IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

Simple Satellite Network Simulation using OMNET++ 5

Narendra Kumar Dewangan [1], Narayan Sahu [2]

Student (M.Tech.), Department of Computer Science & Engineering, ITM University, Naya Raipur, India[1]

Assistant Professor, Department of Computer Science & Engineering, ITM University, Naya Raipur, India[2]

Abstract: In present day's satellite play important role in various part of life and industry. Security, entertainment, data communication and many other things are dependent on satellite networks and communication modules. Satellite is more or less like wireless networks with broadcasting data transfer facility. Data can be transmitted from one point of earth to another point through the geostationary satellites. Satellite implementation is very costly in real, so we have to make first virtual simulation of satellite network to measure its performance. This paper describe the Satellite network Simulation with tool OMNET++5. Before implement a real time model of communication channel, we create simulation model for testing.

Keywords: Satellite network, wireless, OMNET++ 5, Network Simulation, wireless networks.

I. INTRODUCTION

Satellite network is less or more like wireless networks, where the earth station is work like server as well as host and the geostationary station is like the communication channel to receive and send communication signal and data from one station to another. Receiver can be static and mobile both types. In today's world thinking of IoT (internet of Things) can be easily implemented by the use of low earth orbit(LEO) Satellites , many metro IT projects can be handled from far away and it can only be possible through the high speed broadcast satellite data transmission units. Think that if satellite short models with basic data transmission facility and high data rate transmission are possible then we can connect remote areas with the internet and network broadcast technology.

Provide E- services to the remote areas. By using simulation models we can find the ability of data transmission of satellite and easily use the analysis data to implement real model of satellite. There are many network simulator are available but OMNET++ is more powerful and open source simulation model for any type of network.

II. THINKING OF SATELLITE NETWORK

Satellite network communication can be effected by the following factors:

[1] Satellite orbit
[2] Delay
[3] Signal to noise Ration
[4] .Data rate.

A. Satellite orbit

There are LEO, MEO (Medium Earth Orbit) and GEO (Geostationary Earth Orbit) type satellite in the orbital types. In which LEO is designed for the short time benefits with low data rates and frequency. MEO has moderate launch cost but larger delays and big path loss. In GEO is covered 24 hour with 35859.403008 km height from earth. These satellites are good for broadcast communication.

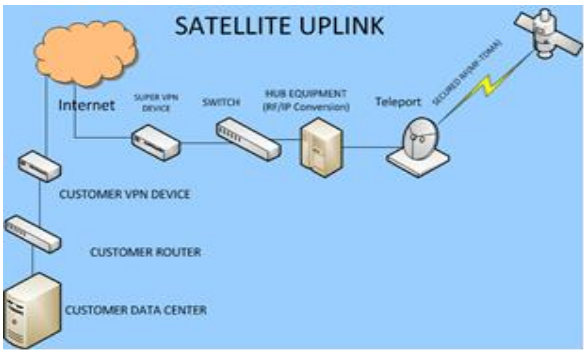

Fig. 1 Satellite Uplink

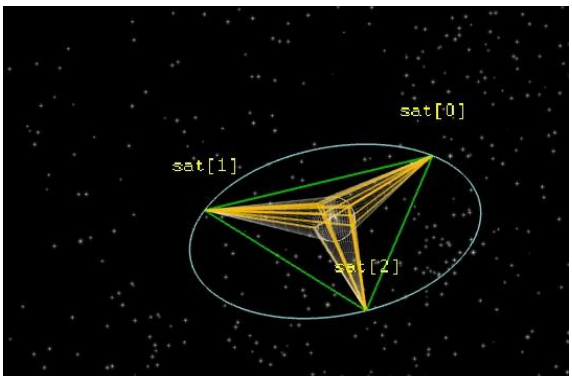

Fig. 1 OSG-satellite simulation in OMNET++

B. Delay

Most of the satellite network communication; TCP is not work for the proper delay. Most satellite delay model is depending on buffering delay and propagation delay. The factors affecting the satellite delay are as follows:

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

[1] Available bit rate(ABR)
[2] Minimum Cell Rate()MCR)
[3] Unspecified Bit rate(UBR)
[4] Guaranteed Frame Rate (GFR)

ABR are from 7.2 Mbps to 634.5 Mbps
Satellite network delay model is an end-to-end model in which transmission delay is calculated as

$$D=t_t+t_{up}+t_{down}+t_l+t_s$$

Where D=end-to-end transmission delay
t_t= sum of transmission delay
t_{up}= uplink delay time
t_{down}=downlink delay time
t_l=link delay time
t_s= switching and process delay time

C. Signal to noise ratio(SNR)
In satellite communication network very low SNR are used. In model satellite communication very high rate of data is transmitted from one end to another so the chances of noise are more than the simple data communication transmission.
So we can reduce noise by using the best transmission medium as CDMA/CS. SNR margin is difference between the actual SNR and minimal SNR required to synchronise at a specific speed. It is normally measured in decibel. SNR margin is often confused and used interchangeably with SNR.

For example to calculate SNR margin
If actual measured snr is 32db
and SNR to sync at 8Mbit/s is 20db
Then SNR margin is =32-20=12db
If the SNR margin is higher than the signal clarity is higher.

D. Data Rates
Data rates of satellite can be organized in following table manner as the available band wise

TABLE 1

S.N.	Satellite type	Band Rate
1	L-band	1-2 GHz
2	S-band	2-4 GHz
3	C-band	4-8 GHz
4	X-band	8-12 GHz
5	Ku-band	12-18Ghz
6	Ka-band	26-40Ghz

As we can clearly see that the recent band with of satellite data rate is 26-40 GHz that is used for the data communication in satellite.

III.INTRODUCTION TO OMNET++ 5

OMNET++ is an open source network simulation environment which has many features. Some of them are discussed as follows:

1. USER FRIENDLY
2. MULTI USABLE
3. VIRTUALIZATION
4. FAST
5. RELIABLE

A. User friendly :
Simulation environment of OMNET++5 is user friendly. Easily modules can be modified and can be develop as our requirement. For example if we required wireless system then a simple module can be modified with IEEE WLAN module by editing its source and NED with C++ definitions and header definitions. Data rates can be define; simulation time limit can be defined. We can limit the speed of simulation at run time and with the stop and finish () we can stop the simulation.
The result can be plotted as graph and other formats. The simulation scenario provides facility to select the number of nodes at run time also, for example in case of "tic-toc" we can select the tictoc1 to tictoc16. We can define own parameters for different simulation models.

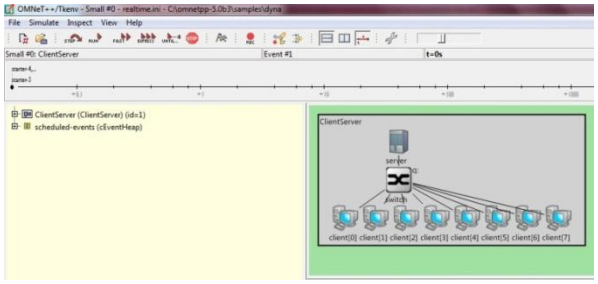

Fig.3 Simple user friendly environment of OMNET++ 5

B. Multi Usable-
The OMNET++ has the quality of multiple usable; we can use the simulation scenario for business communication simulation for a small area network with low bandwidth requirement and also can be used as the high rate broadband communication simulation for the wide area covered with telecommunication system.

C. Virtualization
We can first test the network of small or large in this simulator then we can apply in real world. That means a virtualization of real time network and data communication can be created by the OMNET++, later the simulation results can affect on the cost, time and risk management of real time network.

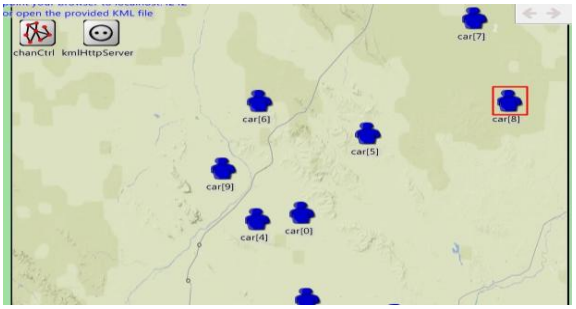

Fig.4 Virtualization of Google earth

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

D. Fast
As compare to other simulation models of network the OMNET++ simulator is fast. It takes large amount of memory and high performance data rates but faster than other simulation packages...

E. Reliability
In case of accuracy with the real time implementation the OMNET++ simulator provides the nearer results to the real time simulation environments.

For example a wireless small area network can be implement in OMNET++ simulator has the efficiency of 95% data transfer with loss, but in real time implementation it cans 90%. So the performance of OMNET++ Simulator is nearby accurate and reliable.

IV. SATELLITE NED IN OMNET++ 5

NED (Network Descriptor) is used to implement the required network with visualization facility in OMNET++. To implement satellite network in OMNET++5 we were used the following components and modules:

A. A satellite transceiver
B. An earth station for satellite data sending
C. Receivers in earth for example a car with satellite receiving facility, a mobile tower, a wireless access point.
The detailed description of NED and their working are as follows:

A. Satellite Transceiver
A satellite transceiver can do both receive data from one earth station or from main source of data updating centre. Main description of this wireless component module is

```
simple SatellitND
{
    @display("i=device/satellite");
    string modelURL;
        double modelScale = default(1);
        // decorations and annotations
        string labelColor = default("#000000ff");
        string orbitColor = default("#80C8C8C8");
        string coneColor = default("#FFFFFF16");
        double altitude @unit("km") = default(2000km);
        string orbitNormal = default("");
        double startingPhase @unit("deg") = default(0deg);
        double timeStep @unit("s") = default(30s);
    gates:
        inout a[];
        input in3[];
}
```

Fig.5 Satellite LEO module

B. Earth Station (Only send data to satellite orbital station)
This module has only one communication path to send only data to the orbital station of satellite. It can also be defined as the satellite data control station. Main components of satellite data sending station are as follows:

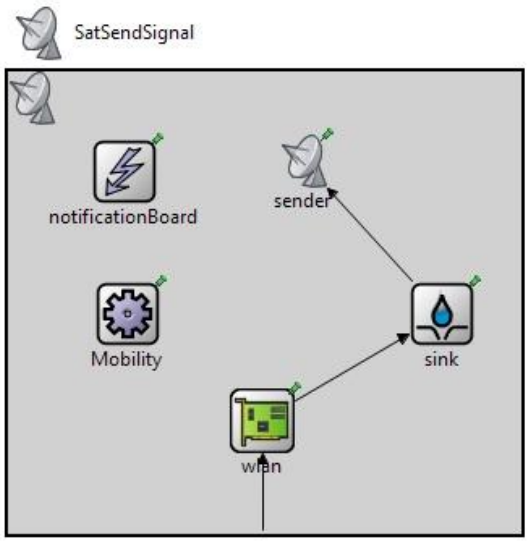

Fig.5 Satellite earth Station

C. Receivers
The receivers on the earth may be different in rates because the capacity of different devices is different. For example a wireless access point is used for distribute the data signal to the other PDA devices; a wireless access point has high capacity receiving facility. An army Satellite driven tank may need only instruction from the driving side so it does not required more data at a time so its data rates may me little bit less. The NED as shown in the following figure

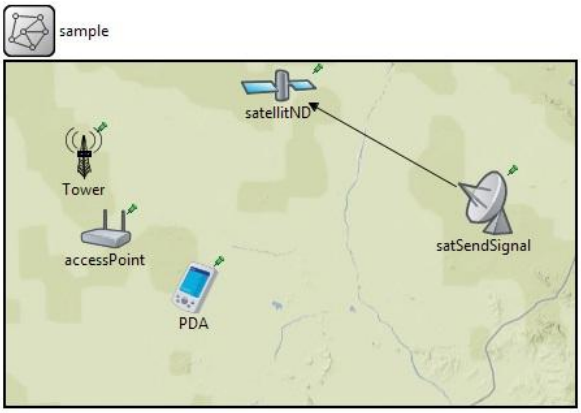

Fig.6 Satellite Network NED

Data rates of the component are as described in the following table

TABLE 2
DATA RATES OF COMPONENTS

S.N.	Component	Data Rate
1	Sate Ground Station	10Gbps
2	Orbital Station	100Gbps
3	PDA	1Gbps
4	Access Point(Wireless)	1Gbps
5	Tower	10Gbps

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

V. CONCLUSION

We can develop various network features of the satellite communication by using this satellite simulation model. This simulation model may be a reference model for future research on the satellite data networks their security and data rates enhancements. In future expectations on research on the satellite controlled war machine, Internet of Things and Life support systems satellite plays an important role. So the satellite security and enhancement of security time to time is also important. This is the base paper for more on the testing on satellite network simulation and their parts with the satellite data networks.

REFERENCES

[1] "TCP/IP Performance over Satellite Links", Craig Partridge And Timothy J. Shepard.
[2] Jiang Lei, Zhu Han, María Ángeles Vázquez-Castro and Are Hjørungnes, "Secure Satellite Communication Systems Design With Individual Secrecy Rate Constraints," IEEE Transactions On Information Forensics And Security, Vol. 6, No. 3, Pp. 661–671, Sep. 2011.
[3] Rohit Goyal, Sastri Kota, Raj Jain, Sonia Fahmy, Bobby Vandalore, And Jerry Kallaus "Analysis And Simulation Of Delay And Buffer Requirements Of Satellite-ATM Networks For TCP/IP Traffic,".
[4] Dr. Ranjit Singh, "Satellite Communications: The Indian Scenario,". Int. Journal of Engineering Research And Applications, Vol. 4,Issue 5(Version 4), Pp. 41-49, May 2014.
[5] Li Xiangqun, Wang Lu, Liu Lixiang, Hu Xiaohui, Xu Fanjiang And Chen Jing, "OMNET++ And Mixim-Based Protocol Simulator For Satellite Network"
[6] Dipak Misra, Dinesh Kumar Misra, and Dr. S. P.Tripathi, "Satellite Communication Advancement, Issues, Challenges And Applications," International Journal Of Advanced Research In Computer And Communication Engineering Vol. 2, Issue 4, Pp. 1681-1686. Apr. 2013.
[7] Michael Kirsche And Matti Schnurbusch, "A New IEEE 802.15.4 Simulation Model for Omnet++ / Inet," Arxiv:1409.1177v2 [Cs.Ni] 13 Sep 2015
[8] Manish Karir, Mingyan Liu, Bradley A Barrett And John S Baras, "A Simulation Study Of Enhanced TCP IP Gateways For Broadband Internet Over Satellite,". Centre For Satellite Hybrid Communication Networks University Of Maryland College Park

BIOGRAPHIES

Narendra Kumar Dewangan, has completed his B.E.(2011) In Computer Science & Engineering from Government Engineering College, Raipur, India and persuing M.Tech in Cyber Security from ITM University Raipur, India. His research interest include Nework Security, Artificial Intelligence, Cryptography and Next Generation Networks.

Narayan Sahu, recived his B.E.(2006) In Computer Science & Engineering from Chauksey Engineering College, Bilaspur, India and M.Tech in Information Security from DIMAT Raipur, India. His research interest include Computer Nework, Artificial Intelligence, data Structures and Biometric Security.He is Curerently working as Assitant Professor in Department of Computwer Science & Engineering , ITM University, Naya Raipur, India.