

Simulation Studies on Zigbee Communication for Video Transmission and Networking

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Abstract— ZigBee is a new wireless communication technique based on the radio frequency electromagnetic waves. ZigBee is based on the IEEE 802.15.4 Standard and 128bit key and AES-128 block encryption tool with Flexible protocol design which make it suitable for many applications. It is most popular technique due to its cost effective and lower energy transmission applications for safely data transmission in various fields like wireless control, monitoring, medical, industrial, and scientific areas. Wireless sensor and control networks are playing crucial role as an integral part of the automation process within chemical plants, refineries, and commercial buildings. In this paper we have performed various simulations on Network Simulator version 2.29 and compared results for the three traffic types-*ie.* ftp, cbr, poisson. Video transmission over such networks is considered an issue since video traffic contains a large amount of information that requires high data rates. This paper also presents analysis of video transmission over this protocol.

Keywords— ZigBee, wireless sensor network, ZigBee, 802.15.4, WPAN, Ns2

I. INTRODUCTION

ZigBee is a new wireless standard which is extensively used in wireless communication. It was developed by the ZigBee Alliance, which is a global network of over 200 foremost original equipment manufacturers *i.e.* OEMS which help in creating wireless solutions for residence, commercial and industrial applications. It focuses on standardizing and enabling interoperability of various products. The ZigBee specification includes protocols like Ad-hoc On-demand Distance Vector (AODV) and neuRFon which are used in wireless communication between the nodes.

ZigBee mainly aims for low data rate applications and helps in energy conservation. The ZigBee protocol stack is built on top of the IEEE 802.15.4, which defines the Media Access Control (MAC) and physical layers for low-rate wireless personal-area network (LR-WPAN). The ZigBee standard offers a stack profile that defines the network, security, and application layers. The ZigBee specification is an open standard that allows manufacturers to build up their own applications that require low power and low cost.

ZigBee network classified into three types of devices as follows:

1. Network Coordinator: It is the most advanced of the three types and requires maximum memory along with computing power. It has the ability to maintain the overall network knowledge. Each network has exactly one coordinator
2. Full Function Device: It can function as a network coordinator if it is supplied with additional memory and computing power. It supports 802.15.4 functions and features which are supported by the standard.
3. Reduced Function Device: It has limited functionality as compared to network coordinator and full function device. This is primarily done to reduce the cost and complexity. An end device is basically a Reduced Function Device (RFD).

II. SIMULATION AND ANALYSIS OVER ZIGBEE

During the simulation on ZigBee networks, we have used the AODV Routing protocol compared the simulation for three traffic types namely-ftp, cbr, poisson. The Ad hoc On-Demand Distance Vector (AODV) routing protocol is developed over DSDV and the improvement is on minimizing the number of required broadcasts by creating routes on an on-demand basis, as opposed to maintaining a complete list of routes in DSDV algorithm. It offers quick adaptation to dynamic link conditions, low processing and memory overhead, low network utilization, and unicast route determination to destinations within the ad hoc network. The distinguishing feature of AODV is its use of a destination sequence number for each routing table entry. The destination sequence number is created by the destination and is included along with any route information it sends to requesting nodes. Using destination sequence numbers ensures loop freedom and is simple to program.

1. PROCESS STRUCTURE

The following passages describe the simulation structure, to generate the final statistics. Several scripts and programs have been designed for this project to generate the results. This section of the documentation concentrates in explaining these programs, the passed parameters, in detail and the organization of the programming structure to create the simulation environment which would generate graphable results. The figure 1 explains the inter dependency of the scripts and programs of the simulation environment.

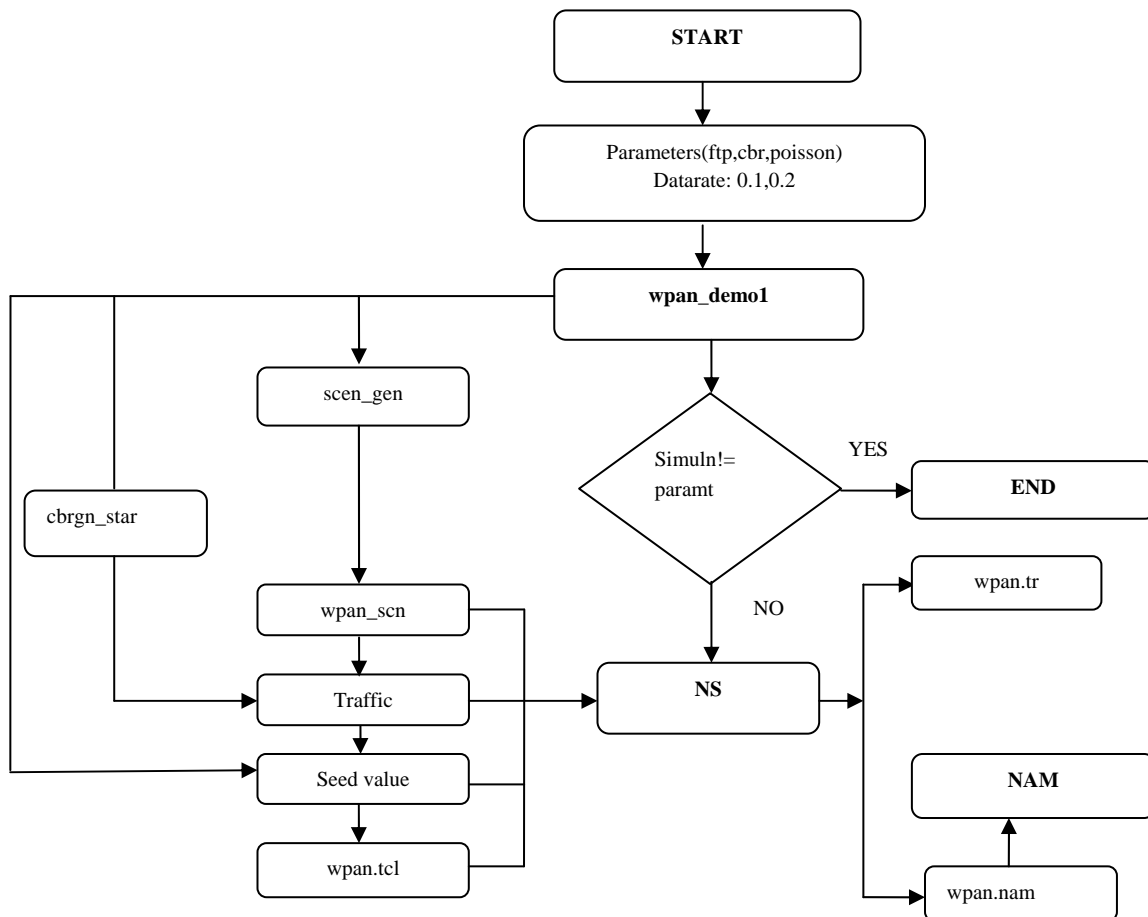


Fig.1 Flowchart of the simulation

2 SIMULATION SCENARIO

In this project, we are considering two scenarios, first we are comparing the three types is FTP,CBR,POISSON.

2.1 First scenario

A. FTP(File Transfer Protocol) : -File Transfer Protocol (FTP), a standard Internet protocol, is the simplest way to exchange files between computers on the Internet. Like the Hypertext Transfer Protocol (HTTP), which transfers displayable Web pages and related files, and the Simple Mail Transfer Protocol (SMTP), which transfers e-mail, FTP is an application protocol that uses the Internet's TCP/IP protocols. FTP is commonly used to transfer Web page files from their creator to the computer that acts as their server for everyone on the Internet. It's also commonly used to download programs and other files to your computer from other servers.

B. CBR(Constant Bit Rate):-CBR is designed to emulate the time-division multiplexed advantages offered by a private line interface. The disadvantage of CBR-classified traffic is that, just like private lines, it does not allow for oversubscription. But CBR offers the best guarantees of traffic delivery.

The whole key to CBR traffic is to transport a totally transparent bit stream. There's no silence suppression because there's no definition of silence. In fact, the traffic is so transparent that there's not even a requirement for eight-bit byte boundaries. CBR traffic

consumes 6 bytes out of every 53 bytes for ATM overhead, or roughly 12%.

C. Poisson Traffic Type:- poisson is well documented and may prove helpful as we go about adding new and exciting protocols to ns-2 and allow for "cleaner" ns-2 scripts than a "hacked"/overloaded Exponential purposes.

2.2 Second scenario

1) Output formats obtained on simulation of wpan_demo1.tcl:-

A. Ftp Traffic Type: \$./ns wpan_demo1.tcl -traffic ftp (by default ftp protocol used)

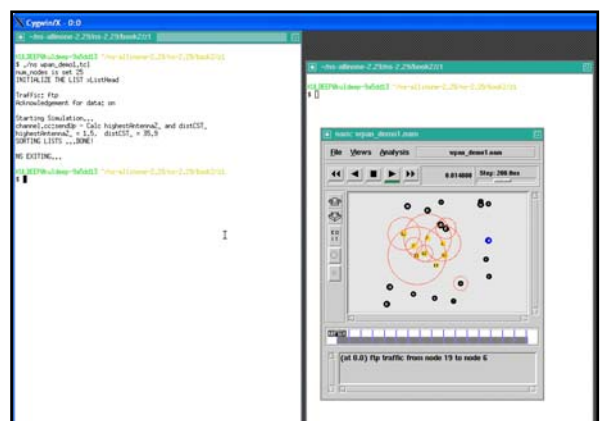


Fig. 2 Ftp Traffic Type

B. CBR(Constant bit Rate):- \$ wpan_demo1.tcl - traffic cbr

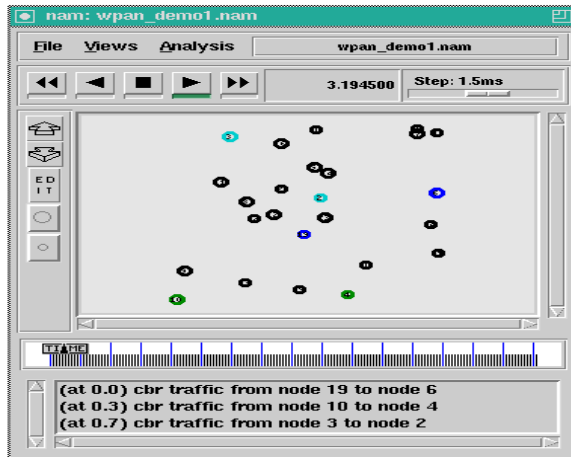


Fig. 3 Cbr Traffic Type

C. Poisson Traffic Type:- ./ns wpan_demo1.tcl - traffic poisson

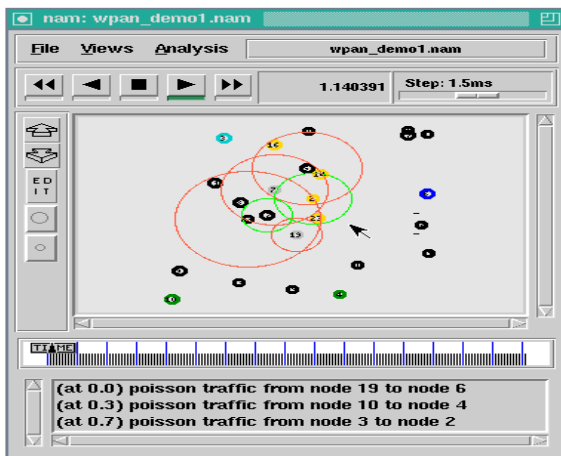


Fig. 4 Poisson Traffic Type

2) Output formats obtained on simulation of wpan_demo2.tcl:-

A. FTP Traffic Type:- \$./ns wpan_demo2.tcl

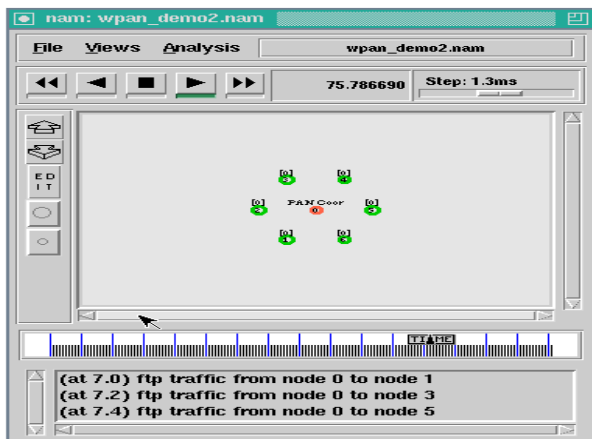


Fig. 5. Ftp Traffic Type

B. CBR Traffic Type:- \$./ns wpan_demo2.tcl - traffic cbr

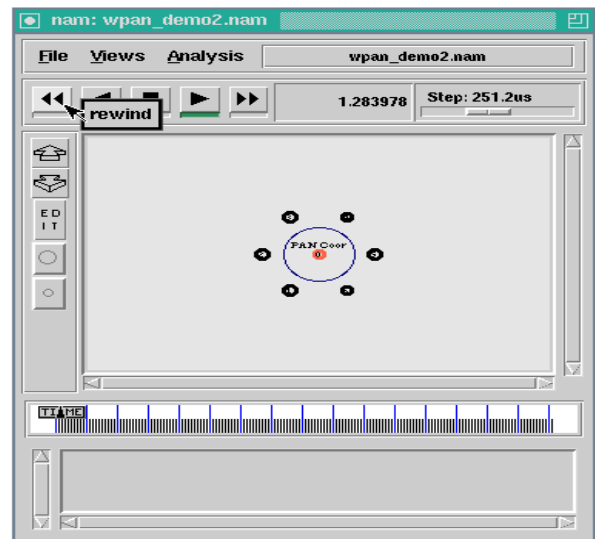


Fig. 6. Cbr Traffic Type

C. POISSON Traffic Type:- \$./ns wpan_demo2.tcl -traffic poisson

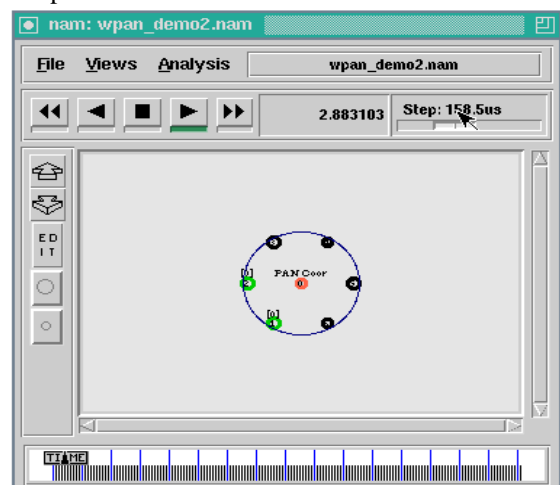


Fig. 7. Poisson Traffic Type

III. TRANSMITTING VIDEO ON ZIGBEE

The emerging IEEE 802.15.4 (Zigbee) standard is designed for low data rate, low power consumption and low cost wireless personal area networks (WPANs). Video transmission over such networks is considered an issue since video traffic contains a large amount of information that requires high data rates.

The availability of low-cost hardware cameras and microphones has advanced the development of Wireless Multimedia Sensor Networks (WMSNs), i.e. networks of wirelessly interconnected devices that are able to ubiquitously retrieve multimedia content such as video and audio streams, still images, and scalar sensor data from the environment. Although sensor networks cannot be used for high quality video transmission, they can be used in surveillance and monitoring applications that require minimum video quality.

We simulation based performance evaluation of video surveillance over wireless ZigBee networks by making use of the non-overlapping channels in the 2.4GHz ISM band. We use multiple channels and multiple radio interfaces over 802.15.4 networks and enhance the performance by using multiple descriptive coding (MDC) over the multiple channels and multiple radio interface network topology.

For transmission of video on ZigBee, we developed a new .tcl file namely we_wpan_demo1.tcl.

We use Video Server to send images to the Video Receiver in Internet or any wireless network. MyEvalVid enables us to do this for the image using Peak to Signal Noise Ratio assessment, PSNR (peak signal noise ratio of the program).

Simulation steps are as follows:

- 1) Step 1: The ffmpeg.exe of the workers(foreman) of the YUV file into the file m4V.
 - s: set frame size, qcif means 176*144.
 - vcodec: specified compression, such as mpeg4.
 - r: set frame rate, set set here to 30 images per second.
 - g: set the group of picture size, set each group has 9 pictures.
 - bf: use 'frames' B frames, set the I and P between the two frames.
 - i: input file name, enter the source of video foreman qcif.yuv.

```
./ffmpeg.exe -s qcif -vcodec mpeg4 -r 30 -g 9 -bf 2 -i foreman_qcif.yuv foreman_qcif.m4v
```
- 2) Step 2(before error correction): MP4Box is then used to generate MP4 file from M4v file.


```
./MP4Box.exe -hint -mtu 1024 -fps 30 -add foreman_qcif.m4v foreman_qcif.mp4
```
- 3) Step 2(after error correction): To remove this error, place msvcr70.dll file into lab6 folder after downloading it from internet and then re-run it.
- 4) Step 3: Mp4trace.exe will be used for each frame to keep information retrieval in forman_qcif.st. For destination IP as 192.168.0.2 and destination port number as 12346, the following instruction is used to generate the foremen_qcif.st file:


```
./mp4trace.exe -f -s 192.168.0.2 12346 foreman_qcif.mp4>foreman_qcif.st
```
- 5) Step 4: Simulation with NS2 network performance simulation tool. Parameters are as follows:
 - Opt(0)= good chance of
 - Opt(1)= bad chance of
 - Opt(2)= in the good state, the packet error probability
 - Opt(3)= in the bad state, the packet error probability
 - Opt(4)= seed number
 - Opt(5)= put each screen size into the size of the number of packets.

For video transmission:
 For wireless, parameters are required.
 For wired, no parameters are required..

```
/ns wpan_demo1.tcl -traffic cbr 0 0 0.01 0 1 1024 1
```
- 6) Step 5: Execution of this step results in creation of 4 files namely:
 - rd
 - sd
 - video1.dat
 - bsc_multicast

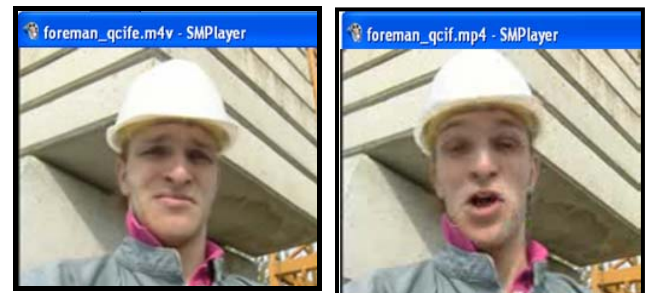
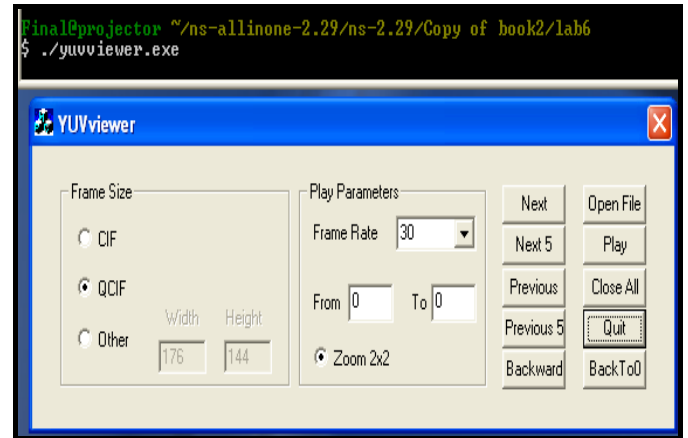
Client to send 659 packets but the receiver has received only 652 packets. Hence loss rate of 0.0106. Now we perform reconstruction of the video files using etmp4.exe which in turn uses received data files. Now ffmpeg uses foreman_qcife.mp4 to reconstruct forman_qcife.yuv.

```
./etmp4.exe sd rd foreman_qcif.st foreman_qcif.mp4 foreman_qcife
```

- 7) Step 6: Now we use Avgpsnr tool to calculate the average value of PSNR:


```
./avgpsnr.exe
./avgpsnr.exe 150 150 420 foreman_qcif.yuv foreman_qcife.yuv
```
- 8) Step 7: We use yuviewer.exe tool to view the difference between the video codex of the send code and received code.


```
./yuviewer.exe
```



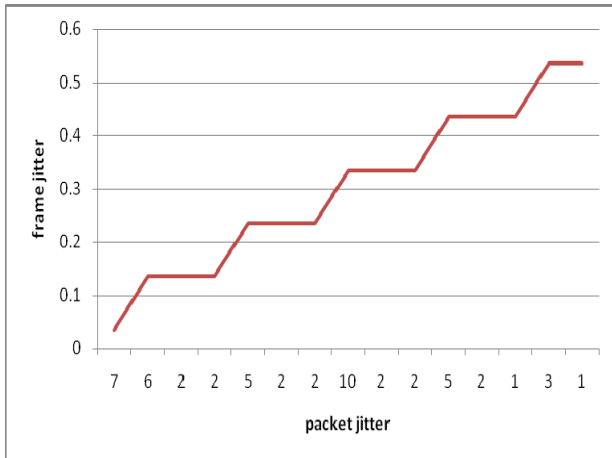
IV. SIMULATION RESULTS

The new .tcl script is simulated on all three traffic types for video transmission:

- ftp
- cbr
- poisson

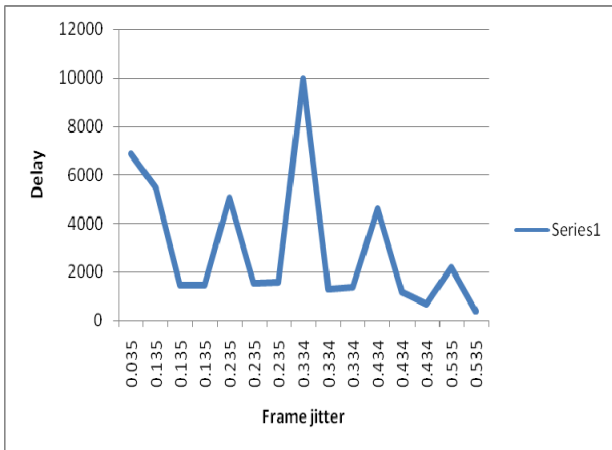
On simulation, PSNR is obtained for all three traffic types. Comparisons are made on their results that have been graphically showed. The graphs plotted can be shown as:

- 1) The first graph is plotted between frame jitter and packet jitter



We obtain a ladder-like graph. According to the graph, it can be seen that as the frame jitter increases, the packet jitter increases.

2) The second graph is plotted between delay and frame jitter.



According to this graph, it can be shown that delay is dependent on frame jitter.

V. CONCLUSION

ZigBee is one of the newest technologies enabling Wireless Personal Area Networks (WPAN). ZigBee is the name of a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4 standard. The technology is intended to

be simpler and cheaper than other WPANs such as Bluetooth. ZigBee protocols are intended for use in embedded applications requiring low data rates and low power consumption. Though WPAN implies a reach of only a few meters, 30 feet in the case of ZigBee, the network will have several layers, so designed as to enable intrapersonal communication within the network, connection to a network of higher level and ultimately an uplink to the Web.

ZigBee is designed so as to remove the shortcomings of have drawn certain conclusions based on their results. These results have been graphically represented by plotting graphs between Frame jitter vs Packet jitter and delay vs Frame jitter.

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