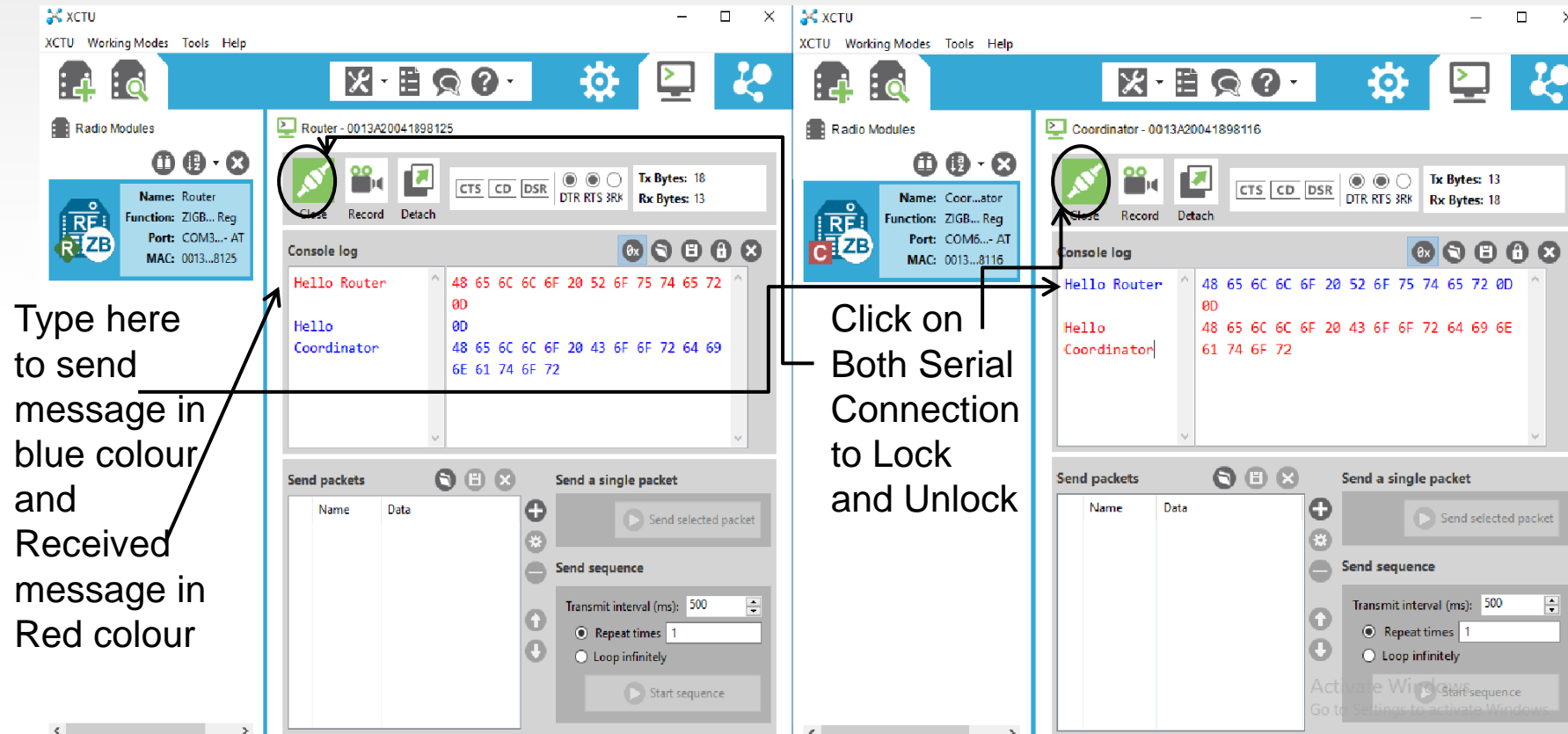
2. Click the TERMINAL icon on both the windows to enter Terminal mode. Click on the SERIAL CONNECTION icon on both the windows to enter the serial connection mode.





# Communication Between Coordinator and Router

3. You can see the SERIAL Icon in LOCK mode & the AT CONSOLE Status changes to CONNECTED. Now you can type any message inside console log window & see that received on the other Radio. The transmit message is in BLUE & received message in RED.



# Communication Between XBee and Ultrasonic Sensor Using Arduino

# Component Required

- Two XBee s2c with breakout board
- Two USB cables
- One Arduino Mega-2560 board
- Jumper wires
- One/Two laptops/computer systems
- One Ultrasonic sensor

# Installation of Arduino IDE

- Must installed XCTU software for configuration of XBee.
- Must installed Arduino IDE for configuration of Arduino mega- 2560 board and also programmed it.

<https://www.arduino.cc/en/main/software>



## Download the Arduino IDE



### ARDUINO 1.8.9

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software.

This software can be used with any Arduino board. Refer to the [Getting Started](#) page for Installation instructions.

**Windows** Installer, for Windows XP and up  
**Windows** ZIP file for non admin install

**Windows app** Requires Win 8.1 or 10  
[Get](#) 

**Mac OS X** 10.8 Mountain Lion or newer

**Linux** 32 bits

**Linux** 64 bits

**Linux** ARM 32 bits

**Linux** ARM 64 bits

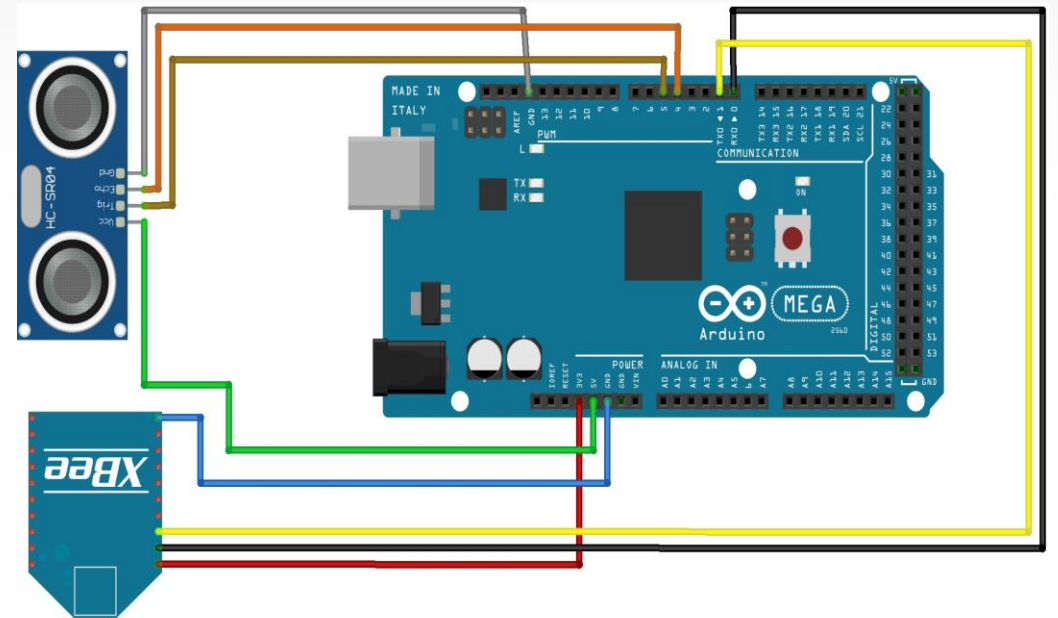
[Release Notes](#)

[Source Code](#)

[Checksums \(sha512\)](#)

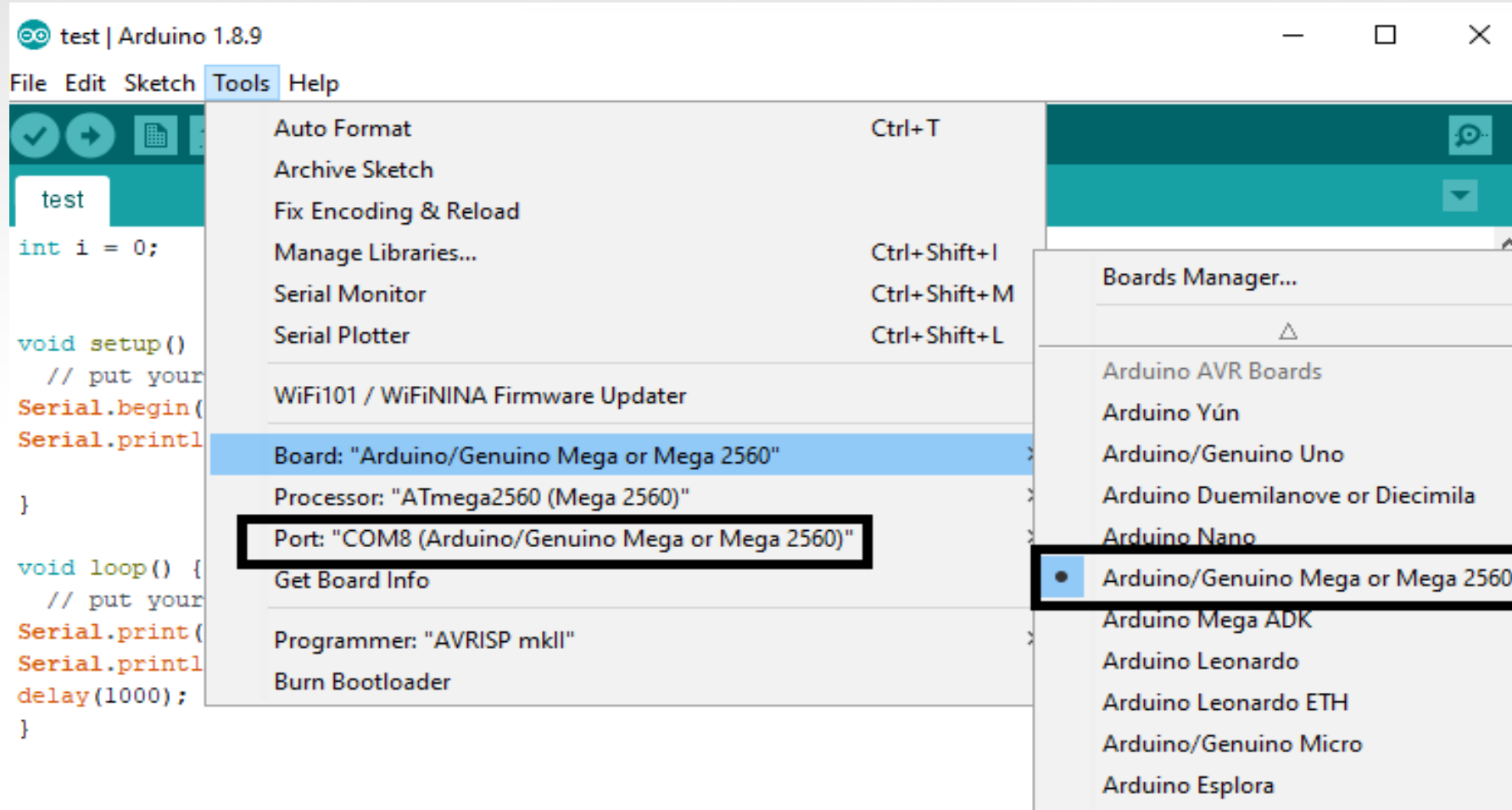
# Connections Between XBee, Arduino Mega and Ultrasonic Sensor

- After installation XTCU software and Arduino ide
- Now make the connections between XBee, Arduino mega and ultrasonic sensor.
- 3vcc of XBee to 3vcc of Arduino mega
- Pin 2-TX , Pin 3-RX of XBee to RX0-0, TX0-1 of Arduino Mega
- GND- XBee to GND -AM
- 5VCC of Ultrasonic sensor to 5vcc-AM
- GND- US to GND-AM
- TRIG and Echo to Pin 5 and 4 resp.



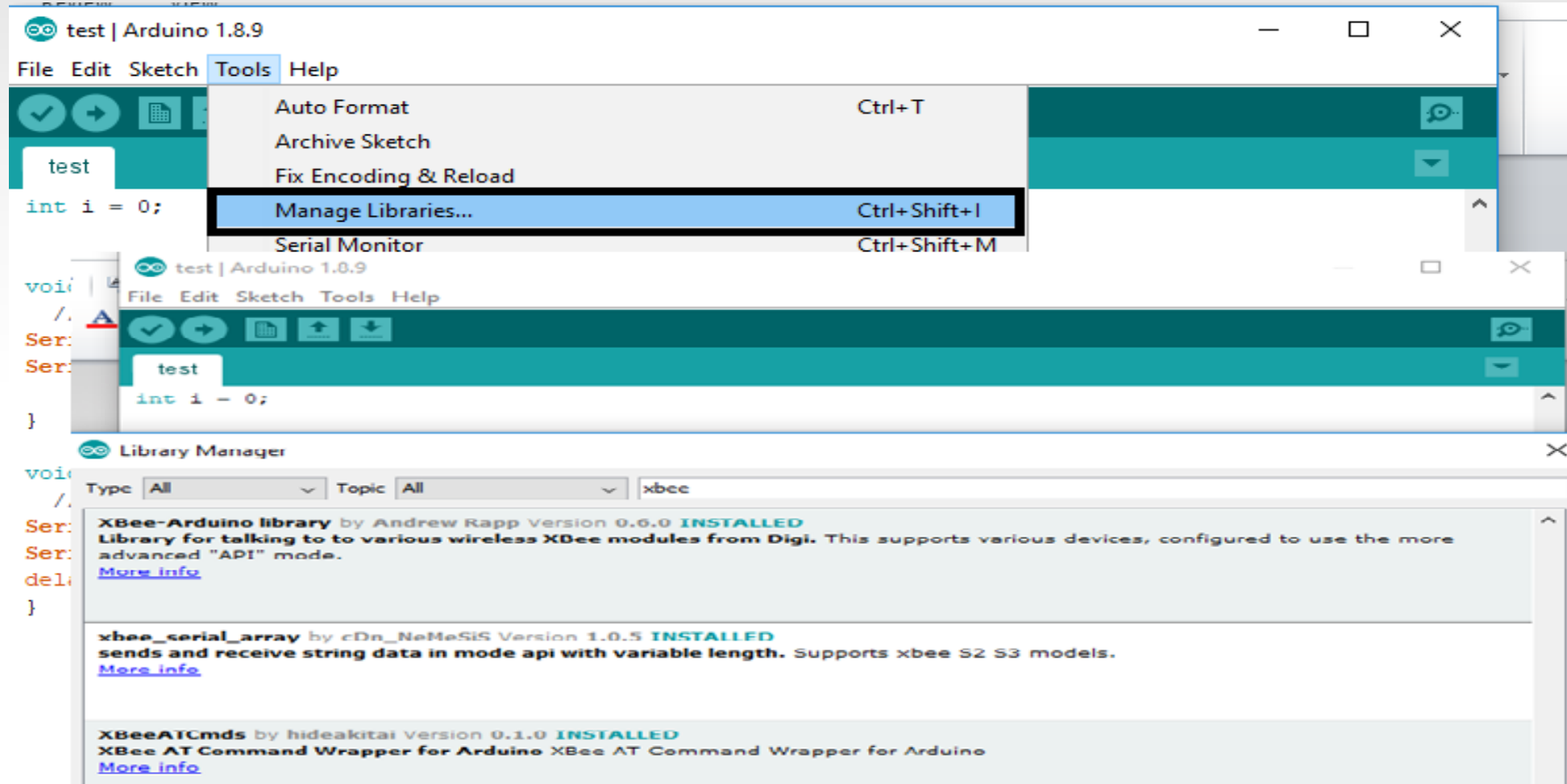
# Configuration on Arduino IDE

- Click on tool → board → Arduino Mega 2560 and port → COM8

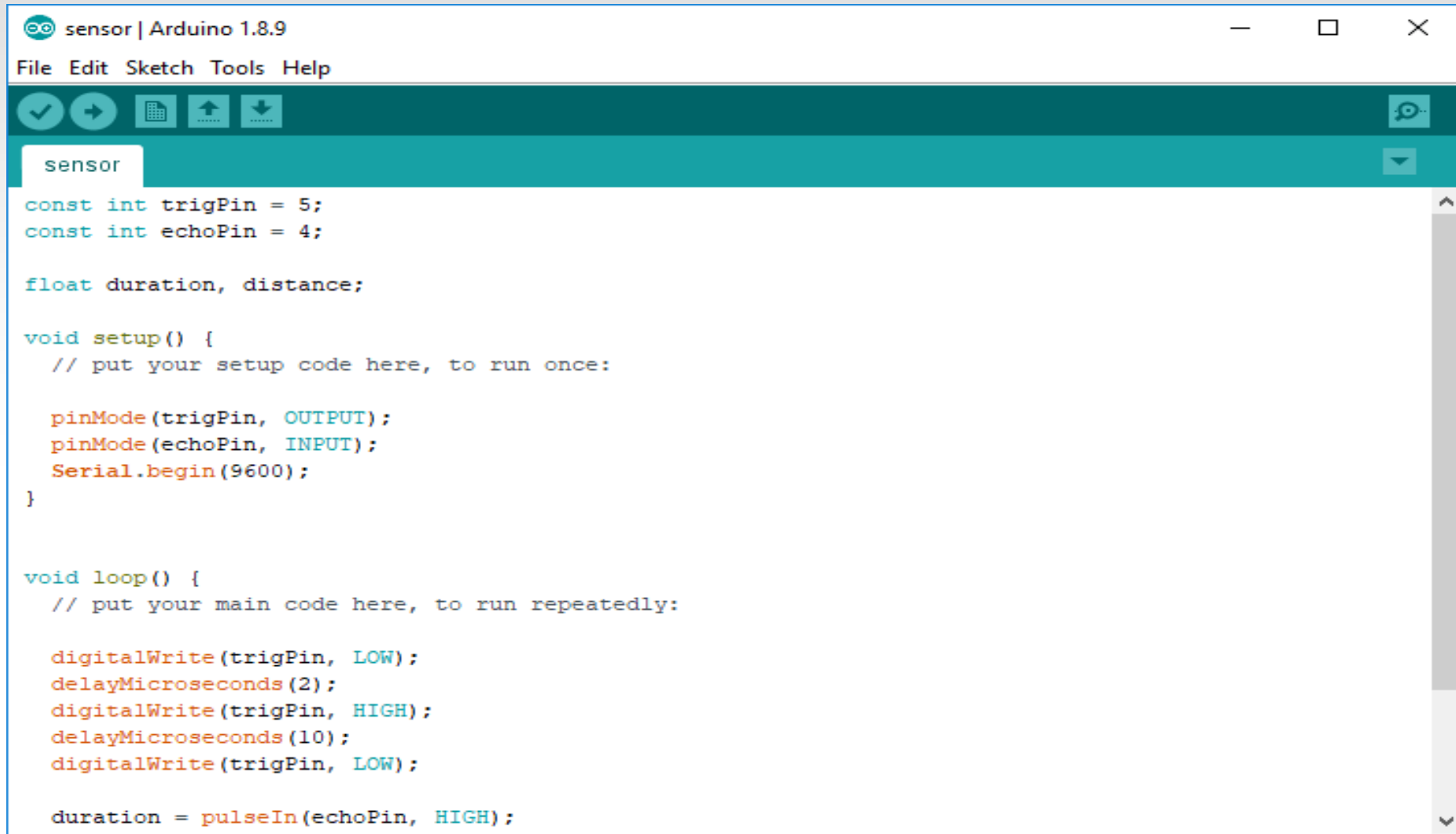


# Manage Libraries on Arduino IDE

- Then install XBee library by click on tool -> manage library -> search XBee library -> XBee – Arduino library by Andrew Rapp, xbee\_serial\_array by cDn\_NeMesis and XBeeATCmds by hideakitai .



# Code for Communication with Ultrasonic sensor

A screenshot of the Arduino IDE interface. The window title is "sensor | Arduino 1.8.9". The menu bar includes "File", "Edit", "Sketch", "Tools", and "Help". The toolbar contains icons for checking, running, and saving. A tab labeled "sensor" is active. The code editor displays the following C++ code:

```
const int trigPin = 5;
const int echoPin = 4;

float duration, distance;

void setup() {
  // put your setup code here, to run once:

  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  Serial.begin(9600);
}

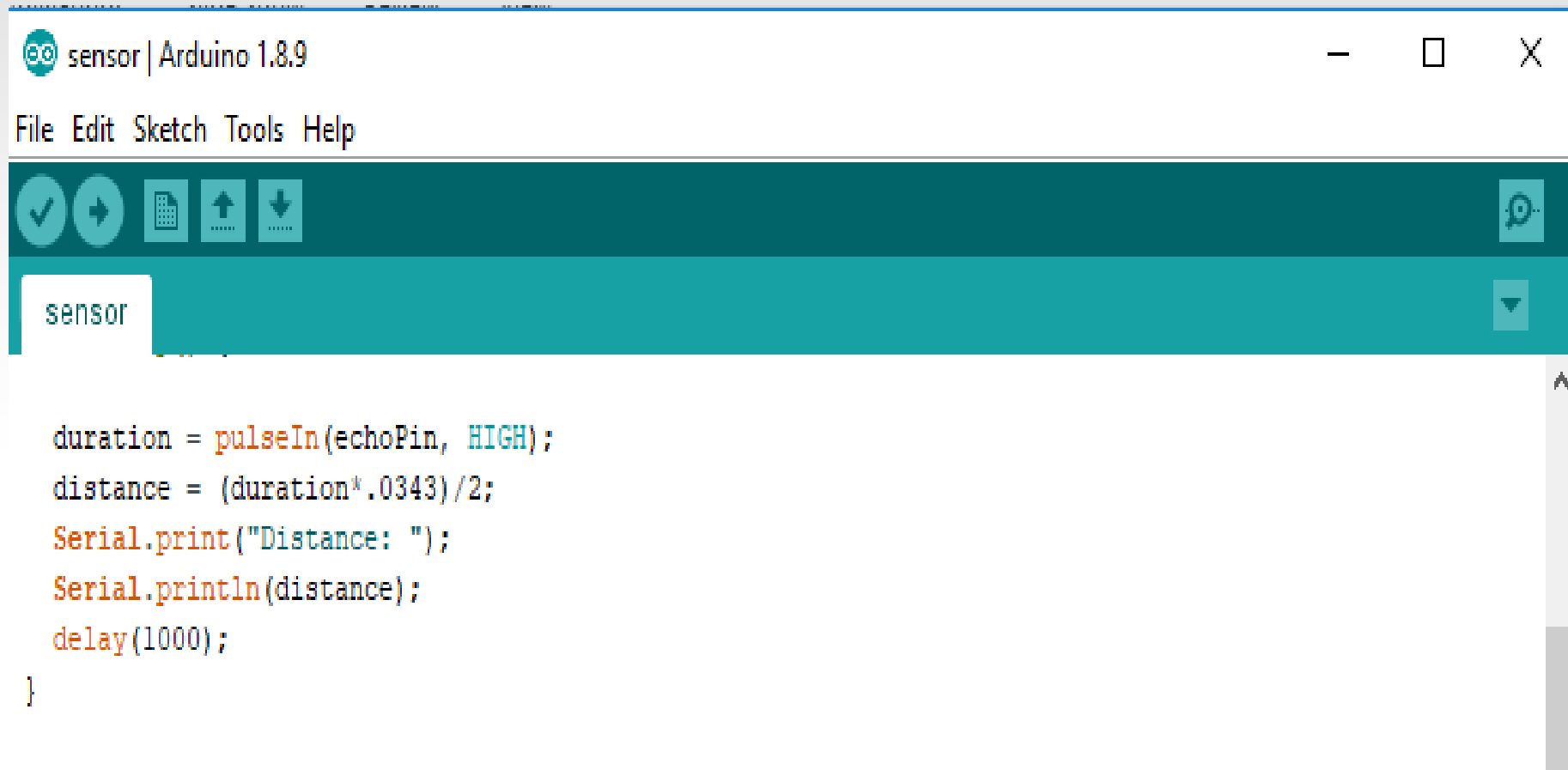
void loop() {
  // put your main code here, to run repeatedly:

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
```



# Code for Communication with Ultrasonic Sensor Cont..



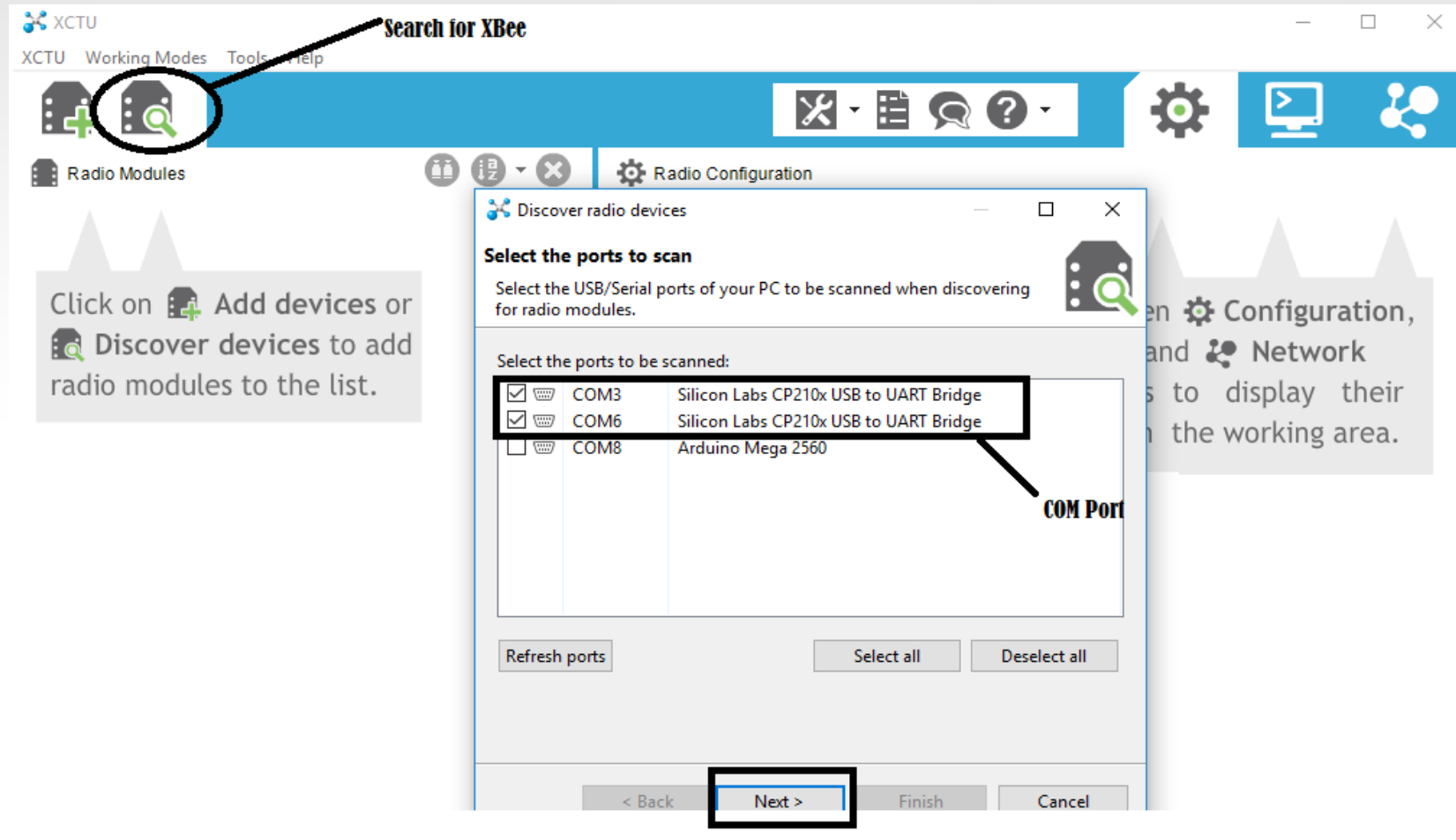
The image shows a screenshot of the Arduino IDE interface. The window title is "sensor | Arduino 1.8.9". The menu bar includes "File", "Edit", "Sketch", "Tools", and "Help". The toolbar contains icons for checking, running, saving, and uploading. The file name "sensor" is displayed in the top left of the editor area. The code in the editor is as follows:

```
duration = pulseIn(echoPin, HIGH);  
distance = (duration*.0343)/2;  
Serial.print("Distance: ");  
Serial.println(distance);  
delay(1000);  
}
```

# Configuration of XBee using XCTU

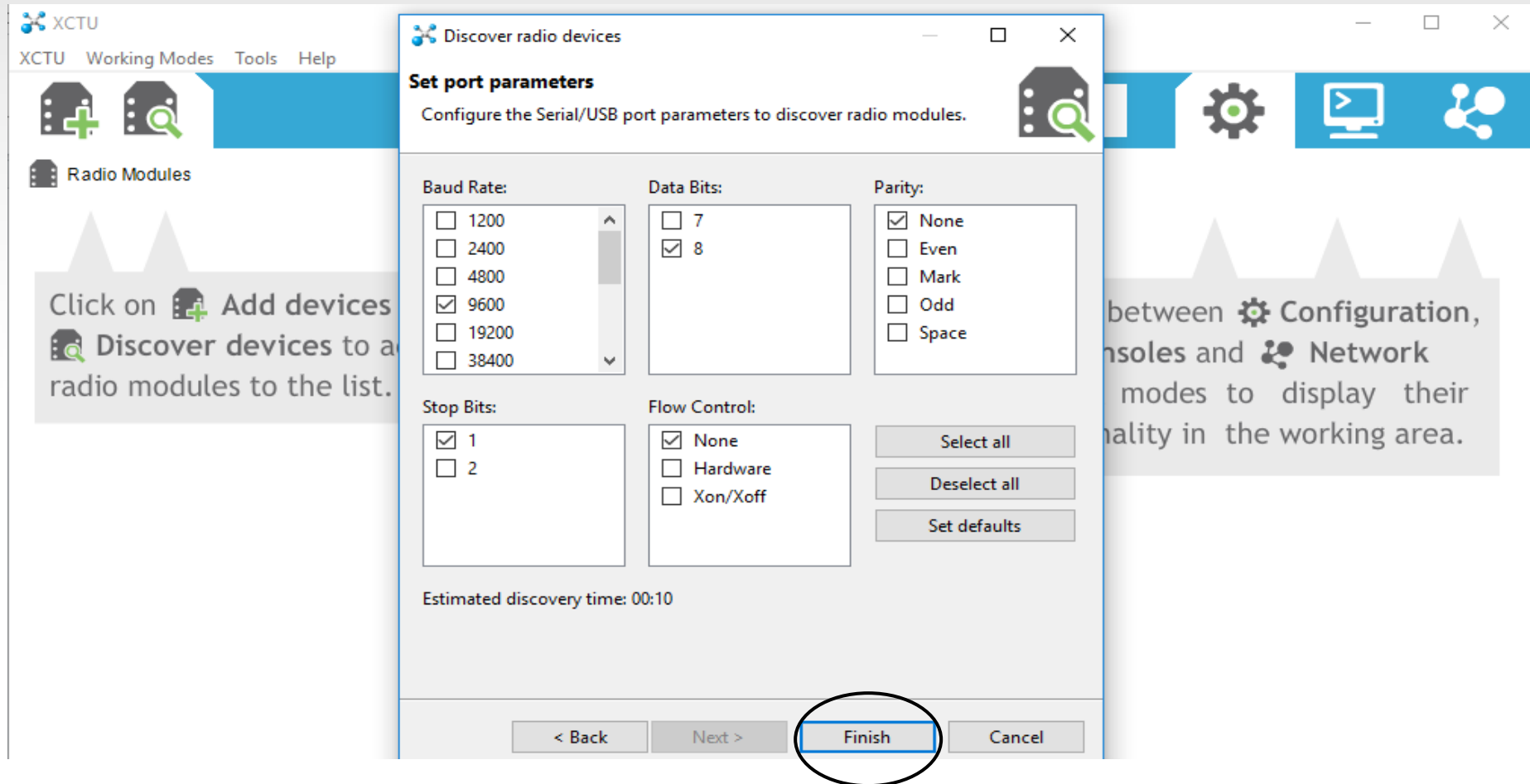
Steps:

1. Open the XCTU software and Click on the SEARCH icon on top to detect the USB ports.



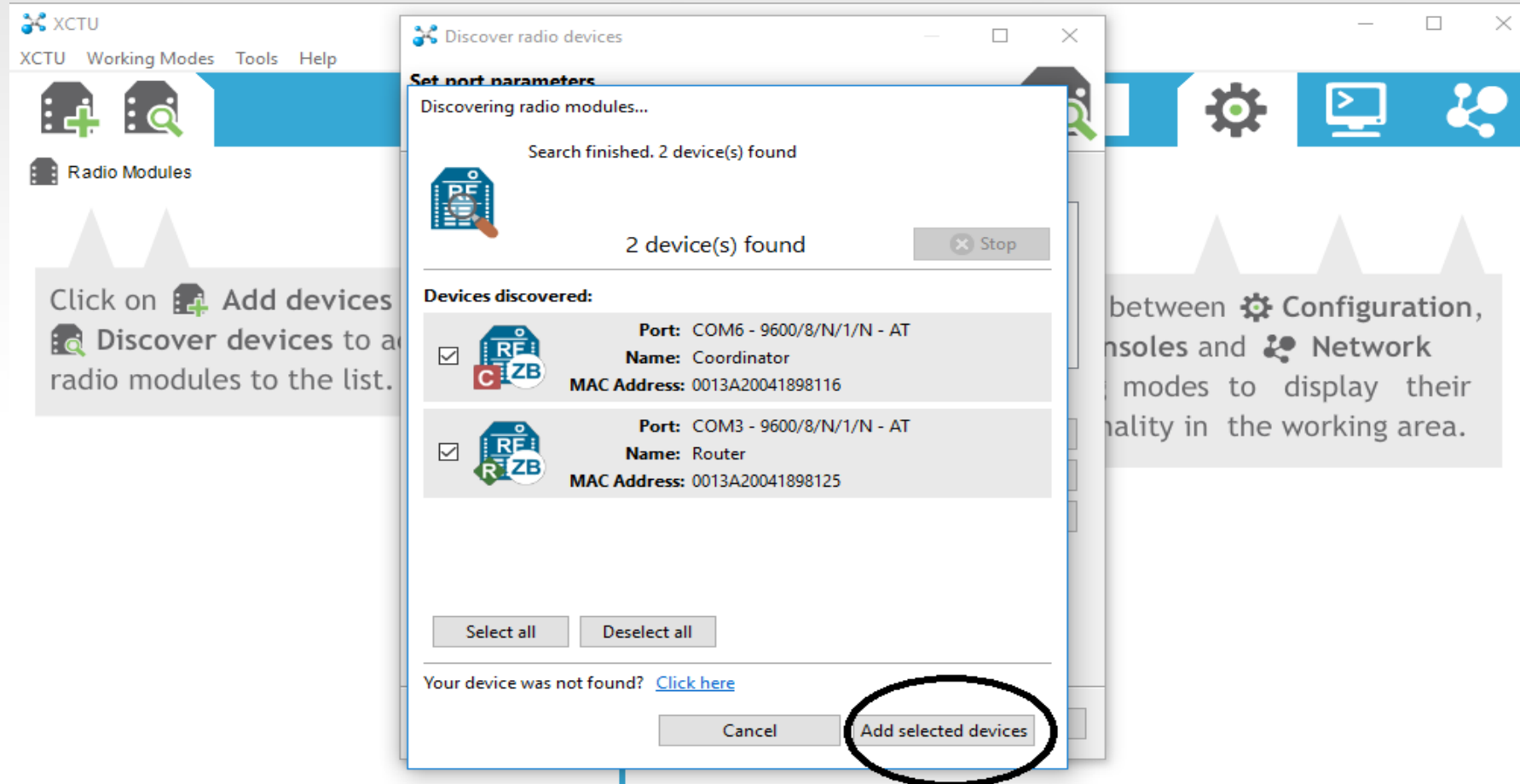
# Configuration of XBee using XCTU Cont..

2. Click on NEXT & accept the default PORT PARAMETERS, 9600 is the BAUD RATE, 8 Data Bits, No Parity, Stop bit 1 and Flow Control None and then Finish.



# Configuration of XBee using XCTU Cont..

3. The XCTU scans the USB ports selected & lists the RADIOS found with their unique 64-bit address and Select both the devices & click ADD SELECTED DEVICES.



# Configuration of Coordinator XBee using XCTU

4. Now both the Radios appear on the left pane. Let us configure the RADIO at COM6 as COORDINATOR first and Load the Settings by Clicking on it and then set the PAN ID -> 1111

XCTU Working Modes Tools Help

Click on Coordinator Xbee

Radio Modules

Name: Coordinator  
Function: ZIGBEE TH Reg  
Port: COM6 - 9600/8/N/1/N - AT  
MAC: 0013A20041898116

Name: Router  
Function: ZIGBEE TH Reg  
Port: COM3 - 9600/8/N/1/N - AT  
MAC: 0013A20041898125

Radio Configuration [Coordinator - 0013A20041898116]

Read Write Default Update Profile

Parameter

Networking  
Change networking settings

ID PAN ID	1111	
SC Scan Channels	7FFF	Bitfield
SD Scan Duration	3	exponent
ZS ZigBee Stack Profile	0	
NJ Node Join Time	FF	x 1 sec
NW Network Watchdog Timeout	0	x 1 minute
JV Channel Verification	Disabled [0]	
JN Join Notification	Disabled [0]	
OP Operating PAN ID	1111	
OI Operating 16-bit PAN ID	9668	

Set PAN ID -->1111

# Configuration of Coordinator XBee using XCTU Cont..

5. Scroll Down and set CE → Enabled[1], Set DH, DL → 0,FFFF and Set NI → Coordinator and then Click on the PENCIL icon on top to WRITE the changes made. This is done with Coordinator configuration.

**Radio Modules**

Name	Function	Port	MAC
Coordinator	ZIGBEE TH Reg	COM6 - 9600/8/N/1/N - AT	0013A20041898116
Router	ZIGBEE TH Reg	COM3 - 9600/8/N/1/N - AT	0013A20041898125

**Radio Configuration [Coordinator - 0013A20041898116]**

**Save All Settings**

**Write** (Pencil icon circled)

**CE Coordinator Enable** → Enabled [1]

**DH Destination Address High** → 0

**DL Destination Address Low** → FFFF

**NI Node Identifier** → Coordinator

**Addressing**  
Change addressing settings

Parameter	Value
SH Serial Number High	13A200
SL Serial Number Low	41898116
MY 16-bit Network Address	0
MP 16-bit Parent Address	FFFE
DH Destination Address High	0
DL Destination Address Low	FFFF
NI Node Identifier	Coordinator
NH Maximum Hops	1E

**Set CE Coordinator --> Enabled[1]**

**Set DH Destination Address High --> 0**

**Set DL Destination Address Low --> FFFF**

**Set NI Node Identifier --> Coordinator**

# Configuration for Router XBee

1. Click on the 2<sup>nd</sup> radio on the left pane to load the setting and then Enter the PAN ID as 1111 , same as that of Coordinator. JV CHANNEL VERIFICATION is Enabled and rest settings are same as default and then Click on the PENCIL icon on top to WRITE the changes made. This is done with Router configuration.

**Radio Modules**

Name	Function	Port	MAC
Coordinator	ZIGBEE TH Reg	COM6 - 9600/8/N/1/N - AT	0013A20041898116
Router	ZIGBEE TH Reg	COM3 - 9600/8/N/1/N - AT	0013A20041898125

**Radio Configuration [Router - 0013A20041898125]**

Product family: XB24C    Function set: ZIGBEE TH Reg    Firmware version: 4060

**Networking**  
Change networking settings

Parameter	Value	Unit
ID PAN ID	1111	
SC Scan Channels	7FFF	Bitfield
SD Scan Duration	3	exponent
ZS ZigBee Stack Profile	0	
NJ Node Join Time	FF	x 1 sec
NW Network Watchdog Timeout	0	x 1 minute
JV Channel Verification	Enabled [1]	
JN Join Notification	Disabled [0]	
OP Operating PAN ID	1111	
OI Operating 16-bit PAN ID	9668	

**Set PAN ID --> 1111 same as Coordinator**

**Set JV Channel Verification --> Enabled[1]**

# Configuration for Router XBee Cont..

2. CE Coordinator is DISABLED, Destination Address DL is left to default 0. and NI Node Identifier as “ROUTER”.  
Now Click on WRITE button to save the changes made.

The screenshot shows the XCTU Radio Configuration window for a Router. The left sidebar displays the Radio Modules list with the selected module details: Name: Router, Function: ZIGBEE TH Reg, Port: COM3 ... - AT, and MAC: 0013A...98125. The main window shows the Radio Configuration [Router - 0013A20041898125] with a 'Save All Settings' button. The 'Write' button is circled. The 'CE Coordinator Enable' dropdown is set to 'Disabled [0]'. The 'DO Device Options' and 'DC Device Controls' are both set to '0'. The 'Addressing' section is expanded, showing 'SH Serial Number High' as '13A200', 'SL Serial Number Low' as '41898125', 'MY 16-bit N... Address' as '2E24', and 'MP 16-bit P... Address' as 'FFFE'. The 'DH Destin...ess High' and 'DL Destin...ess Low' fields are both set to '0'. The 'NI Node Identifier' dropdown is set to 'Router'. The 'NH Maximum Hops' is set to '1E'.

CE → Disabled[0]

DH → 0, DL → 0

NI → Router



# Communication Between XBee and Ultrasonic Sensor using Arduino

3. The modules are paired and ready for communication. Now let us test the communication on the XCTU Router Window as:

Click to Lock for Communication

Output of Communication between XBee and Ultrasonic sensor using Arduino

**XCTU**  
XCTU Working Modes Tools Help

Radio Modules

**Name:** Router  
**Function:** ZIGB... Reg  
**Port:** COM3...- AT  
**MAC:** 0013...8125

**Router - 0013A20041898125**

Close Record Detach

CTS CD DSR DTR RTS 3Rk Tx Bytes: 0 Rx Bytes: 381

**Console log**

```
4.70 34 2E 37 30 0D 0A
Distance: 44 69 73 74 61 6E 63 65 3A 20 34 2E 30
4.03 33 0D 0A
DistanceDistance: 44 69 73 74 61 6E 63 65 44 69 73 74 61
3.00 6E 63 65 3A 20 33 2E 30 30 0D 0A
: 3.36 3A 20 33 2E 33 36 0D 0A
```

**Send packets**

Name	Data
------	------

**Send a single packet**

Send selected packet

**Send sequence**

Transmit interval (ms): 500

☐ Repeat times 1

☐ Loop infinitely

Start sequence

Thank You