Simulation of Open Shortest Path First (OSPF) Algorithm for Routing Signal in Campus Intranet

Minafa-a Thompson Douglas

Ph.D scholar, Department of Computer Science, Faculty of Natural and Applied Sciences, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria

Abstract : **Vast usage of Wireless Networks need improvement in capacity and coverage so that user may receive high Quality of Service (QoS), especially for teaching, learning, assessment and administration in Educational setting, hence, efficient Network Routing and Routing Protocol is basically essential. This paper is directed on quantitative and experimental analysis of packet transmission through Open Shortest Path First (OSPF) by routing a message from one node to another within the available nodes in hypothetical Campus Network. Simulation was carried out in MATLAB to demonstrate path determination capability of OSPF algorithm in Campus Intranet Network. Experimental results and analysis showed that Open Shortest Path First (OSPF) is a suitable algorithm for routing signal by minimizing the delay time, in order to maximize the throughput of data packet.**

Keywords: **Signal, Algorithm, Network, Routing Protocol, Quality of Service (QoS)**

I. INTRODUCTION

Routing plays a prominent role in directing network transmitted information and/or data packets and to provide quality service in networks [2]. Nowadays, wireless networks are being trusted in every facet of life through modern communication and Internet of Things (IoT), for allowing communication between human and computer [5].

Computer networks are becoming more paramount in today's learning environment with central role in maintaining and transmitting message or valuable information between the users [15].

It is considered to be 'intranet' when its connectivity infrastructure are configured as proprietary and private network, which is only accessible to members of a particular educational institution or any other organization. The frequent use of computer networks requires improvements in network technologies and management techniques to derive Quality of Service (QoS). Major aspect of PC networking that is germane to Quality of Service (QoS) is the packet data routing. There is high demand placed on the network by multimedia, mobile applications and web services, in terms of speed, bandwidth and scalability which had strained the resources of existing internet infrastructures [8]. Most of the algorithms used in WLAN helps define set of protocols to enhance bandwidth utilization and higher throughputs [1].

Transmission of data packet or message by internet users through computer network, the quality of service being enjoyed begin to degrade, especially in Campus Intranet where the available bandwidth, packet size and congestion control could affect the distributed broadcast of learning resources and administrative documents being a large scale environment. Inconsistent electricity has worsen the problem of WiFi because, the sequence of data package can change or be damaged, hence, the need to minimize delay, as the waiting period for the data to arrive at its desired destination, through the validation of OSPF algorithm for efficient routing signal [12]. The aim of this paper is to validate the use of OSPF algorithm for routing in campus intranet.

II. LITERATURE REVIEW

Computer networks are quickly becoming a need in today business organizations, leading to a growth in the number of computer networks and networks web applications [3]. Network management involves the coordination, analysis, control, and planning of resources of a computer network in order to provide the users with a quality of service [14].

Routing is an astounding complicated task, and there are a number of diverse algorithms used to determine the shortest route between two points [1]. Distance between communicating nodes at any point in time is calculated; factor in transmitting a packet directly which depends on the distance between the nodes [7]. Methodology of monitoring and metric collection that is bandwidth-friendly and scalable with respect to the number of workstations on the network [10]. Control algorithm must be stable and adaptive with a wide range of scalability parameters on network [16]. Congestion occurs while transferring the data, control mechanism is to improve the performance when demand for the limited transmission capacity exceeds the supply [6]. Router is an internetworking device that transmits data between two computer networks. It operates much like a small computer that executes a special software program that determines the best route for the data to reach its destination [4]. Consequently, routers are free to move randomly and organize themselves arbitrarily, and thus, the network's wireless topology may change rapidly and unpredictable situation could occur [13].

Open Shortest Path First (OSPF) is commonly used in network routing, as dynamic routing protocol [6]. It is a link state routing protocol and belongs to the interior gateway protocols group. The LSR protocol uses OSPF algorithm originated from Jacquet and Clausen is a point-to-point

proactive protocol that employs an efficient link state packet forwarding mechanism called multipoint relaying. It inherits the stability of the state algorithm [11]. The need for routing algorithms is to make decision for the router regarding the best path for data. The router uses the routing algorithms to compute the best path to transfer the data from the source to the destination. Routing algorithm which maintains packet adaptively without significant hardware cost are now in existence [9].

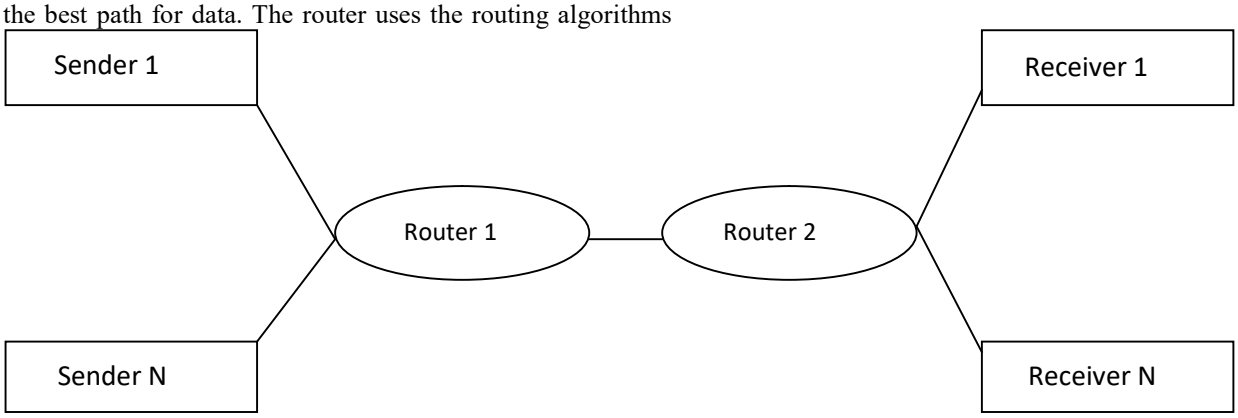

Fig. 1: Multi-Hop Relaying in Packet Routing [16]

III. EXPERIMENTAL DESIGN

The study is quantitative and experimental analysis based, by simulating hypothetical Intranet Network for a Faculty Block on Campus, with Five (5) nodes in mesh topology to demonstrate the efficiency and suitability of Open Shortest Path First (OSPF) algorithm for routing data packet or message in Computer Network. Experimental performance was examined, by measuring the delay and throughput as simulation parameters subject to packet size of the routed message; being the essential metrics for performance and to evaluate Quality of Service.

3.1 Open Shortest Path First (OSPF) Algorithm

Input: Initialized Cost

Output: Minimum Cumulative Cost

STEP 1: Begin with starting node, the transmission root.
STEP 2: Allocate a cost of zero to it and make it the tentative fixed node.
STEP 3: Check every neighbour of the node that was the last tentatively fixed.
STEP 4: Assign a cumulative cost to each node and make it tentative… Among the list
STEP 5: Determine the node with the minimum cumulative cost and make it permanent.
STEP 6: If any node can be reached from more than one location, select the location with the minimum cumulative cost.
STEP 7: Perform steps 3 to 5 until every node becomes fixed.

The data packet (i.e message) to be broadcasted from Source node, 's' to Destination node, 'd' will move through route i to route j to determine the maximum number of channels or hop count for possible routes as delivery links. Route is a path(s) where a message is transmitted from the sender to the receiver and it is mathematically defined as follows:

$$Route_i = \varepsilon^{n}_{\ i=1} \quad path_i \quad \ldots\ldots\ldots\ldots \quad (3.1a)$$

Where i = 1, 2, …, n.

The packets (message) sent and delay (time taken before delivery) experienced is mathematically defined as follows:

$$Packet_{s,d} = \varepsilon^{n,m}_{\ i=2,\ j=1} \quad message\_path_{i,j} \quad \ldots\ldots\ldots\ldots \quad (3.1b)$$

Where *n* is the size of message to be routed through path(s) *i* between each node, and *m* is the maximum number of routes *j* from sender *(s)* to receiver *(d)*.

IV. SIMULATION AND RESULTS

Simulation was performed on HP 630 laptop computer with 2.1GHz Dual-Core processor, 3.00GB RAM and 250GB Hard disk on Microsoft Windows 10 Pro. MATLAB toolbox and commands were used for the simulation and analysis of hypothetical network.

Table 1: Specification of Hypothetical Intranet Network (Faculty WiFi)

Node (Host)	Path (Link Routes)	Broadcast Cost (b/s)
1 (Source)	2,3	(1-2)=11; (1-3) = 9
2	3,4	(2-3)=8; (2-4)=7
3	4	(3-4)=4
4	5	(4-5)=6
5 (Destination)	Packet Delivery	

4.1 Network Representation

MATLAB code for representing the above network at command prompt is given below:

>> Faculty_WiFi=sparse([1 1 2 2 3 4], [2 3 3 4 4 5], [11 9 8 7 4 6], 5, 5)

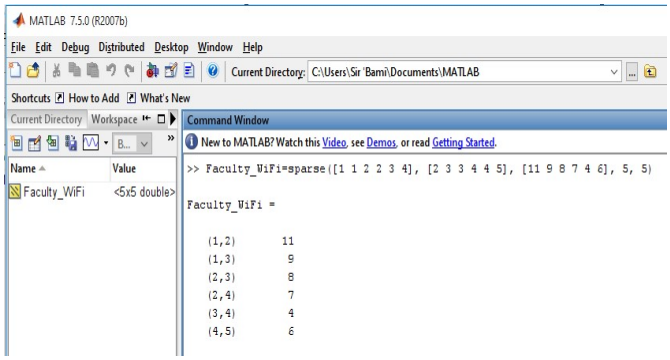

Fig. 2: Source/link, destination node and the broadcast cost

4.2 Best Route for Routing Signal

MATLAB code to determine the best route at command prompt is given below:

>>
[minimum_cost,shortest_path]=graphshortestpath(Faculty_WiFi,1,5)

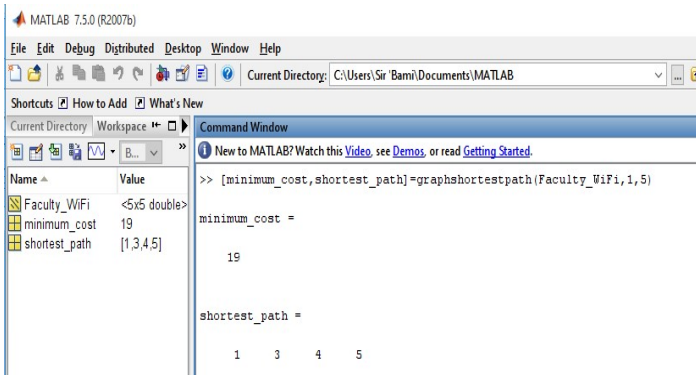

Fig. 3: Least Expected Delay as Minimum Cost and the Shortest Route

4.3 Network Structure

MATLAB code to display the network structure at command prompt is given below:

>> view(biograph(Faculty_WiFi, [], 'ShowArrows', 'off', 'ShowWeights', 'on'))

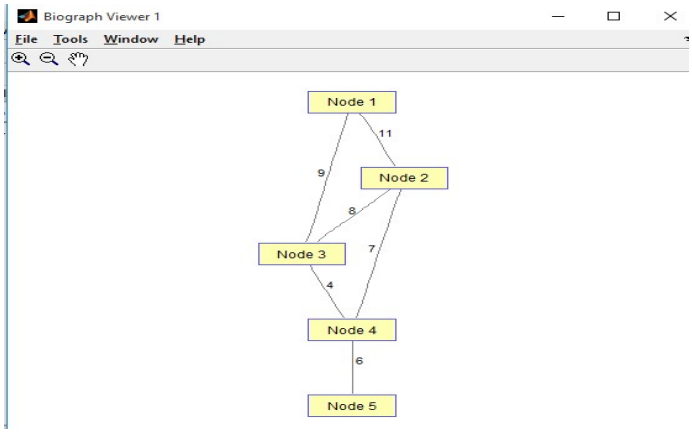

Fig. 4: Simulating the Network Structure

V. CONCLUSION

The strength of Open Shortest Path First (OSPF) has been established, suitable for efficient routing in Intranet Network. A considerable factor in network routing and efficiency is associated with the chosen protocol; a reliable routing algorithm should be able to transfer packets (messages) from source node to destination node with minimum cost and reduced delay.

MATLAB has capability for simulating computer networks and connectivity process in message routing with appropriate functions; in experimental design due to capital intensity to set up network in laboratory scenario. The results and experimental analysis confirmed that the minimum cost of routing from node 1 (source) to node 5 (destination) is 19.

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