On STA Sleep Method for Reducing Energy Consumption and Delay in FiWi Networks

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○ Keisuke Miyanabe, Hiroki Nishiyama, and Nei Kato
Graduate School of Information Sciences, Tohoku University

1 Introduction

Recently, Fiber Wireless (FiWi) networks which put optical networks and wireless networks together are used widely. Although FiWi networks have high broadband and flexible communications, a STAtion (STA) in wireless network has limited battery and Optical Network Unit (ONU) in optical network consumes much energy. Therefore, some power saving mechanisms have been proposed to reduce energy consumption of STA and ONU. However, the existing power saving mechanisms lead to network delay. In our research, we propose a method that reduces both energy consumption of STA and network delay.

2 Power saving mechanisms in FiWi network

In this paper, we consider a FiWi network consisting of a Passive Optical Network (PON) as the optical network and Wireless Local Area Network (WLAN) as the wireless network. In PON, there is a power saving mechanism, namely ONU sleep. On the other hand, in order to improve energy efficiency in WLAN, Power Saving Mode (PSM) is used. ONU sleep and PSM have two states, i.e., active state and sleep state. In active state, data is transfered, but energy consumption is high while in sleep state, data cannot be transfered, but energy consumption is low. In existing methods, ONU sleep and PSM work independently, and thus, the total delay in FiWi network is the sum of the delay of ONU sleep and PSM. In order to decrease the delay, STAs usually have short Beacon Interval (BI), which is the time interval before next activation from the time when STA wakes up. However data cannot arrive at STA when ONU is in sleep state. All data arrive at same time when ONU wakes up. As a result, many activations of STAs are useless and waste energy. In our proposed method, the activation time of ONU and STA is synchronized. In this way, when data is sent from ONU to STA, there is no delay. The total delay in FiWi network is only the delay of ONU sleep. In addition to this, when ONU wakes up, STA is in active state at the same time, and thus, the activation of STA is effective.

3 Numerical evaluation

To evaluate our proposed method, we perform a numerical analysis. STAs work with PSM and the ONU uses ONU sleep to reduce energy consumption. The ONU active-sleep cycle is set to 100ms. We set BI of STA to 25ms and 50ms. In our proposed method, we synchronize BI in ONU active-sleep cycle. In Fig. 1, our proposed method achieves low energy consumption with all data quantity. Moreover, as shown in Fig. 2, the delay of our proposed method is shorter than traditional PSM with BI=25ms and BI=50ms. It is because in our proposed method, no delay of PSM occurs, while in traditional methods, the delay of PSM occurs regardless the value of BI.

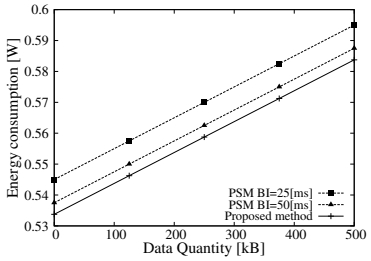

Fig. 1 Energy consumption of a STA

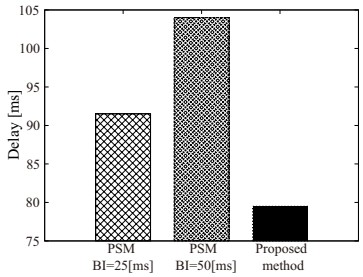

Fig. 2 The delay in FiWi network

4 Conclusion

There are some power saving mechanisms in FiWi networks to conserve limited battery of STA and improve energy efficiency of ONU. In this paper, we proposed a novel power saving mechanism which synchronizes BI in ONU active-sleep cycle to decrease both energy consumption and delay. By numerical analysis, we showed that our proposed method can reduce both energy consumption and delay in FiWi network.

5 Acknowledgment

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