

**Evaluation Form – Technical Background Review**

**Student Name:** \_\_\_\_\_

**Project Advisor:** \_\_\_\_\_

**Team Name:** \_\_\_\_\_

**Team Members:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ / 30    Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

\_\_\_\_\_ / 30    Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

\_\_\_\_\_ / 40    Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

\_\_\_\_\_ / 100    **Total - Technical Review Paper**

## **Wireless module for long distance communication**

### **Introduction**

To transfer information over a long distance without physical connection, a variety of wireless data communication technologies are implemented to fit special circumstances according to their coverage range, local availability, and performances. An ideal wireless module should be lightweight, long-range, high-speed, and low-power-consumption. However, there are trade-offs among them. This technical review paper briefly reviews several commercially available wireless data communication applications, the underlying technology of wireless modules, and some building blocks of their implementation.

### **Commercial applications of wireless data communication**

Due to the demanding requirement of power consumption and cost, the radio frequency module RFM12B-S2 Wireless Transceiver is favored. The RFM12B is a great inexpensive option for wireless communication [1]. The market unit price for RFM12B, produced by Hope RF company, is \$6.95 and it operates under a wide voltage supply range of 2.2-3.8VDC. The data transmitting rate is acceptable, up to 115.2 kbps with internal demodulator, and up to 256 kbps with external RC filter highest data rate [2]. Additionally, it carries a minimized dimension of 15.9 x 16.1 mm and transmitted power of 3.2mW [3]. However, RFM12B has a very limited range of 200 meters.

Another competing product is XBee Pro 900 RPSMA, carried by Digi International. This product is ideally suited for situation where radio frequency penetration and absolute transmission distance are paramount to the application [4]. This design operates at low voltage of 3.3VDC and a current of 210mA. Fast RF data rate of 156 Kbps and capability of multipoint networking adds to it as well. Another advantage of XBee Pro 900 RPSMA is that its range is up to 6 miles with high gain antennas. It's a great improvement for wireless data communication. XBee is one of the few products that can reach up to 6 miles (10 kilometers) while operating under such a low power consumption.

### **Technology for long-distance lightweight wireless data communication modules**

#### *Functionality*

XBee itself is a radio communication module and a “embedded solutions providing wireless end-point connectivity to devices” according to Digi. As a transceiver, XBee can receive signals through antenna like a radio and broadcast through point-to-multipoint mesh networking or peer-to-peer connection. At first, XBee was not a convenient solution to multi-point communication with the old protocol it used. Currently, newly released XBee wireless modules are using Zigbee protocol, which is a wireless communication protocol like Wi-Fi and Bluetooth. As a protocol, Zigbee defines a network layer

to support advanced mesh routing capabilities. It enables convenient and yet powerful mesh communication among XBee units [5].

#### *Improvement*

In 2005, two initial XBee modules were introduced to market, low-cost 1 mW XBee and 100 mW XBee-PRO. Both are mainly for point-to-point wireless communication and run with IEEE 802.15.4 protocol. After XBee DigiMesh, Digi Mesh protocol was introduced to robust mesh networking in applications [6]. After XBee ZB model, Digi International started to apply Zigbee protocol and it enables XBee multi-point communication network [7]. The current XBee model, XBee Pro 900 PRSMA, is already capable to conduct its role as a transceiver in mesh networking applicably and cost efficiently.

#### **Implementation of wireless data communication modules**

Instead of being plug-and-play, XBee is a raw unit with 69-page datasheet. However, as a wireless module, it can be easily connected to an Arduino with a shield. Such shield form-factor mates directly with any dev board that has an Arduino standard footprint and equips it with wireless communication capabilities using the popular XBee module. They can easily hook XBee up with an Arduino and help XBee configuration and data transmission. Regardless of XBee modules, it always requires at least two units to communicate. Information generated by Arduino can be directly transmitted to XBee radio transmitter side and wirelessly sent to the receiver side. Also, Arduino can directly supply power to XBee unit and turn it on or off to save energy.

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