DA372A: Wireless Communications

Mandatory Laboratory Work - #3

Due date: November 6, 2018

Objectives: In this lab, you shall:

1. Familiarize yourself with technologies used to build wireless networks;
2. Learn how to set up and configure wireless networks using one of the popular technologies;
3. Learn how to programmatically control the communication between the nodes of the network.

A. Materials used:

You will use the following items in the lab for this work:

i) Arduino Microcontroller board

ii) AVRISP programmer device.

iii) X-CTU software, a program used to interact with and configure devices. Available for download at:

http://www.digi.com/support/productdetl.jsp?pid=3553&osvid=0&s=386&tp=5&tp2=0

iv) Atmel Studio software (version 5 or 6.x):

v) Zigbee radio communication devices: XB24-B modules from Digi

B. Background

An introduction about Zigbee networks shall be given by the instructor about the wireless technologies at the start of this lab's session. Follow the presentation and read the following documents (available on the Resources section of the course page):

1. XBee™ ZNet 2.5/XBee-PRO™ ZNet 2.5 OEM RF Modules (Chapters 2 & 3)
2. The guide to XCTU configuration and test utility software from Digi.
3. A tutorial to setup communication between two Arduino boards using XBee modules on the link below:

   https://learn.adafruit.com/xbee-radios/arduino-link

C. Procedure:

i) Configuration and diagnostics of the XBee module

- Identify the pin configuration of your XBee module and the purpose of each pin.
- Understand the functions of the different tabs in the XCTU startup screen
- Understand the configuration of the devices. Observe the settings of the various configuration items such as *networking, security, IO settings, serial interfacing, radio setting*, etc and explain the significance of these configuration parameters.
- Observe the differences in various settings of the devices. For example, what major differences do you see between a coordinator and a router/end device?
- Test communication between two Xbee modules using the **terminal** tab

ii) Wireless interfacing of Arduino:

- Read the document 'Setting up XBee ZNet 2.5 (series 2) modules'
- Go through task (i) above and the X-CTU documentation to configure the devices according to this document.
- Set up a Zigbee network with a coordinator and at least 2 end devices (nodes).
- Connect one end device to an Arduino board and the other end device to your PC.
- Configure all Zigbee nodes in one network with a single coordinator. Send and receive messages exchanged between nodes, first from the X-CTU terminal, then from your microcontroller.

Programming Tasks:

1. Write a program and test the connection between two Arduino hosts connected wirelessly through the XBee RF modules.
2. Write an appropriate program on the Arduino board so that it outputs 'high' if it receives a command 'A', and outputs 'low' if it receives command 'B'.
3. Wire the arduino board and a LED, so that the LED will be switched on if the output is 'high' and switched off if the output is 'low'.
4. Expand your Arduino program such that it sends a confirmation message back to the sender telling that 'A' or 'B' is correctly received.

Challenges:

Learn the following skills:

- Configuring Zigbee network nodes (roles and modes)
- Zigbee Channel allocation, frequency band selection, data rate, …
- Data transfer between Arduino and Zigbee
- Network security

Observe the following issues:

- Interference,
- packet loss,
- error detection

D. Report

Write the observations you made in each part of the experiment above.

Discuss the important skills you learnt in this lab.

Explain any difficulties you encountered and how you solved them.

Attach your program source code to the report.