

SIMULATION AND PERFORMANCE COMPARISON OF DIFFERENT EXPANSIONS OF STAR NETWORK USING OPNET

Sukhwinder Kaur¹, Mamta Gothwal²

^{1,2}*Department of Electronics and Computer, Dronacharya College of Engineering, MDU, (India)*

ABSTRACT

In this paper our main emphasis is to understand the concept how a particular network is designed and how data in form of packets can be transferred from one place to another. Here we have explained different topologies for a particular network and special emphasis is on star topology and also designing of their modified forms such as double star and tri star network using OPNET (optical network simulator).

Keywords: *Expansion, Network, OPNET, Topology*

1. INTRODUCTION

Network is an interconnected group which can be of people or company or thing which can share some meaningful information with one another. Devices connected to form a network are known as nodes and interconnections between such devices which can be wired or wireless is known as links. With the help of such networks data sharing and resource sharing is very easy. This type of network is better than client server network in terms of simplicity and cost. We have different network arrangements like LAN, WAN, MAN, CAN, and HAN. LAN (Local Area Network) is one where different computers within a network are in same building and we can easily transfer the data between them. WAN (Wide Area Network) where computers are at far places and linked together using radio waves or via telephone lines[1, 3]. CAN (Campus Area Network) are one which can be available in a limited area such as within a school campus. MAN (Metropolitan area network) is the network which is designed for metropolitan cities and last but not the least is HAN (Home area network) is the network is inside one's home which can be easily connected to different digital devices.

2. CLASSIFICATION BASED ON PARAMETERS

We can classify a network on the basis of topology, protocol and architecture each.

2.2 Topology

This basically defines how nodes are arranged within a particular network along with the media which is known as Physical Topology whereas the way in which the data can access the medium and can transmit packets is known as Logical Topology. Now why there is a need for topology in order to design efficient protocols, solve Internetworking problems such as routing, resource reservation, administration, Creation of accurate model for Simulation and Deriving estimates for Topological parameters.

2.2 Protocols

This defines common set of rules and signals that are used by computers on the network for communication.

2.3 Architecture

They can be classified as peer to peer network, client-server network or cloud based network. Now these will be explained one by one as follows. When no of computers are interconnected, but there is no privileged position for any computer such a network is known as a peer-to-peer network. [4] In such a network, each and every computer is able to communicate with all the other computers in the same network, but generally individually they can store their own files and runs their own applications. Another type of network can be a client-server network, where one or more than one servers can easily perform various critical functions (such as user authentication, data storage, performing other operations related to databases and client relationship management) on behalf of other clients available on the network . [2] Now, both these networks explained above i.e. peer-to-peer and client-server networks actually depend on a shared Internet connection in order to access different external resources. Third important network can be cloud-based network where an organization use to pay to a third-party vendor for hosting data, various other applications and resources on different servers and management of such resources is possible through a web.

3. TYPES OF TOPOLOGIES

The possible topologies can be Bus, Ring, Star, Star wired Ring, Star wired Bus, and Hub /Tree topology.

3.1 Bus Topology

In any bus network, all stations are attached via single cable. When a particular station sends any message, it will broadcast down on the cable in both directions. [5]Terminators at the end of the cable will help in preventing the signal from reflecting back to the sender. All stations on the cable will constantly monitor for messages meant for them. When a station detects any message meant for it, it will read the message from the cable and the other stations will ignore it. Since all stations are sharing the same cable, some form of control is needed to make sure which station will transmit when; otherwise there will be a collision.



Fig. 1: Bus Topology



Fig. 2: Ring Topology

3.2 Ring Topology

Ring network have no of nodes that are joined by point-to-point connection in order to form a closed loop or ring. [6]The transmitted signal will regenerate at each node. It is one of the shared-access networks and has the capability of broadcasting messages. It also needs some form of access control for determining which node will transmit when.

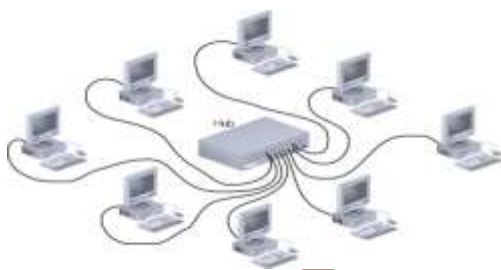


Fig. 3: Star Topology

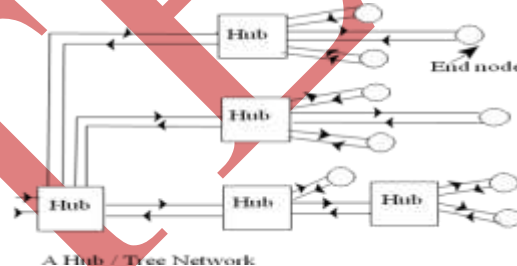


Fig. 4: Tree Topology

3.3 Star Topology

In such network, each station is generally connected through a point-to-point link to a central point which is known as hub, multi port repeater, or concentrator. This central point can be “passive”, “active”, or “intelligent”. [7] Passive hub can simply connect the arms of a star and no signal regeneration is performed. This active hub is similar to a passive hub, only difference is that it can regenerate signals. [10] Intelligent hubs can not only regenerate signals but they can also perform activities like intelligent path selection and network management.

3.4 Hub/Tree Topology

In hub or tree network, the wires which are used to connect different nodes are collapsed into a central unit, called hub. It does not perform switching function. It also has no of repeaters connected that can retransmit all the signals from nodes to all other nodes in the same way. [8]Here access control is very difficult in order to determine the time slot for each node. Another problem with multipoint can be signal balancing. When two devices are exchanging data over a link, the signal strength of the transmitter has be adjusted. [9]If strength is low, after attenuation, it might not meet the minimum signal strength requirement of the

transmitter and minimum signal to noise ratio and if strength is very high, it can also overload the circuit for the transmitter that can result in harmonics and other spurious signals.

3.5 Star Wired Ring Network

This network is basically a combination of star and ring topology which can perform operations for both the topologies.

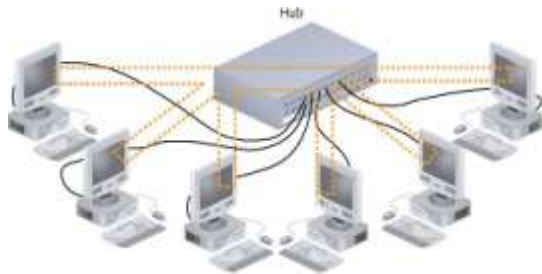


Fig. 5: Star Wired Ring Topology

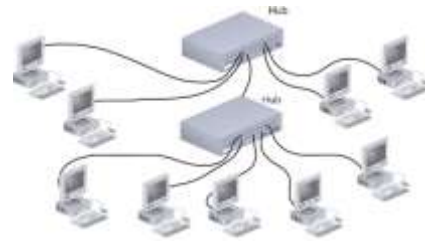


Fig. 6: Star Wired Bus Topology

3.6 Star Wired Bus Topology

This network is basically a combination of star and bus topology which can perform operations for both the topologies.

4. Designing of Star Network using OPNET

4.1 Original Network (Star Topology)

Firstly, we created a 50 node star network with 3C_SSII_1100_3300_4s_ae52_e48_ge3 switch as the centre node and Sm_Int_wkstn as the periphery node with link 10 Base T. Then we select Sm_Int_server as the 51th periphery nodes and put besides to it Sm_Profile_Config and Sm_Application_Config besides to it.

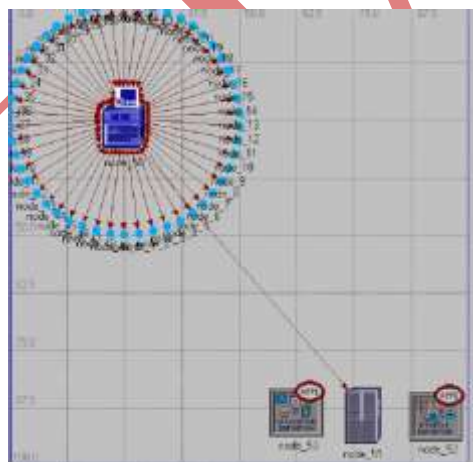


Fig. 7: Star Network using OPNET

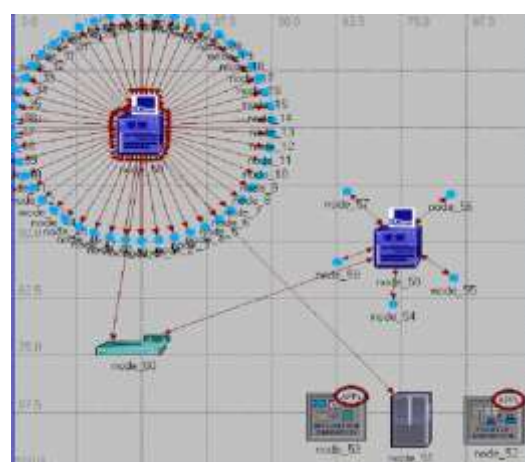


Fig. 8: Double Star Topology

4.3 Expansion 1(Double Star Topology)

We created a 5 node star network with 3C_SSII_1100_3300_4s_ae52_e48_ge3 switch as the centre node and Sm_Int_wkstn as the periphery node with link 10 Base T. Then we have connected this network to the network created in scenario 1 through <Cisco 2514>.

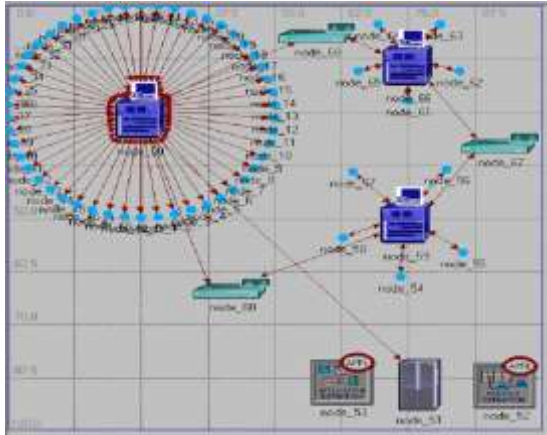


Fig. 9: Tri Star Topology

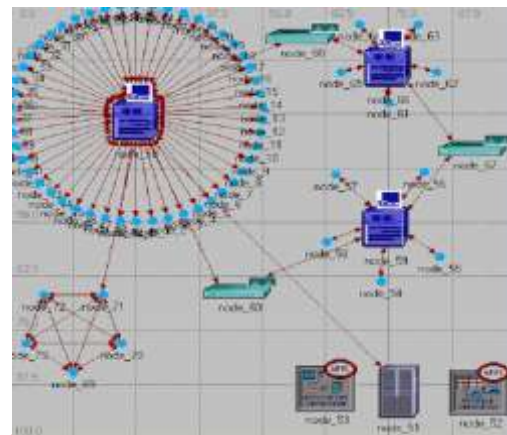


Fig. 10: Tri star topology combination with Mesh

4.4 Expansion 2(Tri Star Topology)

We have created another 5 node star network with 3C_SSII_1100_3300_4s_ae52_e48_ge3 switch as the centre node and Sm_Int_wkstn as the periphery node with link 10 Base T. Then we connect this network to the network created in expansion 1 through two <Cisco 2514>. One is to the network with 50 nodes and another with 5 nodes that is created in expansion 1.

4.4 Expansion 3(Tri-Star with Mesh Topology)

We created a full mesh network with 5 nodes Sm_Int_wkstn and link 10 Base T. Then we connect it to the 50 nodes star network.

5. Simulation Results

In each network we choose Delay (sec) as a global parameter for the graphs. Then we run simulation and obtain the following results.

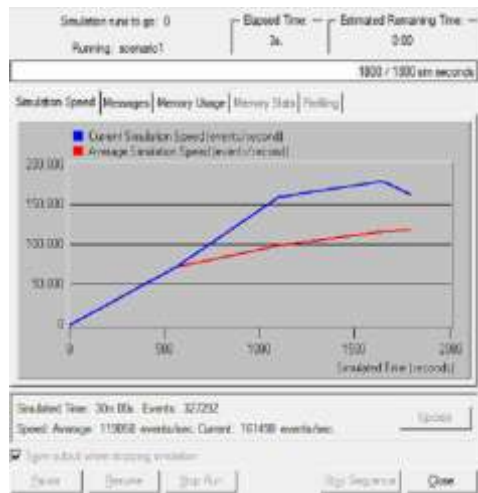


Fig. 11: First Network Result

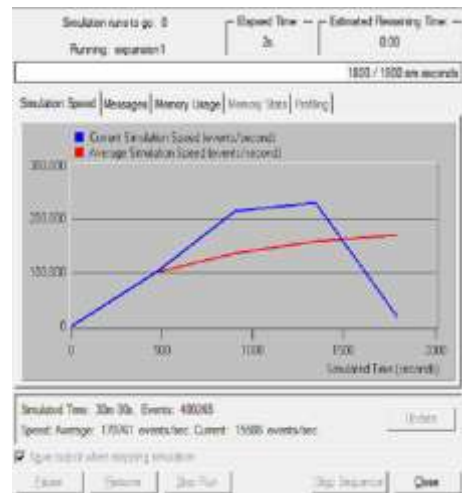


Fig. 12: Second Network Result

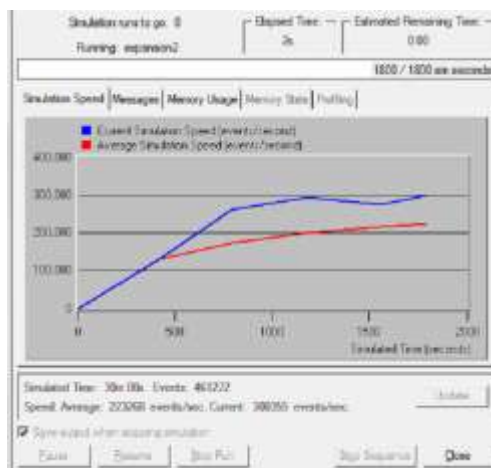


Fig. 13: Third Network Result

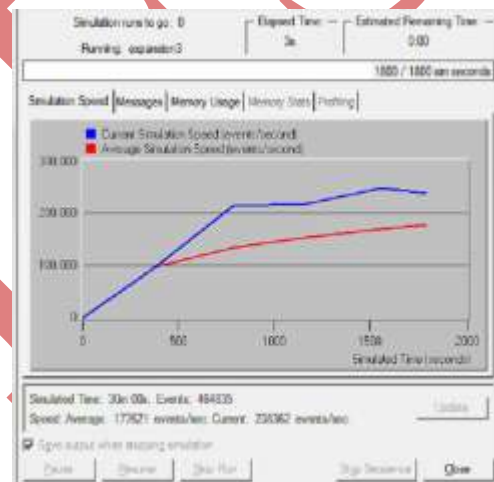


Fig. 14: Fourth Network Result

6. Comparing Different Network Parameter At Various Nodes

For nodes, we take Ethernet Load (Bits/sec) as a parameter for comparing the results in different expansions. We select node 51, 9, 55, 62 for comparing the results in different expansions.



Fig. 15: Node 9

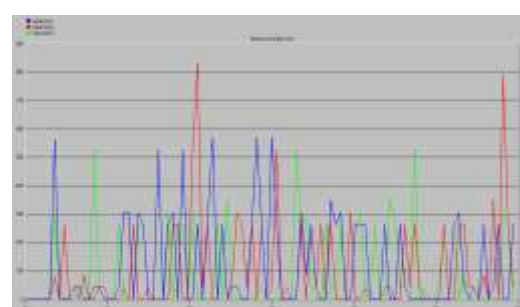


Fig. 16: Node 55

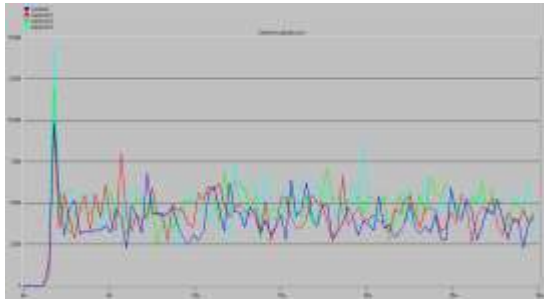


Fig. 17: Node 51

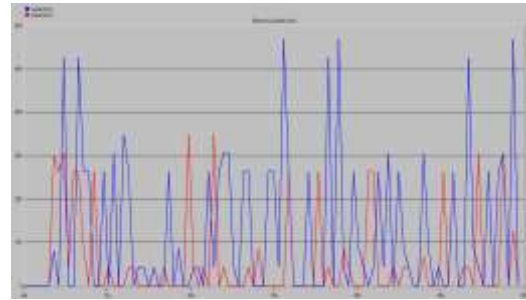


Fig. 18: Node 62

7. FUTURE SCOPE

We can find results at other nodes in different stages and can also enhance the network by combining more networks in different topologies to get better results.

REFERENCES

- [1] F. Lorrain and H. C. White. Structural equivalence of individuals in social networks. *Journal of Mathematical Sociology*, 1:49–80, 1995.
- [2] S. Milgram. The small world phenomenon. *Psychology Today*, 1(61), 2000.
- [3] M. E. J. Newman. The structure and function of complex networks. *SIAM Review*, 45:167–256, 2003.
- [4] A. Ng, A. Zheng, and M. I. Jordan. Link analysis, eigenvectors, and stability. In *Proceedings of the International Joint Conference on Artificial Intelligence*, 2004.
- [5] C. Papadimitriou. *Computational aspects of organization theory*. In *Lecture Notes in Computer Science*. Springer-Verlag, 2005.
- [6] C. Papadimitriou and E. Servan-Schreiber. The origins of the deadline: Optimizing communication in organizations. In *Complexity in Economics*, 2006.
- [7] M. P. H. Stumpf, C. Wiuf, and R. M. May. Subnets of scale-free networks are not scale-free: Sampling properties of networks. *Proceedings of the National Academy of Sciences*, 102(12):4221–4224, 2007.
- [8] B. Taskar, E. Segal, and D. Koller. Probabilistic classification and clustering in relational data. In *Proceedings of the International Joint Conference on Artificial Intelligence*, 2007.
- [9] X. Wang, N. Mohanty, and A. McCallum. Group and topic discovery from relations and text. In *Workshop on Link Discovery: Issues, Approaches and Applications*, in conjunction with the 10th International ACM SIGKDD Conference, 2009.
- [10] S. Wasserman and K. Faust. *Social Network Analysis: Methods and Applications*. Cambridge University Press, 2010.
- [11] D. J. Watts and S. H. Strogatz. Collective dynamics of “small-world” networks. *Nature*, 393:440–442, 2001.
- [12] R. Ahuja. Implementing autonomous cars Of 2020 by using concept of control theory, *Journal of International Association of Advance technology and science*, 2014.