Adaptive Routing Protocol for Multiple Portal in Wireless Mesh Networks

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Wireless Mesh Networks (WMNs) extend the radio transmission range for accessing network in a deployment area. WMNs also interconnect with other wired infrastructure networks to provide Internet service with a low cost deployment. Through the deployment of WMNs, the current IEEE 802.11 wireless local area networks (WLANs) standard can interconnect with each other by the multihop fashion. In general, WMNs consist of mesh stations and mesh routers. The placement of each mesh router forms a wireless backbone to support the connectivity of mesh stations.

Today, wireless mesh networking has emerged as one of the most promising concept for self-organizing, self-healing and self-configuring WLAN networking to provide adaptive and flexible wireless connectivity to users through mesh stations. At the same time, IEEE 802.11s standard mesh networking is currently developing an emerging standardization for mesh networking at the MAC level of the premise WLAN technology. In IEEE802.11s, the standard specifies that the mesh router consists of three different kind devices; mesh point (MP), mesh access point (MAP), and mesh portal (MPP). The functionalities of these devices are different in order to support the wireless connectivity smoothly. IEEE 802.11s also specifies a new approach for building a WMN at the layer-2 makes it appear as a WLAN for layer-3 protocol. In addition, IEEE 802.11s specifies multihop MAC

functions for both mesh station, MP, MAP and MPP using a path selection routing protocol, called a Hybrid Wireless Mesh Protocol (HWMP), and provides a default path metric, airtime link metric (ALM) to build the network of WMNs for transporting traffic. Unfortunately we find that the ALM is not a good path metric for shortest path routing requirement for HWMP. Furthermore, HWMP provides a fundamental framework for the path selection routing and cannot balance the traffic in WMNs with multiple portal issue.

In recent research works, G*á*lvez at el. present a feedback-based adaptive online algorithm for multi-gateway load-balancing in WMN. They called their algorithm as Gateway Load-Balancer (GWLB), which balances the inter-domain flow fairness based on the current network conditions, the rate of flows and number of active flows in the domain. GWLB algorithm needs high computation to switch the appointed flows to the domains with a below average number of flows with the considerations of foreign gateway and increment of new flow. Since the ALM that specified in IEEE802.11s reflects the amount of channel resources consumed by transmitting the frame over a particular link. This measure should be transformed in a generic path metric, i.e., latency. In this paper, latency for a wireless network is defined as the time of the start of packet transmission at the source node to the time of the end of packet reception at the destination node. In this thesis, we introduce an adaptive routing protocol for multiple portal in WMNs in order to optimize the performance of the HWMP for multiple portal issue as well as balance the inter-domain flow fairness with low computation using the depth-first search (DFS) method. We propose a new algorithm, called optimal latency balancing with depth-first search (OLB-DFS) algorithm to enable dynamic and self-corrective to monitor and balance the traffic of the WMN. The basic idea of the OLB-DPS algorithm is to balance the traffic load among the MPPs in order to increase inter-domain flow fairness and minimize the latency of packet sending.

In this thesis, we first examine the default path metric of the HWMP protocol. We estimate the frame error rate (FER) by calculating the distance of the link of 54 Mbps data rate. Using the default equation of ALM, we can obtain the ALM value is almost the same for the distance of 80 meters. Through this result, we propose an extended ALM for improving the

current path metric of the HWMP protocol.

In the second part, we build C++ console application to construct and simulate the performance of HWMP protocol in the WMN environment. This program is event-driven application. All the events are defined in the configuration file. In the program, we simulate each mesh router as an independent object. Each mesh router has its own properties. In the startup, the application first reads the configuration file to initialize the parameters and generate all the events. When an event meets its time, it will be forwarded to the specified node to process event. By this way, we investigate the performance of HWMP protocol with both ALM and extended ALM for multiple portal WMN environments. Simulation results reveal that our proposed extended ALM always outperforms the original ALM.

In the third part, we program the pseudo-code of the proposed OLB-DFS algorithm into our WMN simulator. Since the Internet traffic directed to a MAP will be served by MPPs; the traffic is routed from the MPP to the MAP using a minimum cost path and vice versa. We also model our traffic into two different types; downlink flow and uplink flow. The traffic balancing problem requires choosing the serving MPP function for every downlink or uplink flow. Considering the given conditions, we evaluate our proposed OLB-DFS algorithm for multiple portal issue under the similar WMN environment. OLB-DFS can improve the HWMP protocol to not only optimize the performance of HWMP protocol for multiple portal, but also to balance the inter-domain flow fairness with low computation.

In summary, we have studied the ALM, which is a default path metric that is specified in IEEE802.11s standard. We have proposed new path metric, the extended ALM and incorporated with the latency to minimize the transmission delay of each uplink and downlink flow in the WMN environment by sharing the traffic load in between multiple MPPs. Further research is required to investigate a good factor for interference margin to a nominated flow switches to the domains with a lower average number of flows. Besides that, our future work also will focus on examining the performance effect of the proposed OLB-DFS algorithm when the MPP placement is considered and investigating the performance effect of the proposed OLB-DFS algorithm in the WMN environment with mobility.