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Towards proposing network topology upgrade in Salem University Lokoja

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Abstract: **This paper is about the computer network of Salem University Lokoja, which is located in Kogi State, Nigeria, in the western part of Africa. The existing computer network topology of Salem University Lokoja (SUL) is being investigated via interview and observation methods of survey. With the help of the Technical Staff of the University, information about the topology are being collected and confirmed via observation. The confirmed topology or layout is being design and simulated for behavioural outputs. Then, the outputs of the simulation of the topology will be analyzed, towards proposing a better topology for improving performance of the University's network. CISCO Packets Tracer simulator will be used for all the designs and simulation. In the end a suitable topology requirement will be proposed for improving network performance in Salem University Lokoja.**

Keywords: **Campus Area Network, Network Simulation, Topology Upgrade.**

1. INTRODUCTION

The technology, which we adopt in making network interconnections, influences the performance of any computer network. 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. clearly, network topology is the topological structure (Geon Yoon and Dae Hyun Kwan, 2006) of a computer network. Topology is mathematically expressed in terms of the connectedness of objects which is the most basic properties of space. Network topology simply 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.

A 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. 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. Topologies can be represented in a graph model. In this paper, we present the physical topology of the network under study.

2. LITERATURE REVIEW

A Campus Area Networks (CAN) can be seen as the Local Area Networks (LAN) of a campus. However, CAN could interconnect LANs with geographically dispersed users to create 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.

An optimal performance of a network that meets users' need is key in every campus, which always needs attention. Selection of equipments to be deployed after considering the requirements of the users is necessary (Sood, 2007). 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). Based on risk and performance point of view, it is desirable to break a larger campus networks into smaller 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).

Gigabit Ethernet channel can be used to scale bandwidth between backbone switches without introducing loop (Rich and James, 2008). 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). 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).

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 characterizing, designing and simulating the existing topology for proposing a better topology requirement for improving the performance of the network in Salem University Lokoja.

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 upgrade requirement for improving the performance of the network of Salem University Lokoja. 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 ☐ Write here ☐
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.

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4. RESULTS

Table 1: Number of Nodes in SUL network

Number of Nodes	Universities	SUL
Inter-building nodes		11
Intra-building Nodes		39
Total		50

Table 2: Number of Links in SUL network

Number of Nodes	Universities	SUL
Inter-building links		10
Intra-building links		39
Total		49

Table 3: Weights of Intra-building links in SUL

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

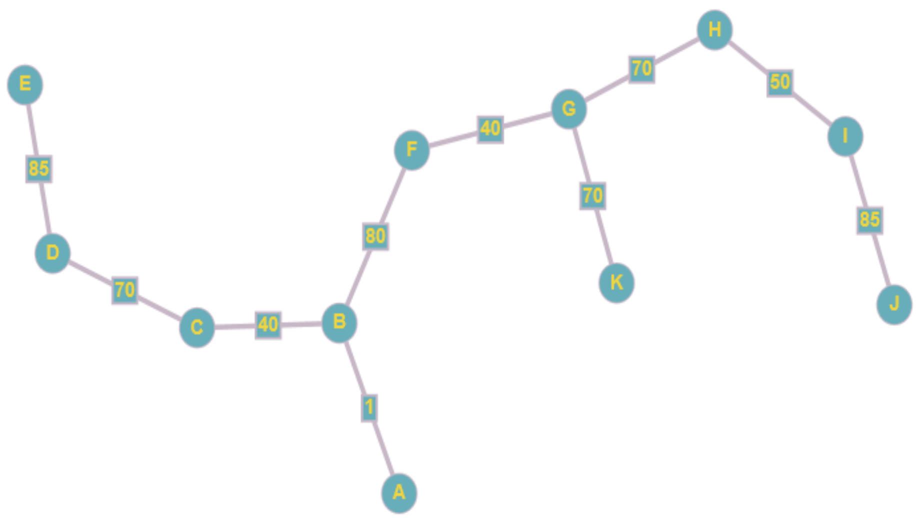


Figure 1: Graph model for SUL network

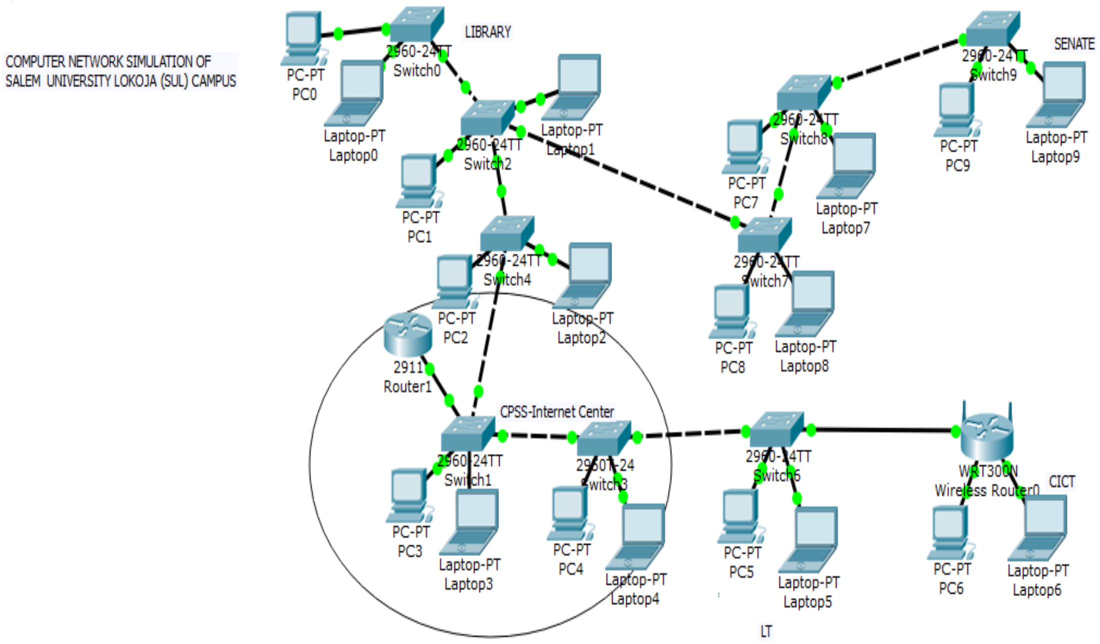
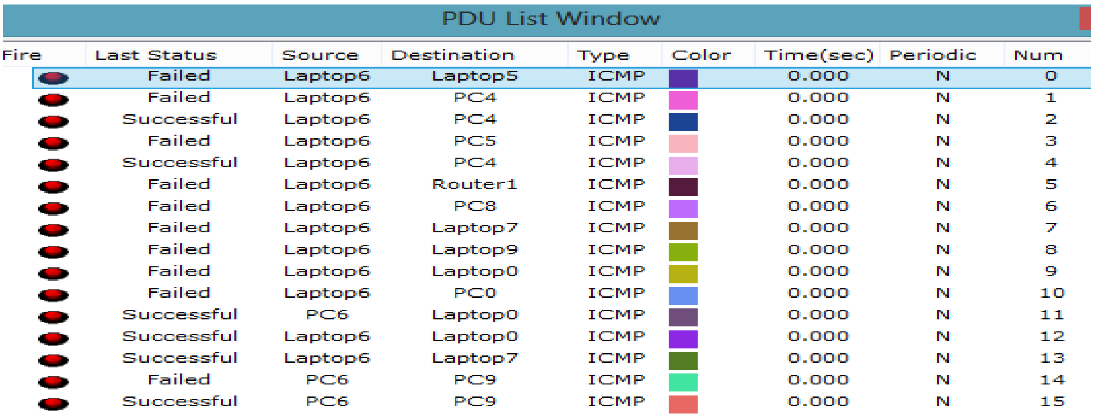


Figure 2: SUL Physical Topology



PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Failed	Laptop6	Laptop5	ICMP		0.000	N	0
	Failed	Laptop6	PC4	ICMP		0.000	N	1
	Successful	Laptop6	PC4	ICMP		0.000	N	2
	Failed	Laptop6	PC5	ICMP		0.000	N	3
	Successful	Laptop6	PC4	ICMP		0.000	N	4
	Failed	Laptop6	Router1	ICMP		0.000	N	5
	Failed	Laptop6	PC8	ICMP		0.000	N	6
	Failed	Laptop6	Laptop7	ICMP		0.000	N	7
	Failed	Laptop6	Laptop9	ICMP		0.000	N	8
	Failed	Laptop6	Laptop0	ICMP		0.000	N	9
	Failed	Laptop6	PC0	ICMP		0.000	N	10
	Successful	PC6	Laptop0	ICMP		0.000	N	11
	Successful	Laptop6	Laptop0	ICMP		0.000	N	12
	Successful	Laptop6	Laptop7	ICMP		0.000	N	13
	Failed	PC6	PC9	ICMP		0.000	N	14
	Successful	PC6	PC9	ICMP		0.000	N	15

Figure 3: SUL Simulation based on PDU packeting

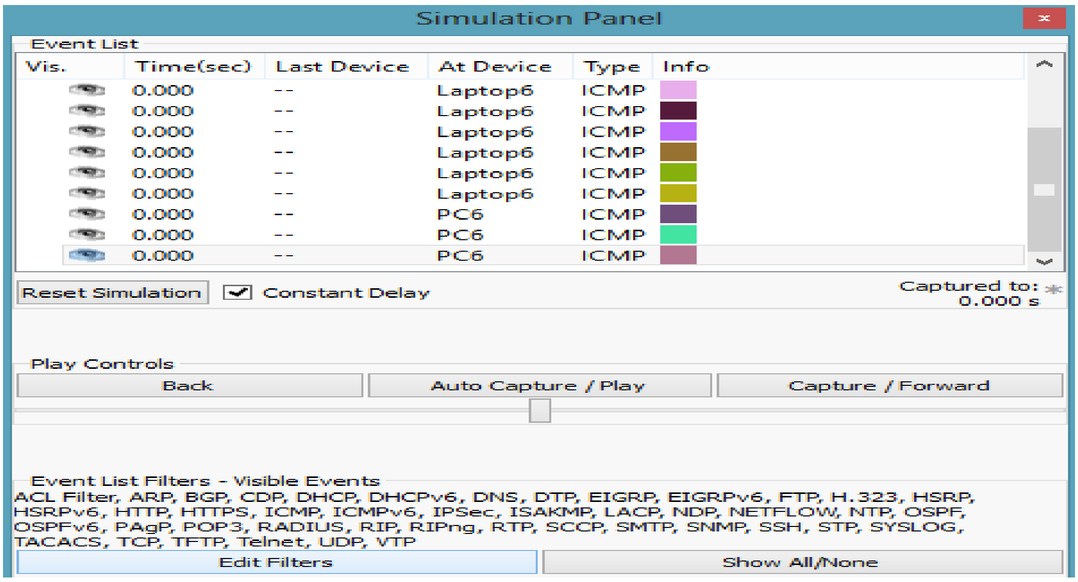


Figure 4: SUL Simulation panel showing delay time at 0seconds

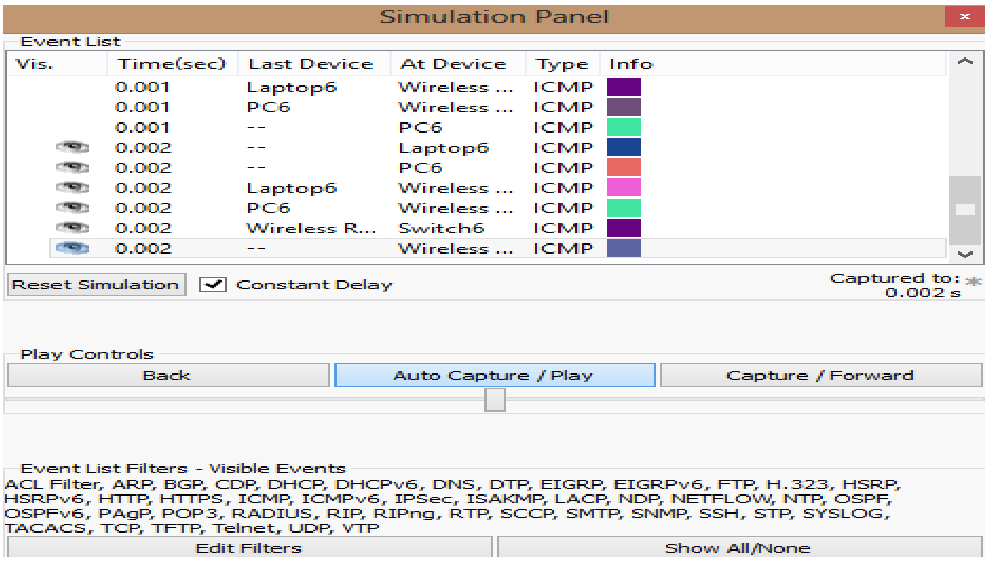


Figure 5: SUL Simulation panel showing increasing delay time

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 SUL. 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 and 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 packets sent from one computer to the other, 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.

6. CONCLUSION

In conclusion, Salem University Lokoja would first of all need to upgrade their links from copper (UTP) to optical (fiber optics) for inter-buildings connections in the University. This is to minimise the delay rate. Next, the topology may be better of, with hybrid topology (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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