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This Novel Launched New Long Range Wireless Technology Through ISM Band 2.4 GHz in Bluetooth Technology

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Abstract: This study introduced new device Sky Tie HRT (High Range Technology) and LDC (Long Distance Communication) through 2.4 GHz ISM band. This Sky Tie technology is an open speciation that enables low cost effective, low power, low band width for long range wireless communication between computer and laptop to each other. This device operate at 2.4 GHz in the license free ISM band (industrial scientific and medical) and this device can perform through Frequency Hopping Spread Spectrum (FHSS) modulation technique. The advantage of operating system in this band is world wide availability and compatibility with free cost. Its gives Sky Tie device a range up to 2 km. We can able to use this new technology in rural and suburban areas. This device can transmit the image up to 500 m and also send text up to 2 km through ISM band. This device gives high level of security because it' s very difficult for a spy device to predict which frequency the new device.

Key words: DIT, STM, FCC, FHSS, ISM band 2.4 GHz

INTRODUCTION

Today, we are using more wireless technology from that bluetooth and ZigBee very important through ISM band 2.4 GHz. Bluetooth is a standard for the short range wireless communication of mobile, laptop and other electronics device (Karmokar *et al*., 2011). We can able to send any image or other piece of data through Bluetooth up to 10-30 m and send text up to 10-100 m through ZigBee. So, we are introducing new technology for this research (Bloem *et al*., 2012). This Sky Tie technology does different work in same categories and increase the transmit range through 2.4 GHz ISM band.

Bluetooth is a protocol known as for exchanging almost all types of data such as text, image and videos among 250 KB. ZigBee protocol is especially for operational instruction and not much many of data' s and sent text only to P2P.

Why this new technology: In current trends, we are using many Bluetooth devices. But these transmit range are up to 30 m only. So are introducing new technology to increase the transmit range up to 2000 m. The list of characteristic include in this new technology (Wendt *et al*., 2015):

- P2P network (reduced hacking)
- Very low cost and using in rural areas

Table 1: Difference between Bluetooth and ZigBee

Processes	Bluetooth	ZigBee
Range	10-30 m	10-100 m
Data types	Text, image, video	Text
Transfer rate	1 Mbits	250 kB
Application	Computer, laptop, mouse, head sets	TV remote, sensor, medical processor
Security	High	Less
N/W topology	Point to point	Star, mesh
Frequency	2.4 GHz ISM band	2.4 GHz ISM band

- It can increase range between 500-2000 m
- Transmit the different document in single device through free cost
- Unlicensed band 2.4 GHz ISM band (Table 1)

MATERIALS AND METHODS

Here, we introduced new method STM "Stone Throw Method". This method is implemented from stone throw process. A little boy with less potent throws a stone of 250 g which travel a distance of 30 m. A man with higher efficiency throws a stone of 250 g which reach a distance 100 m (Medeisis *et al*., 2014). To compare with the attempt of the boy and man's effort in throwing the stone is of greater power and magnitude. So, we have developed new high power technology with low cost under FCC rules through ISM band 2.4 GHz. The following way of developing technique is presented in

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Table 2: Properties of Sky Tie

Processes	Sky Tie
Transmit range	500 m to 2 km
Data types	Text, Image, video
N/W topology	Point to point
Frequency	2.4 GHz ISM band
Layer	IEEE 802.15.1

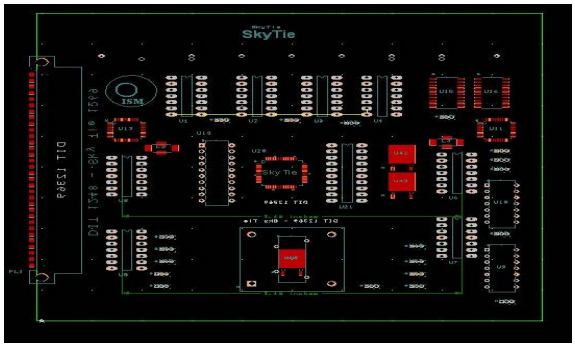

Fig. 1: DIT chip working inner layout

new Sky Tie technology (Wendt *et al*., 2015). The stone throws method to ensure reaching the data's at greater distances with greater power through ISM band 2.4 GHz under FCC rules.

Implementation method: This Sky Tie process is now working through DIT (Distance Increase Technology). It's a very sharp Sky Tie module. It's having an operating system and programmable in basic code as wireless file transfer to P2P (Xu *et al*., 2008). The Sky Tie DIT entity combines three technologies to create the most powerful and flexible Sky Tie module in the industry an improved wireless access technology through ISM band 2.4 GHz. This DIT technology uses to communicate using Sky Tie technology to P2P through ISM band 2.4 GHz. Collect this technology to create low power and high flexible communication network with node to node (Kaiser *et al*., 2001). This DIT module supporting such as PC, Cell phone and Laptop.

DIT working method: The Sky Tie DIT in an intelligent, autonomous, wireless micro controller with ISM band 2.4 GHz wireless communication process to P2P through Sky Tie operation system. It confirms to Sky Tie and support simultaneous master and many salve nodes (Fig. 1 and Table 2).

DIT simulation report (FHSS): The Sky Tie Distance Increase Technology (DIT) specification defines a wide range of communication through ISM band 2.4 GHz. So, here we introduced on DIT to transfer the document one point to another point (Ahmed *et al*., 2012). In this study, the result of three key tests will be shown the following categories 500-2000 m and each test based on frequency hoping spread spectrum through ISM band 2.4 GHz. The Bluetooth devices transfer the document from master to slave mode up to 10-30 m in each testing condition. The DIT device transfers the document from master to slave mode up to 10-2000 m in each testing condition. The DIT through significantly improves and is approximately 92% of the baseline increase the range to P2P (Table 3).

Testing process: The DIT technology to improve and shown result has positive manner. To declare the distance value range of old device and new device 100-500 m with FHSS with different range 202 MHz, 900 MHz, 448 MHz, 2.4 GHz. It achieves the range 30 m to old device and 498 m to the new device with 2.4 GHz. It's also good for other users of the 2.4 GHz ISM band. It is likely that by choosing the best channel available and reduced hacking method and also avoid interfering with other devices:

- RB1-100- C1-500 range bit rate-command end C1
- C1-500-RB1-1000 command end-range bit rate
- RB1-1000 B T1 B 2000 range bit rate-terminate

Test control method: When using a shared resource such as the 2.4 GHz ISM band. It is more important to not more of the recourse than is actually required. This can be thought of as a golden rule for using congested band (Valera *et al*., 2005). The details on the band can communicate by transmitting at a power level of 4-20 dBm. The FCC it allows the DIT device using the ISM band 2.4GHz to transmit range up to 2000 m to P2P.

Result and usages: This result is committed to providing Sky Tie solution that is the medical, education documents to transfer one end to another end through 2.4 GHZ ISM band. As an output, DIT device will be able to coexist in the rural areas and even within the same device without any hacking and interfere. The following figures are showing different kinds of output result. Figure 2 RB1-100-C1-500 it will test the range up to 500 m. Figure 3 C1-200-RB1-1000 it will test the range up to 1000 m. Figure 4 R1-1000-T1-2000 it will test range up to 2000 m. The range bit rate mention master node and C1 and T1 mention command end point.

Sky Tie operating system: The Sky Tie is the long range wireless transmitter technology. It is equipped with an extremely powerful high sensitive wireless transmitter. It can point to achieve a point up to 2 km with a 9 dBi Omni directional antenna (Raajhen *et al*., 2013). The Sky Tie develops for cell phone, Laptop in rural areas of 500 m to

Table 3: Specification requirements

Variables	Details
Benefits of the Sky Tie DIT	Powerful wireless function, high security
	Single processor solution
	Connect to varies slave nodes
	Compatible with all Sky Tie devices
	Making easy software development and deployment
Wireless programmable micro controller	Run application in basic Sky Tie OS
	Easy to make software development and deployment
	Data logging function up to 62 bytes
	Analog, digital, 2-wire serial sensor interfaces
Report master and slave node concurrently	Two profile for streaming data at the same time
	File transfer protocol server profile
	High security and object exchange client profile
	Multiple connections at the same device
	Object exchange server and object exchange client profile
Port contain	Sky Tie 2.1 Standard IEEE 802.15.1
	Two wireless data stream port using serial port profile to one master through many slaves
	One physical UART port
	One 12C master port
	Object exchange client available through basic programming Sky Tie OS
Software specification	Interpreter-Line number 1-2047
	Loop nesting: 64 characters
	Programming pack from standard file mode
	Subroutine-8 levels
	Character size-8 bit
	File system-basic and configuration file independent
	Sky Tie-2.1 with IEEE 802.15.1
	Electronic device support device
Profiles	Master and slave node simultaneously
	Object exchange for file transfer of basic and configuration file
	High security control, pairing and unsparing function
	File transfer protocol server report
Hardware specification	Processor-Sky Tie 5MM with DSP 8BMitinternal flash, 512KBitEEPROM
	Size-12.5×28 mm with antenna
	UART-1200 to 1382400 baud, 3.3 V, TTL level 5 V
	Internal ceramic antenna-5.5dBm transmit power
	Power supply-5 V
	Battery charger-25-100 mA configuration Lithium charger
	Input/output-12 digital I/O lines 3.3 V

2 km (Kumar *et al*., 2012). With most other devices only capable of obtaining a range of above 500 m. The Sky Tie OS process of the operating system it allows running customer application in basic programmable through wireless file transfer of a text file containing the basic code. It only embedded Sky Tie product that allows multiple and simultaneous connection in a single device (Sharma and Tyagi, 2011). Two Serial Wireless Connections (SWC) can be supported at the same time, plus file transfer and send text also.

Independent action: A very powerful input and output system implemented within the Sky Tie operating system allow reading and writing on 3 high ports SWC ports and the UART (Kimionis *et al*., 2014). It can achieve a sustained streaming data rate of 350 Kbits and baud rate of 3 Mbits (Kumar *et al*., 2012). The Sky Tie process has a read and writes file system for data logging and retrieval using a wireless file transfer protocol over an object exchange. The interoperability allows even cell phone, Laptop and PCs to access the file system wireless connectivity (Kamaluddin *et al*., 2011).

Wireless transmitter: The Sky Tie operating system comes with a number of intelligent sensor interface generic 12C, serial peripheral interface, real time clock and temperature sensor, high precision analog to the digital sensor, LCD and more (Kamaluddin *et al*., 2011). This creates the Sky Tie DIR the perfect solution for ALong Distance wireless Communication. It is point to point protocol is superior to Bluetooth, ZigBee or other solution in the wireless sensor network (Kumar *et al*., 2014).

Features of Sky Tie operating system:

- Much more development and deployment cost
- Very low hardware cost
- Ultra low power of under 50 uA with active Sky Tie operating system

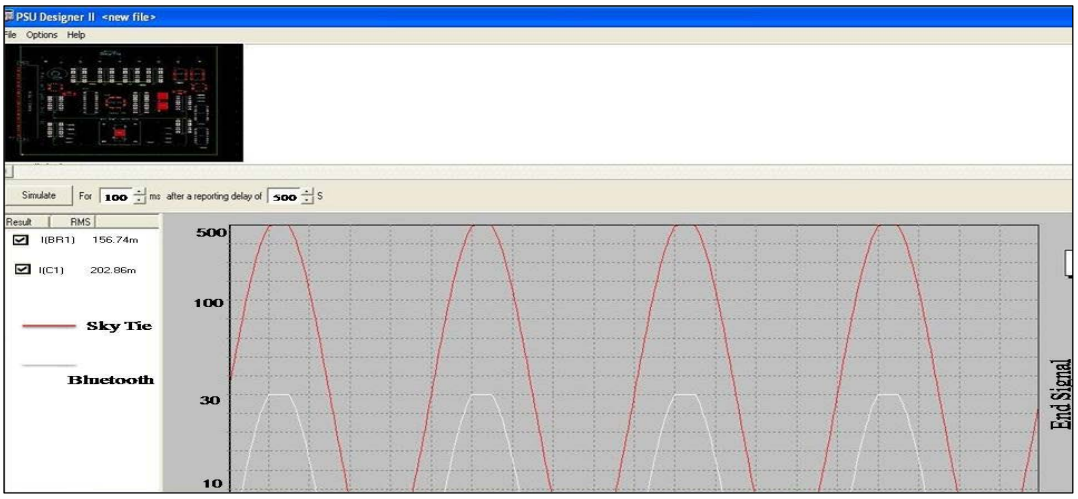

Fig. 2: Testing range up to 500 m

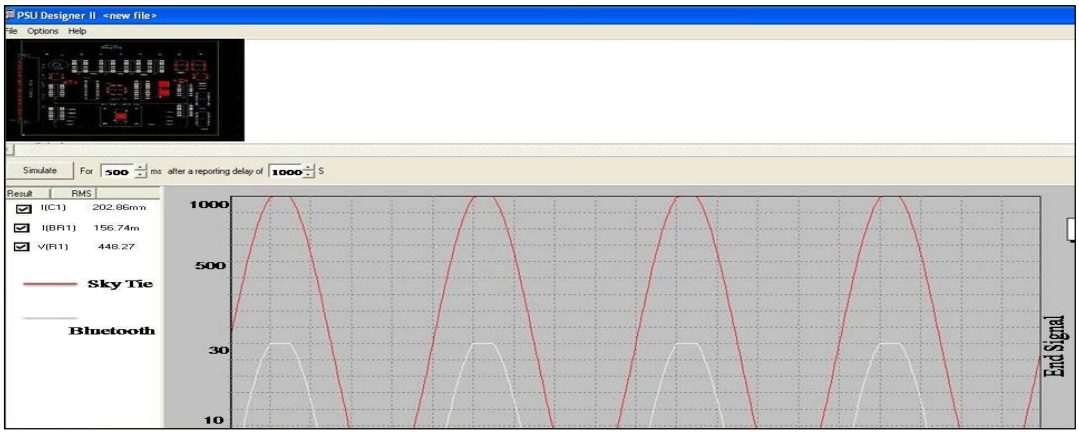

Fig. 3: Testing range up to 1000 m

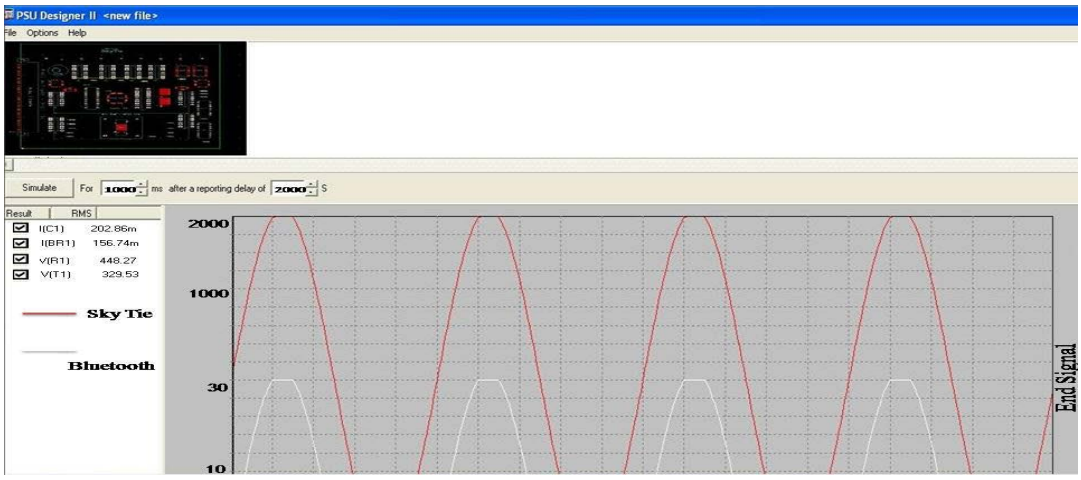

Fig. 4: Testing range up to 2000 m

Table 4: Hardware specifications

Technical specification	Process
Supporting OS	Linux, Windows, Mac OS
Sky Tie external connector	Omni directional antenna 9, 18 dBi
Sky Tie profile	Sky Tie 3.0 with EDR profile
	Master and Slave node at the same time
	IEEE 802.15.1
	Object exchange and file transfer to 4 multiple connection at the same time
File system	32 KB available for files text, Image and Video
Basic Interpreter	1023 lines of basic program
	String operation function
	Embedded function for Sky Tie OS
Radio	Raw output power 19:5 dBm
Output power	19.5 dBm
Input power	-92 dBm
Power supply	Power through USB, 5 V, Max 300 mA
Antenna gain	9 dBi Omni Directional
Certification	Bluetooth 4.1+EDR and BLE
	FCC certification
	CE certification

- Extremely long range of up to 2 km
- Interoperability with and PC, Laptop, Cell phone
- Single processor device is very low hardware cost
- Compatible with all wireless devices to SWC, FTP and OBEX

Sky Tie technical specification: The following characteristic is included in the Sky Tie technology. These technologies are activating to increase the range to file transfer to P2P through 2.4 GHz ISM band (Contaldo *et al*., 2010).

Antenna specification: The 9 dBi gains Omni directional antenna increase the distance range to P2P. This antenna covering vertically at a right angle or any angle between upside and down side through 2.4 GHz ISM band (Table 4) (Liu *et al*., 2012).

Working processing methods: To connect the Sky Tie to your computer through USB cable. Plug one end into the module and the other end into an open USB port on your computer (Valera *et al*., 2005). All power comes from your computer and no software is needed either as long as your computer or Laptop has a wireless connection is installed. The Sky Tie USB transmitter does increase the range between your computer and Laptop through paired devices. And also send data up to 2 km to get this range to be out door had had a perfect list of sight between the two devices. The Sky Tie network device work as a master and all other devices are working as a slave mode and all slave devices can communicate with the master device if they are separated by a distance under 1000 m. The slave device is separated by a large distance up to 2000 m.

Security manner:

- Security is given in three ways
- Pseudo random frequency band hops
- Authentication and encryption
- Frequency band hops make it difficult for anyone to hack
- The authentication allows a user to control connectivity to only device specified.
- The encryption user secret key length of 1-64 bits

Sky Tie software working methods: The following programming steps are including in Sky Tie Software process. There are two main steps that are has to follows:

- Discovering devices in range
- Looking up to user's readable name

Discovering devices in range: The first step is to find the devices that are in range so that a connection can be established with them. This is known as discovering of devices.

Discover method: Discover_device () It return a list of address of devices discovered.

```
discovered device = discover_device ()
```

Looking up the user's readable name: The address of the discovered devices are of the form "@@@@" where each "@" is the hexadecimal character representing "one octet of the 48 bit address".

```
target _device = "sriman"
target_device_address = none
for address in discovered_ device:
if target_device = lookup_name(address)
break
if target_device_address is not None:
print AThe address of the target device is:",
target_device_address
else
print "could not find address of target_device"
```

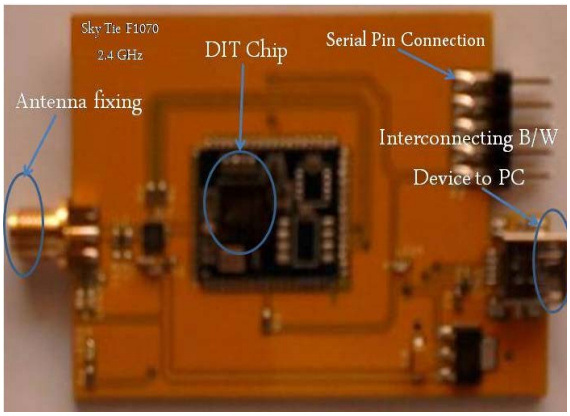

Fig. 5: Sky Tie working layout

Fig. 6: Developing code method

The list of addresses and passes one address at a time to the "lookup_name" method. Then it compares the returned name with the desired device name. If it matches, then a message is printed and breaks out the loop.

How it works: First, the python file receives the command from the android application through Sky Tie. Second, the Python file sends the received command to android cable (Fig. 5 and 6). Third, the command (1 or 0 or 2) turns on the pin 3 and configuration is send back to android application. The following commands are developing and running commands wise:

- 1 turn on pin-3
- 0 turn off pin-3
- 2 close socket

To connect laptop to another laptop using Python Sky Tie on the laptop application on the laptop. To processing for my laptop through Sky Tie.

```
skytie server Socket tmp = badapter.listenUsingRfcomm
WithServiceRecoed (badapter.get Name (),MY_UUID);
Skytie Server Socket bServer Socket=tmp;
if( bserversocket!=null)
{
skytie Socket acceptsocket = bServerSocket.accept
(timeout);
}
if (acceptsocket! = null)
{Out. append (Agot the connectionY.\n)
}
```

Client processing in laptop (python):

```
From skytie import
skytie _addr = "G8: EC: FH: 89: IF:/D"
Sock = skytiesocket (RFComm)
Sock.connect (skytie_addr,2)
Print "connected"
Sock.class ()
```

Communication link: The python program that looks for a nearby device with the user-friendly name "my device".

```
import skytie
target_name = "my device"
target_address = None
nearby devices = skytie.discover_devices ()
is target_name = Bluetooth.lookup_name (bdaddr);
target_address = bdaddr
break
target_address is not none:
Print "found target skytie devices with address",
target_address
else
Print "not find skytie device nearby":
```

- Choosing a device really means choosing a Sky Tie address
- Only the user-friendly name of the target device is known, then the steps must be taken to find the correct address
- First the program must scan for nearby devices. Then routine "discover_device ()scan for approximately 5 sec and returns a list of address of detected devices
- Next, the program use the routine lookup_name () to connect to each detected device, requests its user-friendly name and compare the result to the target name

Calculation: The Sky Tie distance range, calculation producing mathematically predicts the system range based on the power, receiver capacity, antenna gain, path loss and fading margin. The path loss equation represents path loss as a function between the receiver and

transmitter and the wavelength of the operating frequency (Preetha, 2011). This equation is derived from the long transmission equation and is given by:

$$\text{Path loss} = 20 \log (4*\pi*d/\mu) \text{ db}$$

Where:
d = Distance between receiver and transmitter
μ = Wave length

The long transmission equation can be used to represent the path loss as the sum of the other system factors loading to the following equation:

$$\text{Link budget} = P(t) + G(t) + R(t) - R(s) - F(s) \text{ db}$$

Where:
P(t) = Transmitted power
G(t) = Gain of transmitted antenna
R(t) = Gain of receiver antenna
F(s) = Fading margin

Now consider the Sky Tie DIT module with an output power of 19.5 dBm and input power of -92 dBm.

$$\mu = 2000 \text{ m for } (2.4 \text{ GHz})$$

Link budget = 19.5 dBm+9 dBi+9 dBi - (-92 dBm)- 22 dBm = 107 dB.

RESULT AND DISCUSSION

In this study, the proposed method is compared the previous method with same frequency 2.4 GHz through different input and output power status (Langlois *et al*., 2015). The respected value is defined in True RTA System to test the Sky Tie process manually frequency and input and output power. The previous method will reach up to 0-30 m and new method will reach up to 0-1980 m in different power status with same frequency manner. Then, it will produce two different kind wave propagation in testing strategy (Preetha, 2011). The peak gain of DIT is 3, 6 and 9 dBi with a very high and small variation with the 9 dB return and reaches the correct destination without any hacking interaction. The result of these two tests is shown along with transmit range wave propagation in Fig. 7. When the Bluetooth interface are transferring a document as 10-30 m away within this we use Sky Tie process to increase distance range up to around 2000 m.

Transmit test speed level: The every data transmit speed level is always high and beat in Sky Tie processing manner (Fig. 8). The transaction starts at 0-10 sec to link with master and slave mode and after 0-60 to transfer the data to one end to another end with the same frequency manner 2.4 GHz (Friedman and Fernsler, 2001). Figure 9 shows that sometimes the system will be accrued in some

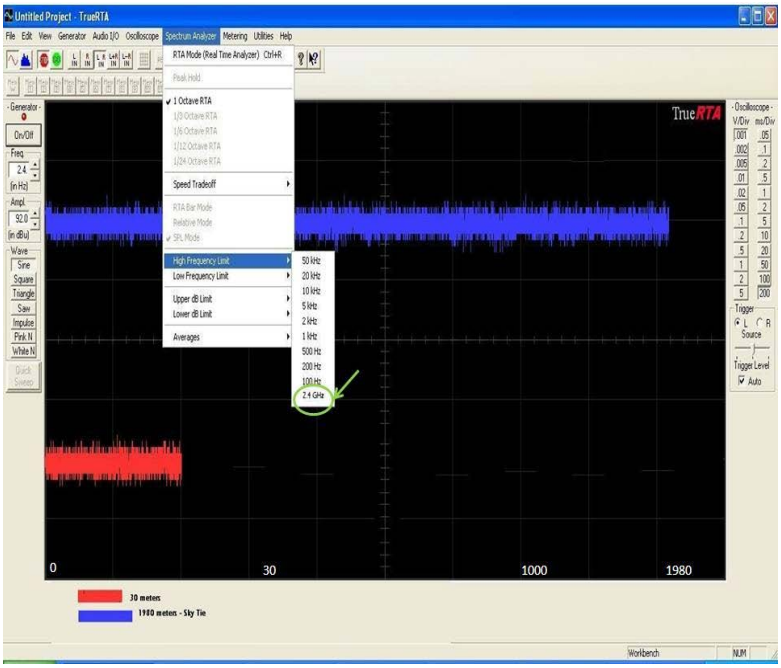

Fig. 7: Testing comparison between old and new device

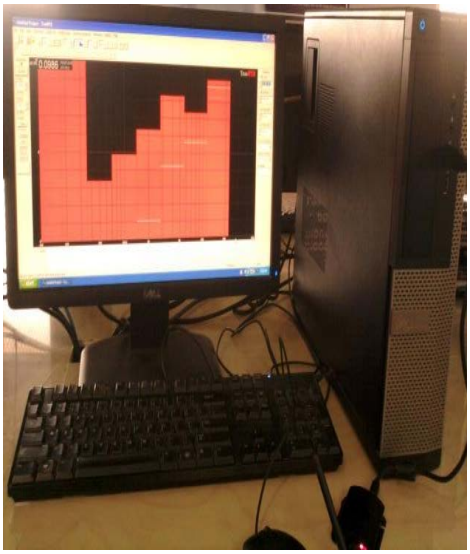

Fig. 8: Transmit speed testing process

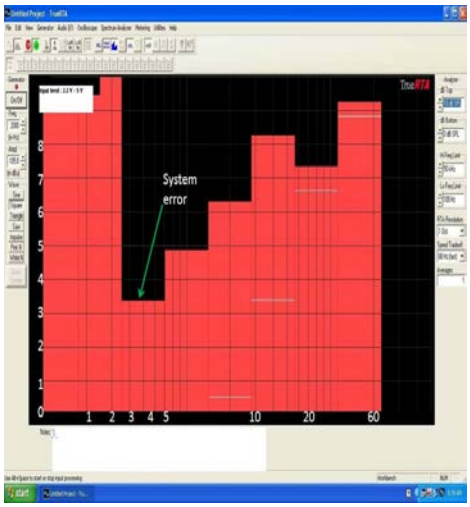

Fig. 9: Reason to fail

Fig. 10: Data successfully send

error in that time transaction time will increase to source to destination. The following error accrued in system error power drop, software error (Langlois *et al*., 2015).

Experimental result: In order to produce the performance of our proposed system delivered positive results. The experimental result is displayed in Fig. 10. The new technology uploaded in PC's, Laptop then it will start the working process between Sky Tie device and connecting devices. Since, all operations are running on the same processor as the device is implementedis a multitasking system. Two processing methods are controlled scheduled routines through Master and Slave mode. The Master process starts with transmitted through FTP. The master process to connect the ongoing Slave mode. The successful connection requires that the two partners are paired and pass key are exchange between Master and Slave mode then the unique link key in stored on both ends to indicate a successfully pairing. The pairing information can be erased either when >8 peers are stored or manually with the unpaired function. Using this 9 dBi directional antenna, the Sky Tie technology can reached an unparalleled PC to PC under FCC rules up to 2000 m with weaker devices such as mobile phone, PC and Laptop.

CONCLUSION

In this research, we produced new wireless communication technology through ISM band 2.4 GHz. This research has been presented a long range wireless communication through new device Sky Tie under FCC rules. The new technology transmits the data up to 0-2000 m and produced high range output to compare and better than with previous Bluetooth device. This new device delivered a step of the next generation of wireless communication with low power and low cost. And future, it will be launch with PC's, Laptop and cell phone mother board.

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