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A PROPOSED SOLUTION TO THE BOTTLENECK AND CAPACITY PROBLEM FOR DATA TRANSFER

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ABSTRACT

There is increased need for solution to communicate larger data over the PON network. In this study, two problems including bottleneck and the capacity load problem were investigated and based on this, a solution is proposed. For methodology, N number of Nodes is used for ring-based architecture which represent the complete PON system. The nodes are the save points are created for monitoring the nodes and tracking their network faults. The distance from each node is equal and there are N number of checkpoints. The source and receiver node are selected dynamically. A ring-based network model is proposed with the optimized solution, less data loss and higher speed. The proposed work sets a scenario which is based on ring topology with 08 number of nodes with same number of save points. 800 m * 800 m is the dimension of the topography. We found that time it took to transfer a packet is about 1.01 second. For solving the bottleneck problem, the tree-based network model is used and accordingly, 4 sub-networks are taken in a hierarchal way. Comparison of results based on packet delivery shows that proposed model has better time factor in terms of sending data compared to the existing system.

Keywords: Ring Model, Data Transfer, Bottleneck, Capacity Load.

INTRODUCTION

With the rise of internet and other wireless products, there is growing demand for the video products including video conferencing, gaming, video on demand, internet, and IPTV. Especially the increased need of gaming lead to the development of new access methods which are meeting the bandwidth requirements. The copper-based networks are already reaching to their maximum

capacity and unable to meet the requirements of the future. The alternative is optical fiber which are found to be a good alternative. There is no active unit in PON, it is considered as cost effective and simple solution which is not achievable by other methods (Ossieur, Qiu, Bauwelinck, Vehulst, Martens, Vandewege, & Stubbe, 2003). Now for backbone networks and long haul networks, the optical networking is in place. For local and metropolitan area network, it is becoming a top choice. The PON is an access network based optical fiber. The network is designed for almost unlimited bandwidth to the subscriber. A passive optical network is a shared and single optical fiber which utilizes a passive optical splitter for dividing the signal towards individual subscribers. PON is called passive since besides central office, there are no active elements within the access network. A PON enables a service provider to deliver a true triple play offering of voice, data, and video. IPTV is an important component of data offering. PON are becoming increased popularity especially in rollout of Fiber to the Home infrastructures.

The main focus of the study is to assess the pocket delay and capacity of sub-network which forms PON through simulations and analysis which makes a comparison with standardized system. 2 lane system is utilized in this study which is based on ring topology for reducing the packet loss than existing system and also aggregation-based bottleneck network where a secure system is implemented using SHA algorithm. This bring reduction in pocket delay and improve capacity over the network.

LITERATURE REVIEW

Passive Optical Network (PON) is a highly developed access network because of its favorable qualities including high reliability of data and rates along with signal format. Because of higher use of optical networks in metropolitan and wide area network, there creates a situation of bottleneck between local area network and the network service providers. This gap or bottleneck can be overcome by utilizing the fiber optic network access bandwidth (Aurzada, Scheutzow, Herzog, Maier, & Reisslein, 2008). For PON, the key parameter for analysis include the jitter, congestion control, delay, capacity and throughput. Accordingly, jitter is about variations of packet delay over time. The jitter is variation of packet delay over time caused by EM interference and crosstalk with carriers of other signals. The congestion control is about situation where a link is carrying so much data that its service quality deteriorates. The delay is the average time from when packet is generated till it is successfully received. Capacity refers to the maximum number of users. Throughput is the mean rate of successful message delivered over a communication channel.

The objective of the paper is to evaluate the key parameters of PON including the delay and capacity features. Previous relevant studies shed some light on the similar topic. For example, study by Aurzada, Scheutzow, Reisslein, Ghazisaidi, & Maier (2011) conducted a probabilistic analysis of NG-PONs by taking the minimum capacity of the sub-networks forming the NG-PON and weighing the packet delays of the sub-networks. Study by Helonde (Helonde, Wavhai, Deshpande, & Bhagwat, 2011) was about introduction of the MRA algorithm for investigation of the influence of changing links capacity and establishing the packet delivery ratio and bounded end-to-end delay. A study based on mobile ad-hoc networks investigated the node mobility

model for delay analysis and multicast capacity (Wang, Chu, Wang, & Cheng, 2011). Wang, Huang, Wang, Zhang, & Hu (2011) investigated the tradeoff for motion and capacity. Study by Lim, Kourtessis, Milosavljevic, & Senior (2011) showed that quality of service aware medium access control protocol for next generation OFDMA-PONs. In this study, the service-level differentiation and class-off service are investigated based on end-to-end delay and network throughput. The study also proposed a new dynamic subcarrier allocation algorithm. Study by Tanaka, Nishitani, Mukai, Kozaki, & Yamanaka (2011) was about proposed DBA algorithm which was about Adaptive DBA switching status-reporting method and traffic monitoring method for traffic load and achieving high data throughput and data transmission delay. Study by 9 was about performing a work on analysis of existing dynamic bandwidth allocation algorithms and its application to long reach passive optical networks (LR-PON). In a study conducted by Skubic, Chen, Ahmed, Wosinska, & Mukherjee (2009), comparison was made between Ethernet POn and Gigabit PON for their typical characteristics of DBA including jitter, delay and bandwidth utilization. A particular PON standard sets the framework for the operation of DBA and the limitations it faces. Author showed that such differences between Ethernet PON and Gigabit PON are based on two separate standards. Based on the findings, a new GPON DBA algorithm is also proposed. Accordingly, the DBA operation is influenced by length of the polling cycles. Authors however found minor differences between the both standards. Study by Luo & Ansari (2005) investigated the DBA scheme based on traffic prediction and prediction error is supposed to be Gaussian. Gaussian prediction error distribution is used for showing the average delay. In summary, there are numerous studies which investigated the capacity and delay performance based on various protocol and showed different results.

PROPOSED METHODOLOGY

N number of Nodes is used for ring-based architecture which represent the complete PON system. These nodes which are identical in nature were placed at equal interval in a ring form. The nodes are the save points are created for monitoring the nodes and tracking their network faults. The distance from each node is equal and there are N number of checkpoints. The source and receiver node is selected dynamically. In case of absence of faults, the data will be transferred uninterruptedly. If there is any fault in the network, the last save-point will find the alternative path to transmit the data over the network. Two parts are created for the entire bandwidth including normal communication and the recovery option. The recovery path will be used for transferring data during the fault. This system provided more desirable results compare to the previous system. The bottleneck problem in PON architecture is considered. Hierarchical architecture is taken for the bottleneck problems. 4 sub-networks is taken that connect in a hierarchal way. The concept of data aggregation travelling over the network is shown in this work. This shows that larger data can be transferred. A filtration approach is also presented based on resolving the load from the channel.

For analysis of delay and capacity problem over a network, two types of network are analyzed in this study. One network is ring topology and the other is tree topology which utilizes the SHA

algorithm for enhancing the capacity of the network. The simulation is performed using the Matlab. The details are as follows;

Ring based Network Model

For solving problems related to the high-speed Wireless PON-Network, the ring based network model is proposed. The proposed model will provide optimized solution with better speed and less data loss. The proposed work sets a scenario which is based on ring topology with 08 number of nodes with same number of save points. 800 m * 800 m is the dimension of the topography. Traffic is generated by using the CBR based on 25 Mbps rate and size of 512 bytes. Communication can be started from any random node and to any destination node. If traffic is initiated from node 1, the destination can be any random number. We found that time it took to transfer a packet is about 1.01 second.

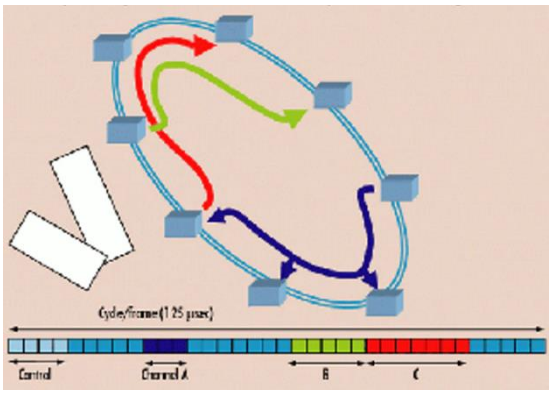

Figure 1: Ring Based Network Model

The analysis suggests that there were some faults generated at some random position and found the final destination node from the opposite side however, performed successfully the delivery of the packet. In situation of the fault, the time to deliver the packet was about 4.56 seconds.

Tree Based Network Model

The bottleneck problem in PON architecture is attempted to be solved using the tree-based network model. 4 sub-networks are taken in a hierarchal way. The concept of data aggregation travelling over the network is captured in this model. It means the data is transferred over the network in large quantity. A filtration approach is used for solving the data efficiency and load problem. SHA algorithm is used for data authentication. A fixed distance is used between each node which is set at 38.36 m with coverage range of about 10 m. Comparison of results based on packet delivery shows that proposed model has better time factor in terms of sending data compared to the existing system. For example, the existing system had higher fault occurrence and corresponding time. At 3 fault occurrences, the time in second was 12 which increased to 20 at 7 fault occurrences. While, in proposed system, the time it took to recover remained 5 second for 1 fault and even for 7 faults, the time only increased to the 7. This shows that this proposed system had better fault recovery. Similarly, in terms of speed, the existing system showed less speed of packet transmission compare to the proposed system. Thus, it can be seen that the proposed system had desirable features of data transmission load and the fault recovery.

CONCLUSION

In this study, a ring-based model is proposed for transferring large data over the network. the ring-based model is used for testing the time it takes to move data from one node to another and the fault rate. The results show that the proposed system achieved higher efficiency. Additionally, for correcting the bottleneck problem, tree-based network model is proposed and found showing good performance compare to the existing model.

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