

Chapter 4

Routing Optimization for Integrated Optical and Mobile Ad hoc Networks

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ABSTRACT

Resource consumption in access network will continue to draw attention due to the increasing trend of mobile user device and application. This chapter will address the issue of resource utilization efficiency via alternate specific method known as Taguchi offline optimization-based on mobile ad hoc network (MANET) to be applied into cooperating multiple layers framework of deploy over passive optical network (PON) called the last mile mobile hybrid optical wireless access network (LMMHOWAN). Adhering to this method, the chapter is also to propose the design of experiment simulation model using OMNeT++ software and its impact is investigated on the identified performance metrics like the end-to-end delay, packet delivery ratio (PDR), network capacity, packet loss probability (PLP), and energy consumption. Simulation result shows that the heterogeneous optical wireless network under the influence of random mobile connection can perform better with the optimized front-end wireless ad hoc.

INTRODUCTION

Today, rapid growth of bandwidth hungry application or services such as video distribution in social media and online gaming presents a global challenge in terms of the architectures and traffic flow of the currently deployed wireless access network. Such a trend lead to an increase in the deployment of hierarchical structure for fixed wireless access such as fiber-wireless (Fi-Wi) network based on R&F (Radio-and-Fiber) technology that support both larger bandwidth capacity and mobility. This can be found in a recent research which investigated the topology design for the distribution mobile ad-hoc network (MANET) in urban power distribution over fiber link (Sun, Wang, Zhang, & Qian, 2009). Therefore, the goal of this chapter is on providing the efficient Internet access to mobile ad hoc users based on IEEE802.11g DCF (Distributed Coordination Function). Specifically, it is to integrate Taguchi optimization Ad-hoc on-demand Distance Vector Routing - Uppsala University (AODV-UU) into the wireless domain of optical fiber-wireless (FiWi) backhaul network architecture. It was carried out with consideration of quality of service (QoS) resource consumption under varying nodes speed.

Previously, Hybrid Optical Wireless Access Network (HOWAN) was introduced where the combined the optical and wireless technologies provide mobility and extended reach of high capacity broadband access networks. In this chapter, an optimization algorithm to improve HOWAN performance is introduced i.e. Last Mile Mobile Hybrid Optical Wireless Access Network (LMMHOWAN) that provides optimization based on adaptive mobile wireless at the front end over optical backhaul such as passive optical network (PON). A heterogeneous multihop wireless networks is considered with the application of multi-rate control for the wireless ad hoc domain. In specific, the best configuration of the entire network was selected in addition to simplification of monitoring and analysis by providing a unified interface for accessing application, protocol and system information. Factors such as noise and control rate determine the minimum variation response for improved quality of service and resource consumption at increasing node speeds.

To the best of our knowledge, there is not much work in the wireless optical broadband access network that accounts for the multi-hop wireless environment. The paper organization is as follows: Next section is devoted to the related works in the field. The following section focuses on the design methodology over LMMHOWAN and descriptions on the Taguchi optimization based on design of experiment framework. The subsequent section discusses the performance evaluation carried out to assess the proposed adaptive optimization model over optical network. Finally, conclusions are made for this paper.

BACKGROUND

An access network has a typical distance of less than a hundred kilometers. It connects the end users (businesses and residential customers) to their primary service provider and the rest of the network infrastructure. Access demands for Internet Services are growing exponentially. It is estimated that access networks consume nearly 70% of the total Internet energy resource consumption worldwide (Skubic, Betou, Ayhan, & Dahlfors, 2012; Zhang, Chowdhury, Tornatoe, & Mukherjee, 2010). Due to this reason, network operators have shifted the direction towards more environmentally-friendly technologies. Thus, this new networking paradigm need to be addressed so that future ICT could be more sustainable by consuming a significantly lower amount of energy without affecting its core functionalities. As a

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