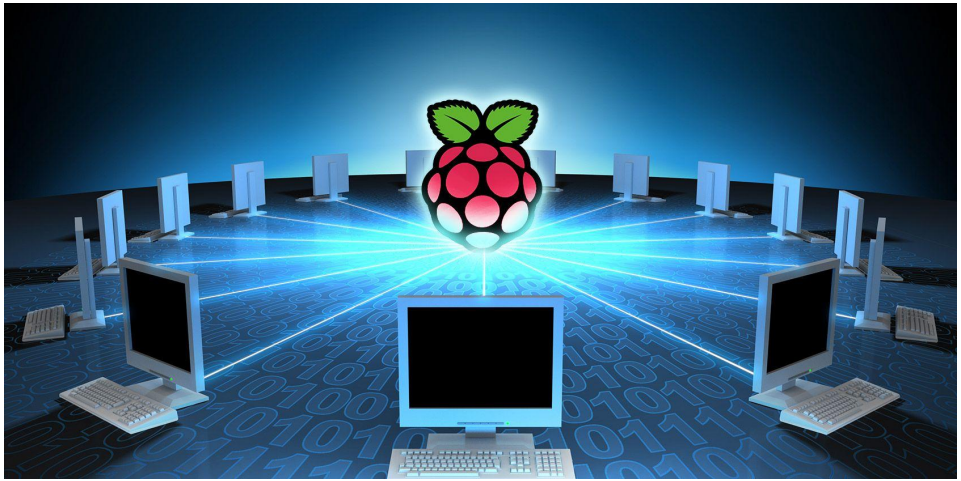
Networking with Raspberry Pi



OUTLINE

1. What is Networking
2. Networking Fundamentals
3. Bluetooth
4. Zigbee
5. WiFi
6. RFID
7. Demo: Bluetooth Communication between Raspberry Pi and Smartphone
8. Demo: USB Communication between Arduino/Zigbee and Raspberry Pi

What is Networking

Networking is the exchange of data between devices.
Example: When you search something in Google, the Google servers send data to your computer / phone through the internet. This data reaches you after it has been routed through multiple networks, so that it can reach your device.

Networking can be of various types.
Networking can be local - between two devices at 10m apart from each other.
Networking can be at organization/company/institute level
Or Networking can be international (e.g. Internet, GPS, etc.)

Networking Fundamentals - Made Easy

What is a Network?
Ans. A Network comprises two or more devices that exchange data.

The Types of Networks (based on extent / coverage of network):

1. Personal Area Network (PAN): These are networks formed within a short distance of about 10 - 20 metres radius. Examples include bluetooth networks
2. Local Area Network (LAN): These are networks formed at organization / company / institute level. E.g. Internet access provided to all labs in VESIT is a Local Area Network.
3. Wide Area Network (WAN): These are networks with nationwide / global coverage. Examples include Internet, GPS.

Types of Networks (based on Medium of data transfer):

1. Wired: Data transfer occurs through cables. Eg. USB cable, Ethernet, Telephone lines ADSL,
2. Wireless: Involves Electromagnetic Transmissions. E.g. RF (Radio Frequency), Microwave (millimeter waves), Radar,
3. Hybrid: Consists of both - Wired and wireless technologies. E.g. WiFi access at VESIT campus.

Networking Fundamentals - Made Easy

Important Terms:

1. **Protocol:** A protocol is a set of rules and mechanisms that define how communication should take place between two devices.
2. **IP Address:** An IP address is a unique address assigned to each device connected to a network that uses internet protocols.
3. **Nodes:** Each device in a network is called as Node. Nodes can receive, send, create and modify data as it travels through the network.
4. **Routers:** A Router is a communication device that moves data from one network to another.
5. **Port:** A Port is used to identify connections between two devices. A port is like an address on a device where messages are sent/received. Each message is sent to a particular device with IP Address on a particular application with port number.
6. **Peer-to-Peer Communication:** Communication between two devices. E.g. sharing files between two phones over bluetooth.

Bluetooth

Bluetooth is a communication protocol for sending & receiving data via 2.4 GHz wireless links. Bluetooth is perfect for short-range, low-power applications.

Important processes in Bluetooth:

1. **Scanning / Inquiry:** Bluetooth device scans for other bluetooth devices in vicinity. If a device is found, its name, address and other information is inquired and obtained by the scanning device.
2. **Pairing:** Pairing is the process of sharing addresses, names, secret key between two bluetooth devices. Once, two devices are paired with each other, they can connect automatically when the devices are close together.

Advantages of Bluetooth:

1. Avoids interference from other wireless devices.
2. Low Power Consumption
3. Low Cost
4. No Line-of-sight required. Can transmit through obstacles like walls.

Disadvantages of Bluetooth:

1. Short-range upto 10-100 metres.
2. Can communicate with only 8 devices at a time.

WiFi

WiFi is a popular communication technology for wireless local area networking. It uses the 2.4 GHz Spectrum.
WiFi acts as a wireless bridge between wired internet networks and mobile devices like smart phone, laptops, etc.

Important Terms related to WiFi:

1. **Access Point (AP):** Access Point is a WiFi device, which is also connected to some other network (mostly internet), thus providing access to the network. E.g. of Access Point is WiFi Router.
2. **Station (STA):** Station is a WiFi device which can communicate with Access Point. E.g. of station: Mobile devices like smartphones and laptops.
3. **SSID:** Service Set ID - used to identify an AP with name.

Connection Process:

1. STA scans for other WiFi devices in vicinity.
2. AP responds with its information to STA.
3. STA sends association request to AP with SSID and password
4. AP responds with Success / Failure message
5. If the Association is successful, STA & AP can start communicating with each other.

Advantages of WiFi:

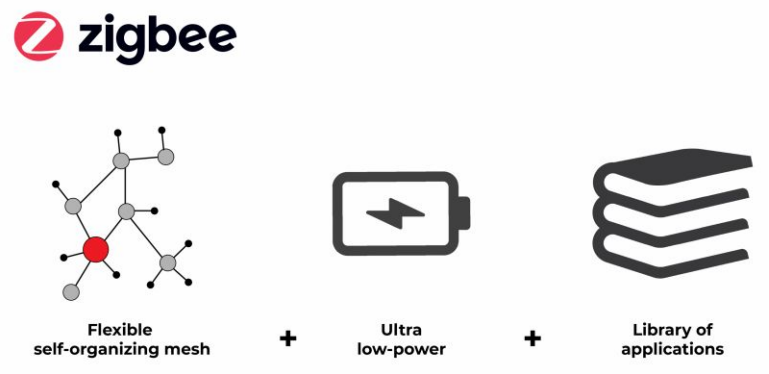
1. High Data rate
2. Avoids interference from other wireless devices

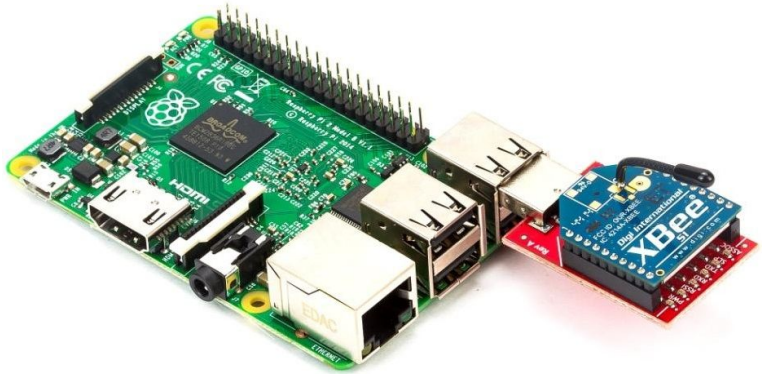
Disadvantages of WiFi:

1. Low range at low power
2. Difficult to customize for custom use

Zigbee

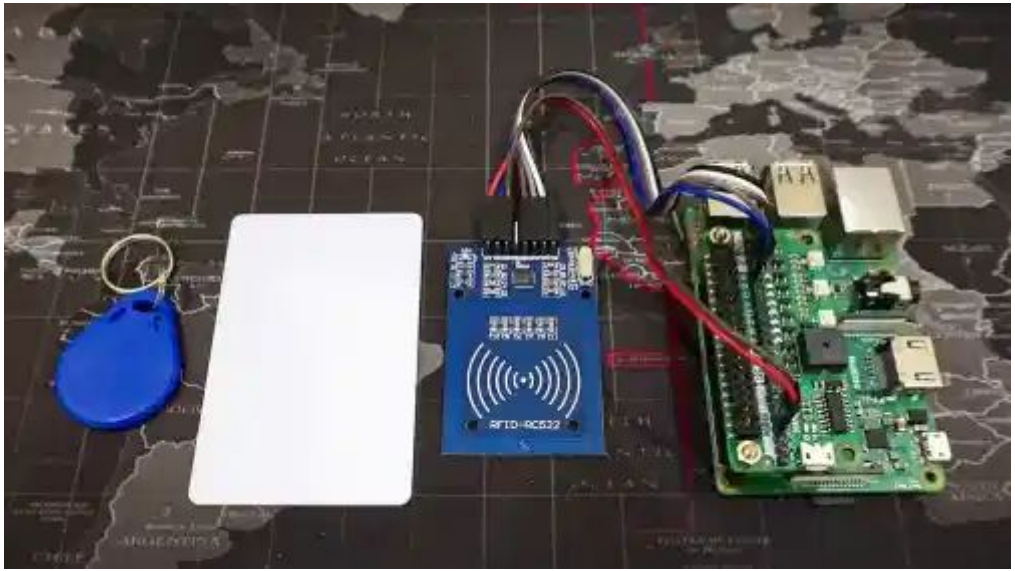
Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless IoT networks. The Zigbee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz.





RFID

- Radio Frequency Identity
- RFID Tag: Contains Identification information. Transmits this Information to RFID Reader.
- RFID Reader: Reads RF Identification Information



Setup: Connecting to WiFi on Raspberry Pi

1. Connect through WiFi Settings for basic internet access.

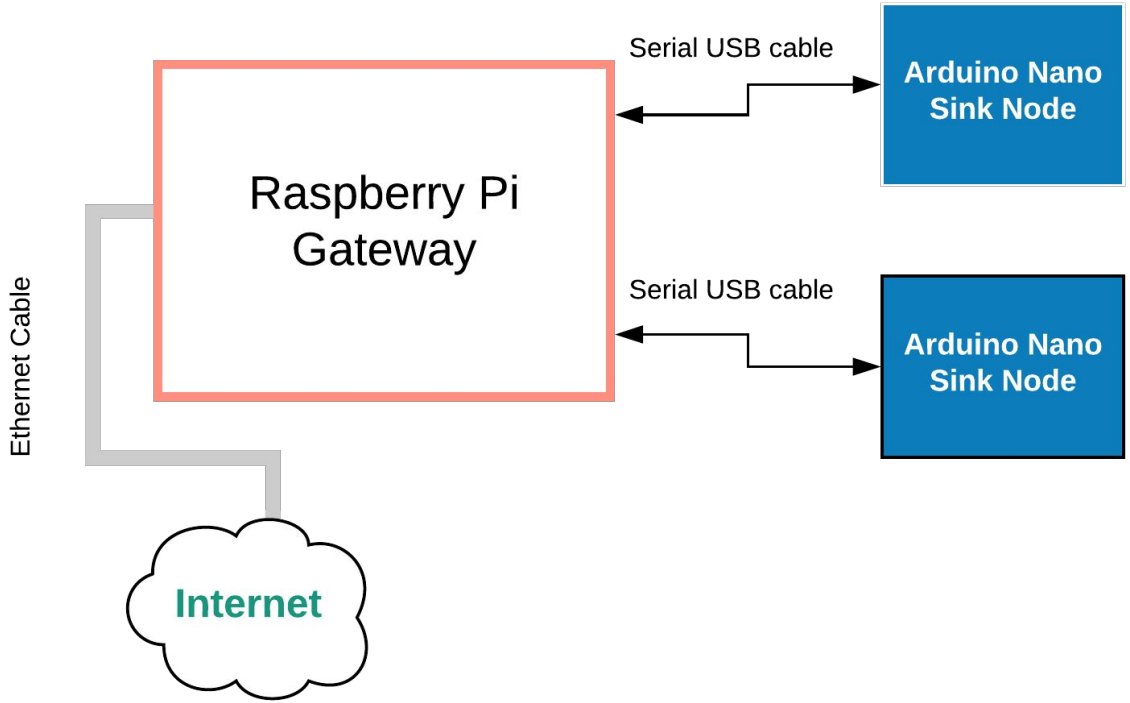
2. Use Python Library “wifi” to program WiFi connection as per own requirements.

Bluetooth Communication between Raspberry Pi & Smartphone

1. Connect through Bluetooth Settings for basic internet access.

2. Use Python Library “bleak”/”PyBluez” to program Bluetooth connection as per own requirements.

Demo: Communication between Raspberry Pi and Arduino/Zigbee using USB



Authors:

Shubham Annigeri - 9167721560

LinkedIn: https://www.linkedin.com/in/shubham-annigeri-6720b3169/

Sunit Raut - 9869082908

LinkedIn: https://www.linkedin.com/in/sunit-raut-5b6849139/

Shubham Madhavi - 9820507812

LinkedIn: https://www.linkedin.com/in/shubham-madhavi-a2a37b166/