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Towards proposing network topology for improving performance in Plateau State University Bokkos

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ABSTRACT

This paper is concerned with the computer network of Plateau State Universities Bokkos, which is located in Plateau State, Nigeria, in the western part of Africa. The existing network topology of Plateau State University Bokkos (PSU) is being investigated via interview method of survey. With the help of the Technical Staff the University, information about the topology will be collected and/or confirmed via observation. The confirmed topology or layout will be design and simulated for behavioural outputs. Then, the outputs of the simulation of the two topologies will be analyzed, towards proposing a better topology for improving performance. CISCO Packets Tracer simulator will be used for all necessary designs and simulation. In the end a suitable topology requirement will be proposed for improving network performance in Plateau State University, being a newly established University.

Keywords: *Campus Area Network, Network Simulation, Comparative Analysis*.

1 INTRODUCTION

The performance of any computer network is certainly influenced by the technology, which we adopt in making network interconnections. Network topologies (Banerjee, S. et al, 1999; Cem Erosy and Shivendra PanWar, 1992; C. M. Harris, 2008; D. Bertsekas and R. Gallager, 1992) are the technology for arrangement of various computer elements like links, nodes etc. Basically network topology is the topological structure (Geon Yoon and Dae Hyun Kwan, 2006) of a computer network. In mathematics topology is concerned with the connectedness of objects which is the most basic properties of space. In simple term, network topology refers to the way in which the network of computers (Nicholas F. Maxemchuk and Ram Krishnan, 1993; Bannister, J.A. et al, 1990) is connected. Each topology is suited to specific tasks and has its own advantages and disadvantages. A most simple and good example of network topology is a Local Area Network (LAN) (F. Backes, 1988; Li Chiou Chen, 2004). A situation Where a node has two or more physical links to other devices in the network, a star topology is described. Which is the most commonly adopted topology in most campuses. In recent days there are basically two categories of network topologies: Physical topologies and Logical topologies. Physical Network Topology emphasizes the hardware associated with the system including workstations, remote terminals, servers, and the associated wiring between assets. Conversely, Logical Network Topology emphasizes the representation of data flow between nodes. This can be represented in a graph model. In this paper, we present the physical topology of the network under study.

2 LITERATURE REVIEW

Local Area Networks (LAN) and Campus Area Networks (CAN) are synonymous. However, CAN could interconnect LANs with geographically dispersed users to creat connectivity (Zubbair S. et al, 2012). Network Topology shows the way in which a set nodes are connected to each other by links (Qatawneh Mohammed et al, 2015), which basically is synonymous to CAN. The technology for arrangement of various computer elements like links, nodes etc describes the concept of network topologies. T1 (William, 1998), T3 (Regis, 1992), ATM (Koichi et al., 1997), ISDN (Jonathan, 2004), ADSL (Michel, 2003), frame relay (Jim, 1997), radio links (Trevor, 1999), amongst others, constitutes few of these technologies. Technologies are accompanied with various topologies and model of deployment that best suit the technology.

A network for optimal performance and meeting users' need is key in every campus, which always needs attention. Properly selecting of equipments to be deployed after considering the requirements of the users is necessary (Sood, 2007). The impact of TCP window size on application performance as against the choice of an increased bandwidth can help boost network (Panko, 2008b). the use of redundant links may also increase performance, implement load balancing and utilise links from say 92% to 55% and response time reduced by 59% (Panko, 2008; Seung-Jae, 2008). From a risk and performance point of view, it is desirable to break a larger campus networks into several smaller collapsed modules and connect them with a core layer (Robert, 1998). Distribution modules are interconnected using layer 2 or 3 core (Tony, 2002). In effect, the layer 3 switches at the server side becomes a collapsed backbone for any client to client traffic (Graham, 2010).

A Gigabit Ethernet channel can be used to scale bandwidth between backbone switches without introducing loop (Rich and James, 2008). A truncking capacity is necessarily provided into the backbone of any network design (Jerry and Alan, 2009). Hierarchical design is common in practice, when designing campus or enterprise networks (Saha and Mukherjee, 1999; Sami et al, 2002). There is no need to redesign a whole network each time a module is added or removed, provided a proper layout has being in place. Distinct building blocks can be put in-service and taken out of-service with little impact on the rest of the network. This capability facilitates troubleshooting, problem isolation and network management (Damianos et al., 2002) is necessary in an ideal CAN. In a hierarchical design (Saha et al., 1993), the capacity, features, and functionality of a specific device are optimized for its position in the network and the role that it plays. The number of flows and their associated bandwidth requirements increase as they traverse points of aggregation and move up the hierarchy from access to distribution and to core layer (Awerbuch et al., 2000).

In network analysis, problems related to network mapping, characterization, sampling, inference and process can be adopted (Eric D. Kolazyk, 2009). This has to do with identifying the network components; nodes and routing system, which has to do with the analysis of the path. It could also be mathematical analysis of the network that yields explicit performance expressions (Leonard Kleinrock, 2002). This study is concerned with simulating the existing topology for proposing a better topology requirement for improving network performance.

3 METHODS

The methods used for survey are interview and observation. After the survey, data collected on the networks will be used to design and simulate the topologies, towards proposing a topology for improving network performance in Plateau State University. The sample of interview questions is below:

Computer Network Technical Questions

This interview seeks to collect technical Information on the Computer Networks in the various campuses. These shall be Information on LAN Topology, Network Devices Internet Subscription Information, for the selected University Campus in Nigeria, being administered by Mr. Datukun Kalamba Aristarkus in 2016 to respective technical staff. Your participation in this study is voluntary and will form part of this study and will not identify you as an individual.

Part A- Basic Questions; tick as may apply

1. Staff: Technical Administrative IT

Part B-Survey Interview Questions; tick all that applies

1. Topology of the LAN: Star Bus Others
2. Network Devices: Enterprise Home Basic Both
3. Network Media: Category Fiberoptic State others
4. Bandwidth Subscription: Dedicated Shared
5. Number of Nodes on Network:50 100 Others, Pls write Figure
6. Kindly provide the following Information if available on your campus Network: A Network Model or layout, History of Internet Subscription to date.

From the questions sample above, only part B, question numbers 1, 5 and 6 are useful to this study, which is concerned with the network topology. This will further help in design and simulation of the topology for behavioural outputs.

4 RESULTS

Table 1: Number of Nodes in each University Network

Number of Nodes	Universities	PSU
Inter-building nodes		0
Intra-building Nodes		5
Total		5
Topology type		Star

Table 2: Number of Links in each University Network

Number of Nodes	Universities	PSU
Inter-building links		0
Intra-building links		4
Total		4

Table 3: Weights of Intra-building links in PSU

Direct links	Descriptions	Weight (Meters)
A-A		0
A-B		1
A-C		0
A-D		0
A-E		0
B-C		5
B-D		50
B-E		80
C-D		0
C-E		0
D-E		0

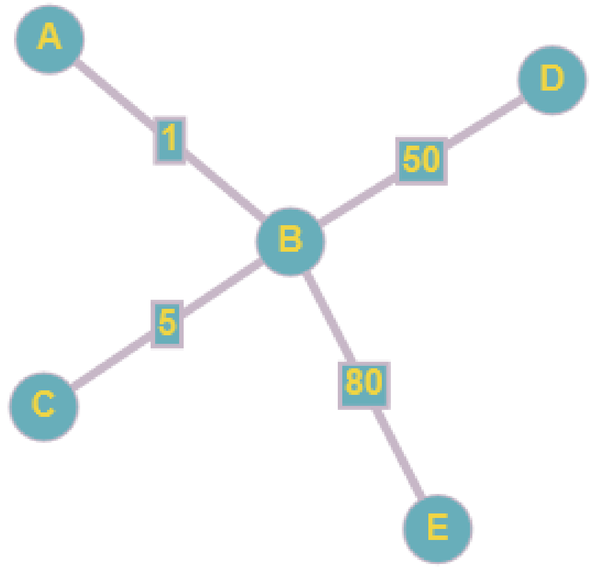


Fig. 1. Graph model for PSU network

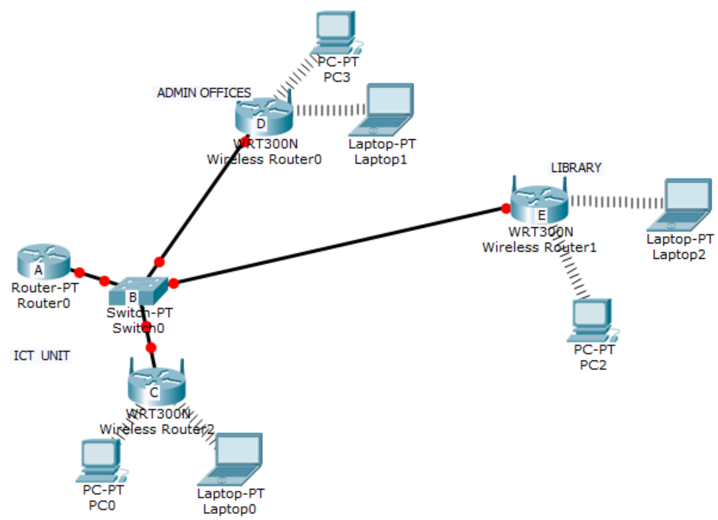
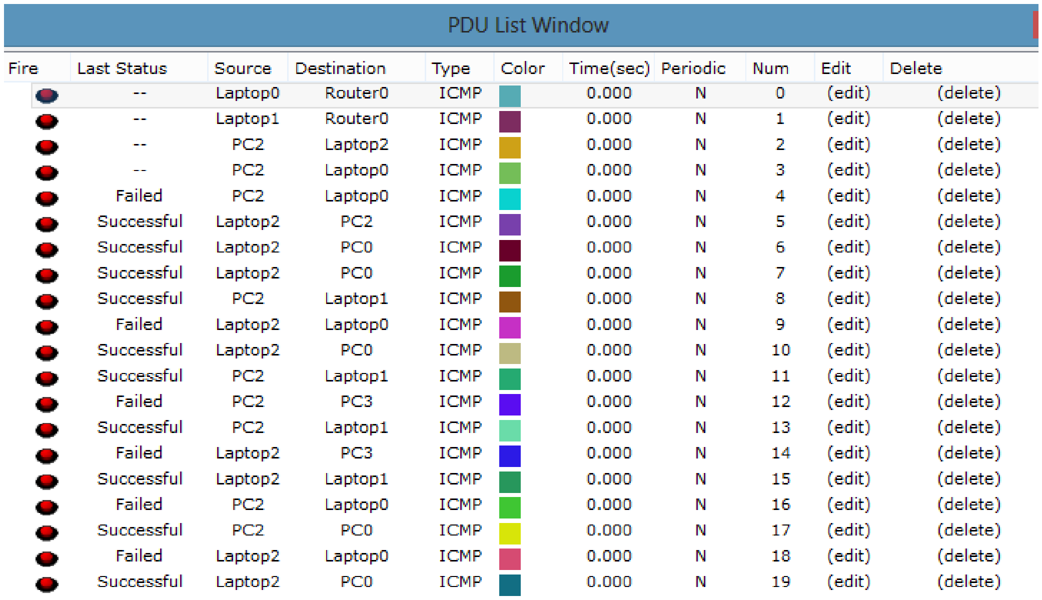


Fig. 2. PSU Physical Topology



PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	--	Laptop0	Router0	ICMP		0.000	N	0	(edit)	(delete)
	--	Laptop1	Router0	ICMP		0.000	N	1	(edit)	(delete)
	--	PC2	Laptop2	ICMP		0.000	N	2	(edit)	(delete)
	--	PC2	Laptop0	ICMP		0.000	N	3	(edit)	(delete)
	Failed	PC2	Laptop0	ICMP		0.000	N	4	(edit)	(delete)
	Successful	Laptop2	PC2	ICMP		0.000	N	5	(edit)	(delete)
	Successful	Laptop2	PC0	ICMP		0.000	N	6	(edit)	(delete)
	Successful	Laptop2	PC0	ICMP		0.000	N	7	(edit)	(delete)
	Successful	PC2	Laptop1	ICMP		0.000	N	8	(edit)	(delete)
	Failed	Laptop2	Laptop0	ICMP		0.000	N	9	(edit)	(delete)
	Successful	Laptop2	PC0	ICMP		0.000	N	10	(edit)	(delete)
	Successful	PC2	Laptop1	ICMP		0.000	N	11	(edit)	(delete)
	Failed	PC2	PC3	ICMP		0.000	N	12	(edit)	(delete)
	Successful	PC2	Laptop1	ICMP		0.000	N	13	(edit)	(delete)
	Failed	Laptop2	PC3	ICMP		0.000	N	14	(edit)	(delete)
	Successful	Laptop2	Laptop1	ICMP		0.000	N	15	(edit)	(delete)
	Failed	PC2	Laptop0	ICMP		0.000	N	16	(edit)	(delete)
	Successful	PC2	PC0	ICMP		0.000	N	17	(edit)	(delete)
	Failed	Laptop2	Laptop0	ICMP		0.000	N	18	(edit)	(delete)
	Successful	Laptop2	PC0	ICMP		0.000	N	19	(edit)	(delete)

Fig. 3. PSU Simulation based on PDU packeting

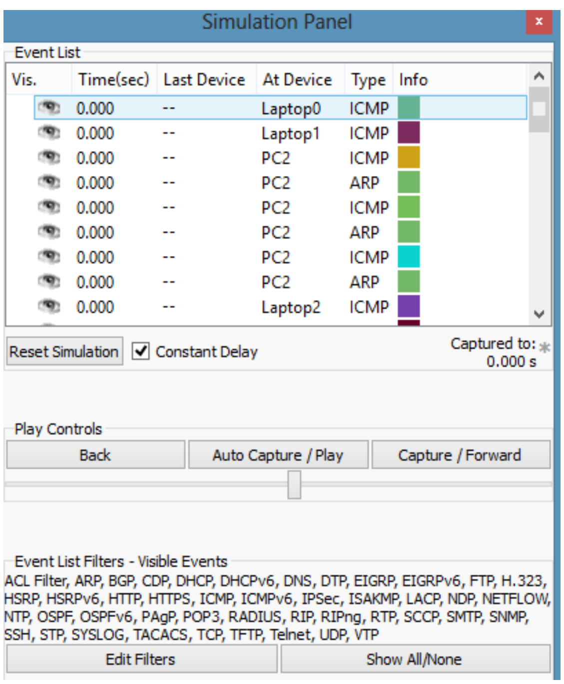


Fig. 4. PSU Simulation panel showing delay time at 0seconds

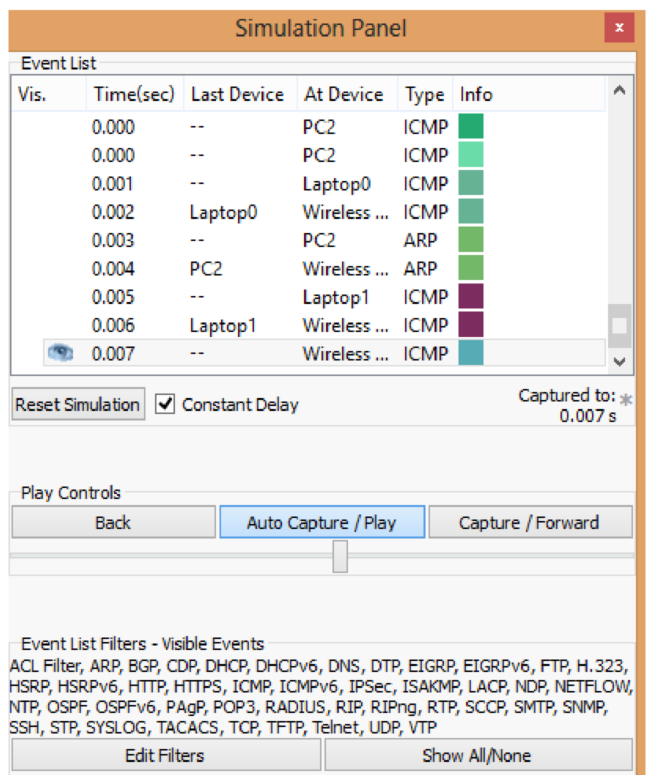


Fig. 5. PSU Simulation panel showing increasing delay time

5 DISCUSSIONS

We will notice that the number of nodes and type of topology are given in table 1, whereas, number of links given in table 2.This is referred to the fact that a star topology with N nodes has N-1 links. Based on the given fact in tables 1 and 2, the topologies were designed and simulated.

In our design, we were concerned with the only provision (intra-building requirements) for PSU. Here, we first consider the graph model, which was generated via an online graph generating platform, before subsequent physical design.

Table 1-3 corresponds to figure 1 while figure 1 corresponds to figure 2 accordingly. In simple terms, the graph model was used to design the physical topology but the information from tables 1-3 was used to generate the graph model itself.

We will further see that figure 3 described the PDU packeting from one host to another (origin-destination packeting), showing the deliverability of the packets as they are being sent from one computer to the other. Figure 4 and 5 depicts the delay time in packets delivery, which clearly showed that the time it takes to deliver a packed increases with increase in loads on the network.

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7 CONCLUSION

In conclusion, Plateau State University would first of all need to extend connection to other buildings in the University. Next, the topology needs to be upgraded to a hybrid one, say mesh, star and bus. Using mesh for inter-building, bus for inter-floor and star for users, access. This would improve the network performance by reducing the impact of loading and further reducing delivery delay of packets.

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