Towards Providing Fairness in PON-WMN based FiWi Networks

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Towards Providing Fairness in PON-WMN based FiWi Networks

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1. Introduction

Optical Fiber Cables (OFCs) are able to provide high capacity, but are difficult to deploy due to cost and other physical limitations. On the other hand, wireless networks are cheaper and extremely easy to deploy but do not have as much capacity. Fiber-Wireless (FiWi) access network is a type of network architecture, which combines the massive capacity of the optical fiber networks and the flexibility of the wireless networks [1].

In this work, we consider a FiWi network where the optical domain is made up of PON and the wireless domain is made up of 802.11 WLAN standards. The considered PON consists of multiple Optical Network Units (ONUs) which are connected to the Optical Line Terminal (OLT) through optical splitters, which allows all ONUs to act as if they are within the same cable segment. The WLAN is 802.11 based WMN composed of wireless Gateway (GW) connecting to the ONU by physical cable. The Access Points (APs) are connected to a GW wirelessly. Our considered architecture is illustrated in Fig. 1.

2. AP Selection Algorithm and Simulation

OFCs can be used in many situations that required high bandwidth connectivity. However, OFCs are not easily accessible to the end users who lack proper equipment. This is where the wireless domain of FiWi network comes in to play. With demonstrated FiWi architecture, users with WiFi equipped devices may connect to the Internet directly with their devices. However, the serviceable area of different APs may overlap as illustrated in Fig. 1. Traditionally, clients are configured to choose the closest AP. In an area like evacuation center, many clients are clustered and may attempt to associate to a single AP that has highest signal strength when there are other APs within the area that are less crowded. Since each AP can be set to operate in a non-overlapping channel, the capacity of each AP is independently limited. Therefore, the capacity that each client can receive depends on the number of clients associated to the AP and the unbalanced number of clients may cause fairness issues and cripple the network performance.

In order to achieve fairness and maximize overall throughput, we have proposed an AP selection method for the FiWi network architecture. When a client attempts to associate with an AP, the APs that can receive the association message send a request message which includes number of current users associated with it and the RSSI of the client to the OLT. The OLT then decides the APs that the client should associate with based on the current number of users associating with the contending APs. The simulation is conducted under Qualnet network simulator where the scenario that is shown indicated that majority of the node are clustered around a single AP while also being in range of farther AP. All clients attempt to send as much traffic as possible. As

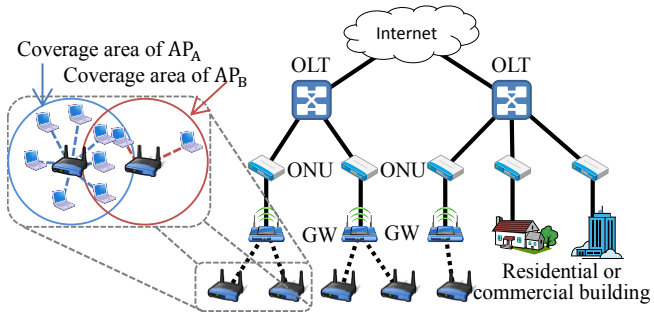

Fig.1. FiWi architecture with PON as optical domain and WiFi as wireless domain components

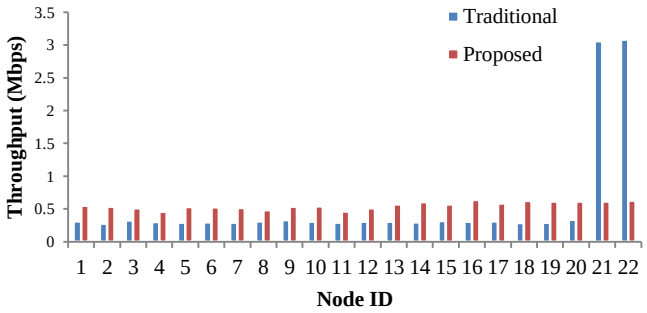

Fig.2. The simulation results shows that the proposed AP selection method increase fairness of the overall network

shown by the results in Fig. 2, the traditional method where clients select AP based on RSSI indicates that there is unfairness problem where node 21 and 22 which are closer to the farther AP get much more throughput than the rest. Our proposed method balance the number of nodes between each AP with the help of OLT, thus results in a more fair network where each node generally receives a fair but higher throughput than the traditional method.

3. Conclusion

In conclusion, we have demonstrated the problem of unbalanced number of clients, which cause the unfairness in the network. In addition, we have proposed and demonstrated the performance of an AP selection method to increase the fairness of all clients within the network under high traffic load.

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Reference

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