

Testing MANET Protocol using Zigbee based Xbee Modules

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Abstract

In the last few years, there has been big interest in adhoc wireless network as they have tremendous military and commercial potential[1]. Traditionally to test various parameters in the MANET, the most popular approach is to use mobile phone and Laptops and use the popular WIFI based protocol i.e. IEEE 802.11 wireless LAN [2]. The problem with the approach of using this protocol is that it doesnot cover the mobile nodes which require less bandwidth and dynamic reconfigurable architecture which are required in the low pwer battery operated sensor nodes . In the recent years there is a huge attraction towards the Internet Of things and specifically wireless sensor network. In this paper we are going to test the MANET protocol using zigbee based Xbee modules specifally to determine the Range and Throughput of the Xbee network using XCTU Software. The sensor network will be deployed in the car parking application to see the parameters in the real time and dynamically see the sustainability of the network .The network is being designed keeping in mind that the nodes are mobile and at the same time the network does not require a standard infrastructure.

Keywords: MANET (mobile adhoc network), XCTU (software used to measure the parameters of Xbee), IOT (internet of things)

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1. Introduction

Internet of Things has created a new buzz in the tech world because it has the huge potential in the lives of people and numerous applications it has in various fields like Smart Home, Smart Manufacturing, Smart Agriculture and Smart Healthcare.

The overall concept of IOT revolves around one type of core network i.e. wireless sensor network which is connected with the internet and hence make the overall system smart. There are lots of protocols to implement wireless sensor network and we have chosen the MANET protocol for this project.

Using this manet we are targeting smart car parking application with the use of 3 sensor nodes and 1 master coordinator node which can manage the network.

The term MANET i.e. mobile ad hoc network, is typically used for mobile ad hoc networks i.e. for those nodes which does not have a static location.

The main aim of the designing the MANET is to fulfill the following features [1]:

1. Self Configuring: The MANET should be designed in such a way that each nodes should be capable of changing its configuration based on the changing topology, changing environment conditions and without relying on the static links.

2. Infrastructure Less: There is not a standard infrastructure followed by the MANET because of the nature of nodes. Each node inside MANET is capable of moving in any direction and hence there always be a probability of forming and breaking links and hence MANET should be designed keeping in mind the nature of mobile nodes.

3. Routing Capability: Each node should be capable of acting as a router and hence can forward the packet independent of the fact that the information is useful for it or not.

4. Scalable: The MANET should be designed in such a way that the network is flexible enough to add or remove new nodes into the network and hence it should have a scalable architecture even though not a fixed architecture.

5. Frequency Range: Typical MANET works in the frequency range of 30MHz to 3 GHz

MANET Routing protocols [3]:

1. Topology Based Routing:

One type of Topology Based Routing is Dynamic Source Routing (DSR) which is a routing protocol for wireless mesh networks [4] It is similar to AODV [5] in that it forms a route on-demand when a transmitting node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device.

2. Position Based Routing:

Location Based Services: E.g. GLS This type of protocol is actually being used in the General Logistics System.

3. Forwarding Strategy:

Greedy and hierarchical algorithms used this kind of strategy.

4. Dynamic Source Routing [4]:

a. Cooperative Nodes

b. Relatively Small network diameter

c. Detectable Packet Error

5. AODV Routing Protocol [5]: Ad Hoc on demand distance vector

a. Source floods route request in the network.

b. Reverse paths are formed when a node hears a route request.

2. Research Method

MANET protocol is used mostly with Laptops and mobile phones. But due to increasing popularity of Internet of Things, there is a need for this kind of mobile nodes which does not include mobile phones and laptops but rather a mobile sensor node is more required. The typical requirements and features of sensor nodes are:

1. Real time traffic generation: The traffic generated by the sensor nodes are basically the real time events and mostly involves the environmental conditions.

2. Low Bandwidth requirement: The typical bandwidth required for the sensor network is far less than the bandwidth required by the laptops and mobile phone used for sending voice and video transmission.

3. Low power: The power required by the sensor nodes is far less as compared to other mobile nodes because most of the time the nodes are in the sleep mode till there is an event occurred to wake the device and hence in this process consumes very less power.

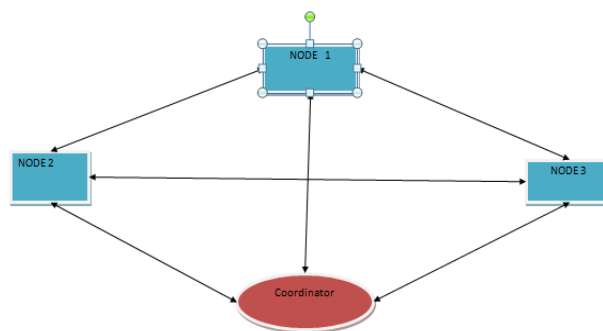


Figure 1. Topology of Xbee Network

2.1. Methodology

To implement the network as shown in Figure 1, 4 xbees are used in which 3 worked in routing mode and 1 worked in coordinator mode. 3 routing nodes are connected to arduino nano and 1 coordinator node is connected to raspberry pi and data is being displayed in the serial monitor.

To test the MANET protocol using xbee modules the algorithm is being developed which looks like this:

Algorithm for Coordinator:

1. Receive the packet from the sender node
2. Decode the address
3. If the address exists in the list of destination addressed in the destination node, broadcast
4. Otherwise discard the packet

Algorithm for Router:

1. Receive the packet
2. Decode the address and data
3. Check if the data is useful for him, accept the packet
4. Otherwise discard the packet

To implement the application of smart car parking, 3 pairs of IR sensors are used to detect the presence of car in the particular spot. The circuit used for achieving this behavior is being shown the Figure 2.

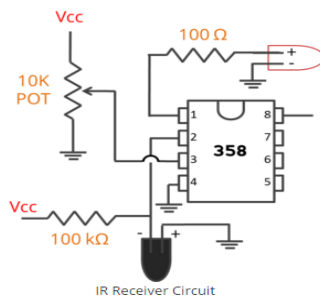


Figure 2. IR Receiver Circuit

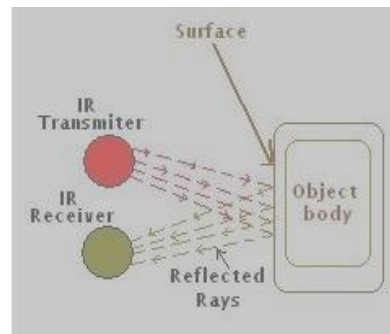


Figure 3. Obstacle Detection

2.2. Working

Connections:

1. Power terminal is connected to arduino's power supply
2. 330 ohm is connected between the sensor and ground terminal to protect IR emitter from burning as shown in Figure 4.
3. 1K resistor is connected between the output terminal and ground.
4. Output of the sensor is given to Arduino Analog pin A0.

Working:

1. Sensor here will detect the presence of a car. IR emitter will transmit infrared rays continuously, there will no reflection and the output voltage will be 0V.
2. But when a car is placed over the sensor IR rays will be reflected back and output voltage raises above 2V which is transmitted to the microcontroller.

Software Used:

To analyze the given xbee network, software used is XCTU which is provided by Zigbee to test the zigbee protocol for xbee based ntworks. This software is being ised to determine the throughput and range of the given xbee network after applying the MANET algorithm.

Software Configuration:

1. The tool is configured in unidirectional mode which sends the data from the local device to remote one and waits for the data back from the remote device.
2. Duration: Determines the time of the session. Here the duration is kept 10s.
3. TX packets, Bytes: Number of packects the bytes transferred in the session.
4. Time window: Configures the visible time window of the transfer ration measured by the throughput session.

3. Throughput Test

3.1. Throughput

Throughput is the rate of production or rate at which something can be processed. In context of communication throughput is rate of successful data transmission.

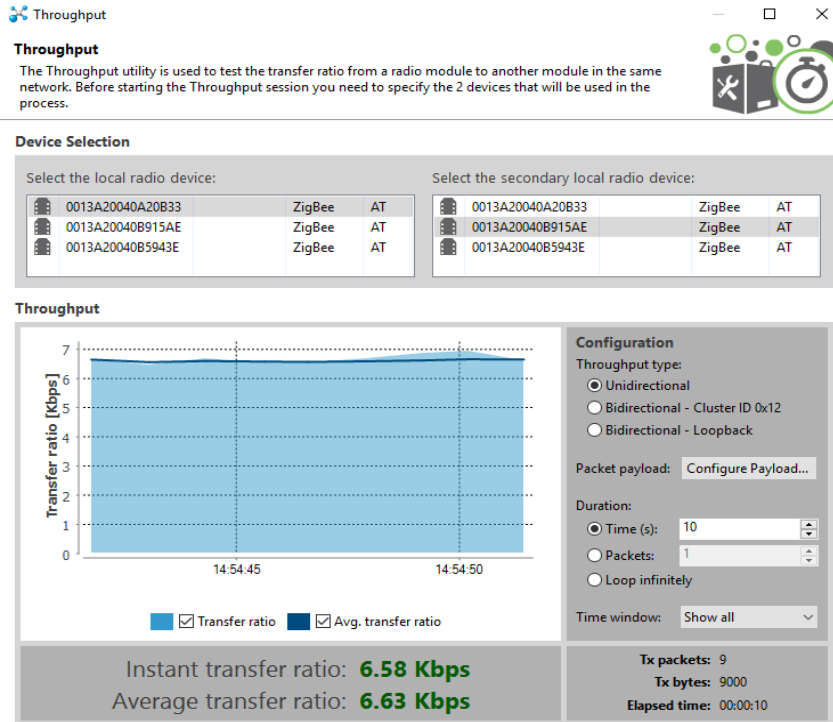


Figure 4. Throughput Node 1 to Node 2

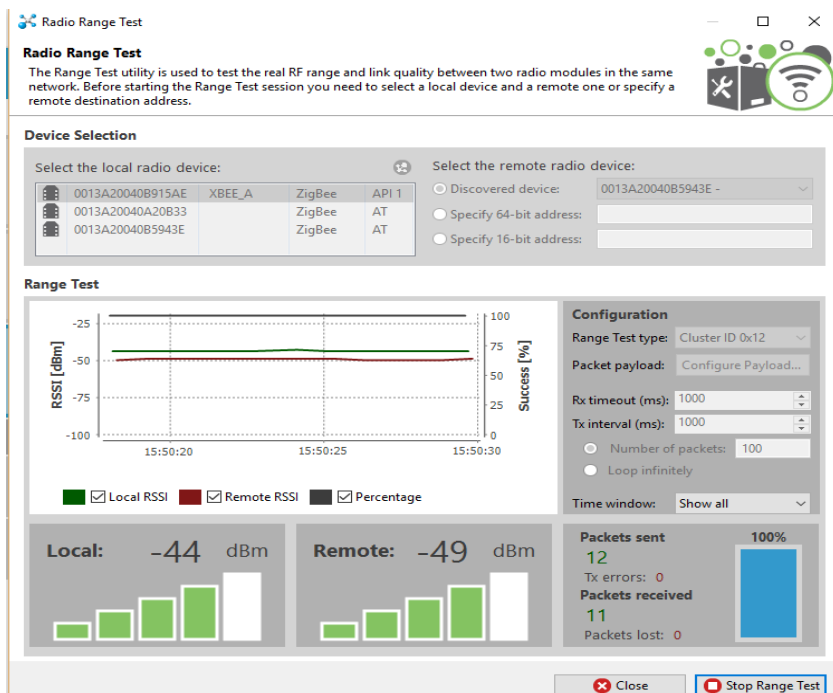


Figure 5. Range Test Node 1 to Node 2

3.2. Range Test

This tool is to test RF range and link quality between two modules in the same network. A local and a remote device are added to test the range between two modules.

4. Conclusion

1. A wireless network using 3 mobile nodes and a coordinator is being designed.
2. The throughputs of the xbees are observed to have the Instant Transfer Ratio varying from 6.5Kbps to 7.0Kbps and Average Transfer Ratio varying from 5.8Kbps to 6.8 Kbps
3. The ranges of the xbees are observed to have the local range varying from -35dBm to -45dBm and remote range varying from -40 dBm to -50dBm.
4. This wireless network can be used in various applications. In this project smart car parking system is being implemented.
5. The throughput and range we got is enough that this system can be used in a parking area.
6. This network can be also used in other sensing application by just few modifications.
7. Since this kind of network uses both the advantages of MANET protocol as well as wireless sensor network, capable of powering future IOT applications.

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