Data Transmission Analysis using MW-5000 at 5.8 GHz Frequency

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ABSTRACT
In the recent years, the data communication system become the main type of communication in the world. The FSK modulator or demodulator is one of the part that becomes the most important part and extremely advanced with the involvement of microwave active and passive circuits. This paper presents the data transmission analysis using MW-5000 at 5.8 GHz frequency. This experiment use the microwave communication module MW-5000 that is available in electronic laboratory. From this experiment the duration taken for the transmission of data is depend on the length of sentence and the value of baud rate.

1. INTRODUCTION
In the recent years, the wireless communication system become the main type of communication in the world [1]. The field of Radio Frequency (RF) design is a growing one as a result of increased demand for wireless products. The FSK modulator or demodulator is one of RF system that becomes the most important part and extremely advanced with the involvement of microwave active and passive circuits [1]. WiMAX, which is short for Worldwide Interoperability for Microwave Access, is a novel wireless communication technology. It is an attractive technology due to the high transmitting speed (up to 70Mbps) and long transmitting distance (up to 30 mile). The system bases on IEEE 802.16 standards and uses several bands (2.3-2.7 GHz, 3.4-3.6 GHz and 5.1-5.8GHz) to transmit data. The design of the front-end low noise amplifier (LNA) is one of the challenges in radio frequency (RF) receivers, which needs to provide good input impedance match, enough power gain and low noise figure (NF) within the required band [2], [8]. Many high gain amplifier topologies have been proposed as a way to satisfy the requirement for low power dissipation as well as good performances. The cascode techniques to produces results in a higher bandwidth and gain, due to the increase in the output impedance, as well as better isolation between the input and output ports [3], [7].

2. LITERATURE REVIEW
Basically, microwave transmitters start with a carrier generator and a series of amplifier. It also includes a modulator followed by more stages of power amplification time. The final power amplifier applies the signal to the transmission line and antenna. A transmitter arrangement could have a mixer used to up-
convert an initial carrier signal with or without modulation to the final microwave frequency. Microwave
receivers, like low frequency are the superheterodyne type. Their front-end are made up of microwave
components. Most Basic concept and consideration in design of super high frequency amplifier is presented
in this paper. A simple, short-range wireless microwave communication system is the transmission,
reception, and processing of information with the use of electronic circuits. Information is defined as
knowledge or intelligence communicated or received. Figure 1 shows a simplified short-range microwave
communication system of which comprises three primary sections: a source, a destination, and a transmission
medium.

![Figure 1. Short-Range Microwave Communication System](image)

2.1. Wireless Communication

Wireless communication system is rapidly becoming one of the fastest growing segments of the
communication industry. Increasing the data rate, expending the coverage area and accommodating more
components on the same chip are the crucial motivations behind the occurring of different generations of
wireless communication systems [3]. An WLAN can provide the area of coverage less than 10km which the
application is between buildings to building. In Wireless LAN, MAC uses contention access, so the device
competes with all other devices on the network for attention on random basis to pass data through. Data
sent and requested by devices closer to the network access point (AP) constantly interrupt and even crowd
out data sent and received by devices farther away from the AP. Also, the more devices seeking access to
the network, the lower the quality of the signal. This means if we access the Internet with a Wireless router
hooked up to local cable TV company’s broadband service, for instance, and the company also offers VoIP
(Voice over Internet Protocol) phone service, the more people who are online, watching TV, and talking on
the phone in the access area, the weaker the signal and the slower of the connection speed. VOIP & IPTV are
difficult to maintain for large number of users. Encryption is not enabled in wireless LAN. This means the
Access Point typically default to an open mode. Wireless LAN networks can be monitored and used to read
and copy data (including personal information) transmitted over the network when no encryption is used. The
most common wireless encryption standard, Wired Equivalent Privacy or WEP, has been shown to be
breakable even when correctly configured. Therefore, no security provided in wireless LAN system. Wireless
LAN uses OFDM technique to support internet access data rate up 54Mbps. The required speeds defined in
IEEE 802.11a are 6, 12 and 24 Mbps with optional speeds up to 54Mbps [4].

WiMAX offers significant improvements over Wireless LAN, and among the more important is
the specification making 802.16a a system that uses a scheduling MAC (Media Access Control). The
subscriber station only has to compete once (for initial entry into the network). After that, it is allocated a
time slot by the base station. The time slot can enlarge and constrict, but it remains assigned to the
subscriber station meaning that other subscribers are not supposed to use it but take their turn. Unlike
802.11a, Even since its invention by Edwin Armstrong in 1917 [6], the superheterodyne architecture has
dominated the design of practical radio. This architecture uses two frequency conversion steps: first the
received frequency is converted to an intermediate frequency, and after some amplification and filtering, the
IF is converted to baseband. Note that the final down-conversion is performed twice to produce I (in-phase)
and Q (quadrature) output. This is necessary because the down-conversion operation cannot tell the
difference between frequency above and below the carries, so they end up on top of each other when the
carrier is converted to zero frequency. This information about the side band can be preserved by doing two
frequency conversions using different phases of the carries this scheduling algorithm is stable under

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overload and over-subscription. It is also much more bandwidth efficient. The scheduling algorithm also allows the base station to control Quality of Service by balancing the assignments among the needs of the subscriber stations.

The difference is distance and area of coverage. WiMAX provides up to 30km (18.641 miles) in every direction for fixed stations and 3 to 10 miles for mobile stations. It allows the connectivity between users without direct line of sight. WiMAX will provide fixed, nomadic, portable and, eventually, mobile wireless broadband connectivity [5]. Wireless can be used for a number of applications including last mile broadband access, hotspot and cellular backhaul for carrier infrastructure, and high speed enterprise connectivity. WiMAX support the frequency range 2-11 GHz, of which most parts are already unlicensed internationally and only very few still require domestic licenses. The 802.16a specification improves upon many of limitation of 802.11a standard by providing increased bandwidth and stronger encryption. WiMAX specified the theoretical data rate up to 70Mbps. However, in the real world test, the maximum data rate is between 50kbps and 2Mbps. It can be achieved by providing OFDM technique as well as wireless LAN modulation technique [5].

2.2. RF Transmitter Architecture

A microwave transmitter starts with a carrier a generator and a series of amplifiers. It also includes a modulator followed by more stages of power amplification. The final power amplifier applies the signal to the transmission line and antenna. A transmitter arrangement could have a mixer used to convert an initial carrier signal with or without modulation to be final frequency. Figure 2 shown the block diagram of transmitter for microwave communication system.

![Figure 2 Transmitter](image)

2.3. RF Receiver Architecture

It is the receiver that ultimately determines the performance of the wireless link. Given a particular transmitter power, which is limited by the regulations, the range of the link will depend on the sensitivity of the receiver, which is not legally constrained. Of course, not all application require optimization of range, as some are meant to operate at short distances of several meters or even centimeters. In these cases simplicity, size and cost are the primary considerations [4]. The purpose of a radio frequency (RF) receiver is to process incoming energy into useful information, adding a minimum distortion. How well receiver performs its purpose is a function of the system design, its internal circuitry, and its working environment. The acceptable amount and type of introduced distortion vary with the application.

All modern digital radios have two sections. One section is analog part and another section is digital part. Among their other services, radio must provide frequency conversion between antenna and the digital circuitry. In wireless MAN, the signal at the antenna which operates in the GHz is converted to the IF by tuning the local oscillator. A wireless MAN superheterodyne receiver might look like a block diagram shown in Figure 3.

The RF signal to lower IF signal to the desired level, the cascaded IF amplifier is used so that I and Q demodulator (in Indoor unit) can detect and down convert the IF signal to the I and Q signal [4]. Finally, the signals are further processed by OFDM baseband in order to get actual baseband data.
3. MEASUREMENT RESULTS

Measurement set up for measuring data transmission analysis shown in Figure 4.

Table 1 shows that, using different length of sentence at the same baud rate for each test, the duration taken to reach the receiver is almost same. When using the same length of sentence but different the baud rate as shown in Table 2 the duration taken to reach the receiver is different. For example 4800 baud rate send in 1.14 sec, while 9600 baud rate send in 0.60 sec. While the Table 3 shows that, the duration will become shorter, when use same size of sentence but different the baud rate.

### Table 1. Fix Baud Rate 4800

| No | Text Send                                           | Baud Rate | Duration Taken to reach the receiver (Sec) |
|----|-----------------------------------------------------|-----------|---------------------------------------------|
| 1  | “The flower is very beautiful and feel comfortable to see” | 4800      | 1.02                                        |
| 2  | “The flower is very beautiful and feel comfortable to see and touch it” | 4800      | 1.09                                        |
| 3  | “The flower is very beautiful and feel very very comfortable to see touch it” | 4800      | 1.19                                        |

### Table 2. Fix Text sender

| No | Text Send                                           | Baud Rate | Duration Taken to reach the receiver (Sec) |
|----|-----------------------------------------------------|-----------|---------------------------------------------|
| 1  | “Ahmad adalah kawan di Universiti”                  | 4800      | 1.14                                        |
| 2  | Pendidikan Sultan Idris”                            | 9600      | 0.60                                        |
| 3  |                                                    | 14400     | 0.27                                        |

### Table 3. Fix text sender at 12KB

| No | Text Send | Baud Rate | Duration Taken to reach the receiver (Sec) |
|----|-----------|-----------|---------------------------------------------|
| 1  | 12 KB     | 4800      | 27.58                                        |
| 2  |           | 9600      | 14.39                                        |
| 3  |           | 14400     | 9.56                                         |

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4. CONCLUSION

From this experiment, the distance is 1 Meter between sender and receiver antenna and 12 volt adopter is connected correctly. The different text sent with same baud rate can be sent with duration taken to reach the receiver is almost same. When, the value of baud rates is different the duration taken to reach the receiver is different. For example 4800 baud rate send in 1.14 sec while 9600 baud rate send in 0.06 sec. Generally, from this experiment can concluded that the duration taken for transmission of data is depend on the length of sentence and the amount of baud rate setting.

REFERENCES
[1] Abu Bakar Ibrahim, Arhardi Abas and Akmanisah Abdul Kadir, “Simulation of Microwave Low Noise Amplifier for Long Term Evolution (LTE) Application”, ICETVESS 2017.
[2] Rohit Kumar, Zoonubiya Ali “Analysis and Design of Single-ended Inductively-Degenerated Inter stage Matched Common-source Cascode CMOS LNA,” International Journal of research in Advent Technology, Vol 3, No 12, 2015.
[3] Saeid Yasami, Magdy Bayoumi “Forward Body Biasing Techniques in Current Folded CMOS LNA in Subthreshold Region for Biomedical Applications,” International Journal of Scientific Engineering. 2014. PP-1441-1448.
[4] M.Pozar, David, “Microwave and RF Wireless System,” Third Avenue, N.Y.John Wiley & Sons, in 2001.
[5] Gonzalez, Guillermo. Microwave Transistor Amplifier. 1996.
[6] Othman A.R, Hamidon A.H, Ting J.T.H and Mustaffa M.F. “High Gain Cascaded Low Noise Amplifier Using T-Matching Network,” 4th ISBC 2010.
[7] Weber, Wuezhan Wang and Robert. "Design of a CMOS Low Noise Amplifier (LNA) at 5.8GHz; and its Sensitivity Analysis," 11th NASA Symposium 2003.
[8] IEEE Computer Society and IEEE Microwave Theory Technique and Society. Part 16 Air Interface For Fix Broadband Wireless System, IEEE Standard 802.16.2004
[9] Inder J.Bahl. Fundamentals of RF and Microwave Transistor Amplifier. 2009
[10] Abu Bakar Ibrahim, and Ahmad Zamzuri, “Design of microwave LNA Based on Ladder Matching Network”, International Journal of Electrical and Computer Engineering, 2016.

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