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MODERN CONSOLIDATED ENERGY SAVING SCHEME IN GREEN FIBER-WIRELESS (FIWI) ACCESS NETWORK

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Abstract

Energy savings in Internet have been regarded as a significant technical issue for academic and industrial community. Particularly, access network accounts for more than 70% of the total energy consumption of Internet. As a promising access technique, Fiber-Wireless (FiWi) network not only enables the cost-effective broadband access, but also provides more opportunities for energy savings. Previous works mostly focused on the energy savings in the optical back-end of FiWi. Generally, they extended the Optical Network Unit (ONU) sleep mechanisms initially designed for Passive Optical Network (PON) to FiWi by combining with the wireless rerouting. However, most of these works left the energy savings in the wireless front-end untouched. In fact, when one or more ONUs in the network is/are sleeping, many wireless components remain idle or underutilized which cause a lot of energy waste. Motivated by this, project propose the modernConsolidated Wireless-Optical Energy Savings (WOES) scheme for the comprehensive energy savings in FiWi. The WOES scheme consists of two interactive modules, Energy-Efficient ONU Management (EEOM) and Energy-Aware Topology Configuration (EATC). EEOM aims at the energy savings in the optical back-end by putting the low-load ONUs into sleep state. A pair of thresholds is introduced into EEOM to maintain the states of ONUs. As soon as ONUs states change, EATC will reconfigure the wireless topology by putting the idle Radio Interfaces (RIs) into standby state, thus minimizing the energy consumption of the wireless front-end. Simulation results show that the WOES scheme can reduce the energy consumption significantly with just a little performance degradation in network throughput and end-to-end delay.

Keywords: Wireless-Optical Energy Savings (WOES), Fiber-Wireless (FiWi), Energy-Aware Topology Configuration (EATC), Optical Network Unit (ONU), Radio Interfaces (RIs), Passive Optical Network (PON) .

1. INTRODUCTION

FiWi access networks introduce wireless optical wireless communication. Fiwi access networks enable traffic to be sent from the source wireless client to an ingress ONU, then to the egress ONU close to the destination wireless client, and finally delivered to the destination wireless client. FiWi support direct inter-ONU communication in the optical sub network. Significant progress has been made on the design of advanced FiWi network architectures as well as access techniques and routing protocols/algorithms over the last few years [3]. Among others, the beneficial impact of advanced hierarchical frame aggregation techniques on the end-to-end throughput-delay performance of an integrated Ethernet passive optical network (EPON)/wireless mesh network (WMN)- based FiWi network was demonstrated by means of simulation and experiment for voice, video, and data traffic [4]. A linea r programming based routing algorithm was proposed in [5], [6] with the objective of maximizing the throughput of a FiWi network based on a cascaded EPON and single-radio single-channel WMN. Extensive simulations were conducted to study the throughput gain in FiWi networks under peerto-peer traffic among wireless mesh clients and compare the achievable throughput gain with conventional WMNs without any optical backhaul.

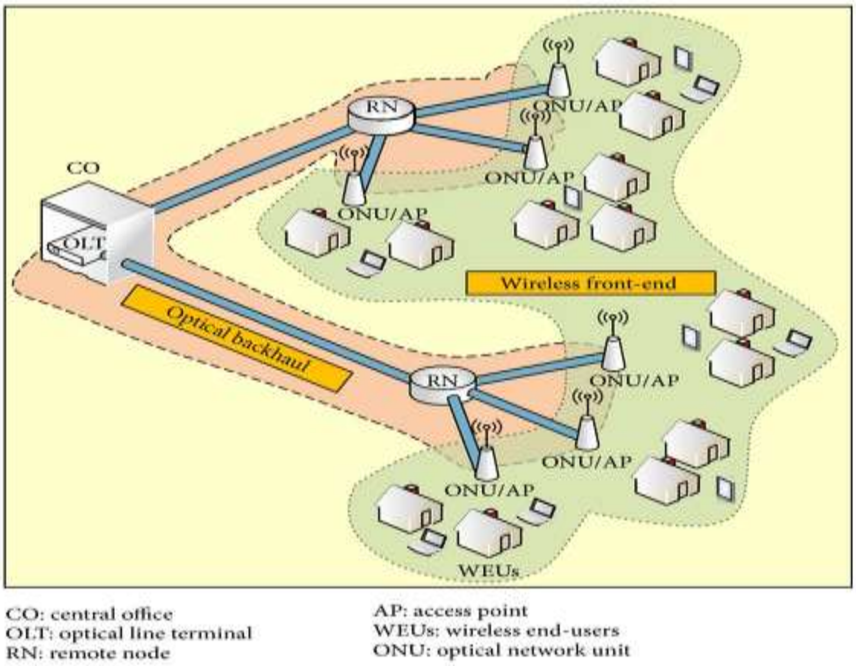

Figure 1.1 Architecture of a FiWi access network

Figure 1.1 shows architecture of a FiWi access network. The optical backhaul is a tree network connecting the central office (CO) and wireless front-end. The optical backhaul is comprised of an optical line terminal (OLT) at the CO, an SMF, a remote node (RN), and multiple access points (APs). The wireless front-end consists of widespread APs to penetrate numerous wireless end users (WEUs). There are two main methods to transmit the wireless signals over the FiWi systems: ROF transmission and digitized radio-over-fiber (DROF) transmission. Designing security in wireless network is a challenge. Among others, key security issues in wireless networks are the shared wireless medium, severe resource constraints, dynamic network topology, reliable and trusted infrastructure, open peer-to-peer network architecture, roaming, handover as well as interference in co-channel and adjacent cells. Security issues have also been studied in optical networks considering different scenarios such as in-band-jamming, out-of jamming, tapping attacks, channel attacks, denial and theft of service, eavesdropping, and masquerading. For detecting and preventing these threats and security holes in optical networks, a variety of authentication and encryption protocols may be used, e.g., Rivest Shamir Algorithm, Advanced Encryption Standard(AES), and Elliptic Curve Cryptography (ECC).

2. RELATED WORK

The recent survey of hybrid optical-wireless access networks [28] explains the key underlying photonic and wireless access technologies and describes important FiWi access network architectures. Energy-efficient FiWi network architectures as well as energy-efficient medium access control (MAC) and routing protocols were reviewed in [29]. Recent efforts on energy-efficient routing in FiWi access networks focused on routing algorithms for cloud-integrated FiWi networks that offload the wireless mesh front-end and the optical-wireless gateways by placing cloud components, such as storage and servers, closer to mobile end-users, while at the same time maintaining low average packet delays. F IBER-WIRELESS (FiWi) access networks, also referred to as wireless-optical broadband access networks (WOBANs), combine the reliability, robustness, and high capacity of optical fiber networks and the flexibility, ubiquity, and cost savings of wireless networks. To deliver peak data rates up to 200 Mb/s per user and realize the vision of complete fixed-mobile convergence, it is crucial to replace today's legacy wireline and microwave backhaul technologies with integrated FiWi broadband access networks. Consolidated fiber-wireless (FiWi) access networks provide a powerful platform to improve the throughput of peer-to-peer communication by enabling traffic to be sent from the source wireless client to an ingress optical network unit (ONU), then to the egress ONU close to the destination wireless client, and finally delivered to the destination wireless client. Such wireless-optical-wireless communication mode introduced by FiWi access networks can reduce the interference in wireless subnetwork, thus improving network throughput. With the support for direct inter-ONU communication in the optical subnetwork, throughput of peer-to-peer communication in a FiWi access network can be further improved. In this paper, we propose a novel hybrid wavelength division multiplexed/time division multiplexed passive optical network (WDM/TDM PON) architecture supporting direct inter-ONU communication, a corresponding decentralized dynamic bandwidth allocation (DBA) protocol for inter-ONU communication and an algorithm to dynamically select egress ONU. The complexity of the proposed architecture is analyzed and compared with other alternatives, and the efficiency of the proposed system is validated by the simulations. A promising approach to increase throughput, decrease delay, and achieve better load balancing and resilience is the use of multipath routing schemes in the wireless mesh frontend of FiWi networks.

3. EXISTING SYSTEM

We consider the problem of jointly optimizing routing, linkscheduling and transmit power control while ensuring end-to-endQoS to individual data users. Within these constraints we try to optimize the overall average transmit power of all the nodes. The QoS to a user may be simply stability of its queuesat all the nodes in the network or a minimum rate guarantee. There are two components in a joint scheduling and powerallocationscheme: a scheduling policy that decides which userto use the time-slot and a power allocation policy that decidesthe transmission power of the selected user (and thus its correspondingdata-rate).

Draw Back

- Poor usage of network throughput
- RI energy efficiency is low

4. PROPOSED SYSTEM

All wireless gateways are uniformly configured with 4 RIs. The IEEE802.11a standard is applied for the implementation ofWMN. It is guaranteed that each wireless node hasat least two neighbor nodes. Each pair of neighbor wireless nodes is located in the transmission rangeof each other and has the common channel. The capacity of wireless links are determined by the givenlink scheduling. In the optical back-end, we deploy the IEEE 802.3ah EPON with the distribution fiberlength of 5 km and the feeder fiber length of 15 km. Each ONU is connected to a wireless gateway bywired cable and allocated the bandwidth capacity of 50 Mb/s for upstream and downstream transmission,respectively. These five ONUs integrated with wireless gateways are used as the interface between wirelessfront-end and optical back-end of the simulated FiWi network. We simulate each connection as a Constant-Bit-Rate (CBR) flow, which generates the packets at the rate of 125 packets per second with the packet size of 1000 bytes. Thus, the flow rate is 1 Mb/s. We consider the upstream and downstream traffic together. The number of upstreamconnection requests is

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half that of downstream connection requests. All upstream connection requestsare sent to the OLT and each one is randomly designated a source wireless router. All downstreamconnection requests originate from the OLT and each one is randomly designated a destination wirelessrouter. The shortest path routing algorithm is used to calculate the route for each connection requestwhen it enters into the network. Thus, we observe that OES and WOES have differentONU sleep ratio for the given LT and HT. When network load increases, each ONU ill carry more trafficload at any given time and thus experiences shorter sleep period. As a result, both OES and WOESschemes have a decreasing ONU sleep ratio.

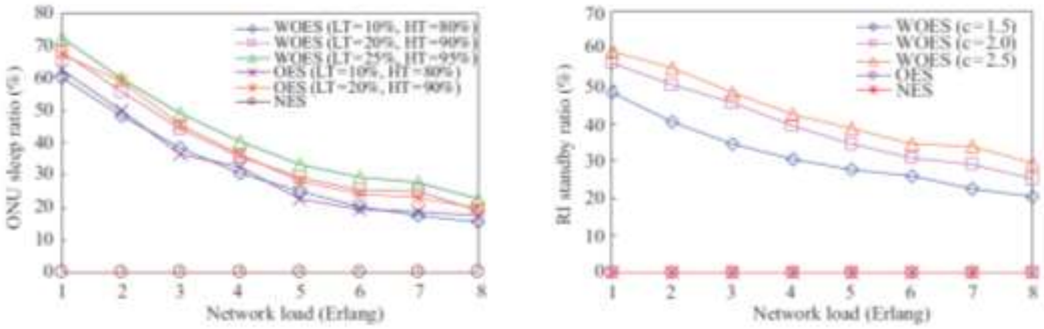

Figure 4.1 (Color online) ONU sleep ratio vs. network (and) RI standby ratio vs. networkload.

The project investigate the performance ofWOES in the RI standby ratio under different network loads. RI standby ratio is defined as the ratio ofstandby period to simulation duration for each RI on average. Higher RI standby ratio indicates betterenergy savings in the wireless front-end. Both NES and OES schemes exhibit zero RI standby ratiobecause they do not cover wireless energy savings. In our WOES scheme, we enable the energy savingsin the wireless front-end by putting the idle RIs into standby state. the performance of the WOES scheme inaverage end-to-end delay and compare it with the NES and OES schemes. Here, we define the averageend-to-end delay as the time that each packet goes from source node to destination node on average,including all queuing delay and transmission delay. With the network load growing, all three schemesshow the gradually increasing average end-to-end delay. In the OES and WOES schemes, the ONUsleep mechanism encourages more connections to share the active ONUs, such that more low-load ONUscan be put into sleep state for energy savings. As a result, each connection is allocated less bandwidthcapacity, which causes larger transmission delay in ONUs. Thus, we observe that the OES and WOESschemes exhibit larger average end-to-end delay than the NES scheme. In theWOES scheme, RIs standbydiminishes the connectivity of wireless topology in the front-end. Each connection has to transfer its trafficthrough the longer wireless path and thus experiences larger delay for wireless transmission

Rewards

- Provides detailed background information, enabling the reader to get the big picture and to acquire the technical understanding of past and current broadband access solutions
- Describes the latest and next-generation optical and wireless access networks in great technical detail, offering an update on the latest developments in each type of network
- Covers all important aspects of FiWi-related research and development activities, providing the reader with a comprehensive yet comprehensible overview of research findings, challenges and opportunities

5. SYSTEM MODEL

- WOES scheme
- EEOM: energy savings in optical back-end
- EATC: energy savings in wireless front-end
- GA Approach

5.1 WOES scheme

In this section, we first introduce the notation of the proposed WOES scheme. Then, we elaborate onthe interactive modules EEOM and EATC in the WOES scheme.

Notation

Given.

- N_{WN}: number of wireless nodes in the network, including wireless routers and wireless gateways.
- x: index of wireless node, x ∈ {1, 2, 3, . . . ,NWN}.
- S_R: set of wireless router indices. |Sk| is the number of wireless routers in the network.
- WN-x: wireless node indexed by x. Particularly, ∀x ∈SR , WN−x denotes the wireless router.
- N_O: number of ONUs in the network.
- i: index of ONU, i ∈ {1, 2, 3, . . . ,NO}.
- ONU-i: ONU indexed by i.
- w: index of ONU State Set (OSS), w ∈ {1, 2, 3, . . . , 2NO − 1}
- NRI: number of RIs in the network.
- k: index of RI, k ∈ {1, 2, 3, . . . ,NRI}.
- RI-k: RI indexed by k.
- N^x_{RI}: number of RIs in WN-x.
- μ^k_x: binary constant, taking 1 if RI-k is attached to WN-x, and 0 otherwise.
- $H^w_{x,i}$: length of the shortest wireless path (measured in hops) from the wireless router WN-x (x ∈SR) to the wireless gateway connected with the active ONU-i when all RIs in the network are active for the wth OSS.
- H^w_x : length of the shortest wireless path from the wireless router WN-x (x ∈SR) to the wirelessgateway connected with any active ONU when all RIs in the network are active for the wth OSS, thatis, H_x^w= min{ H_x^w,i, ∀i}.
- $\bar{H}^w$: average length of the shortest wireless path from each wireless router to the wireless gatewayconnected with any active ONU when all RIs in the network are active for the wth OSS. Hw is calculatedin Eq.(5).
- P^x_{max} : maximum power consumption of WN-x when all Nx RI RIs are active.
- P_{ARI}: power consumption of an active RI.
- P_{ARI}: power consumption of a standby RI.
- P_{AONU}: power consumption of an active ONU.
- P_{SONU}: power consumption of a sleeping ONU.

Variables.

- λ_k: binary indicator of RI state, taking 1 if RI-k is in the active state and 0 otherwise.
- N^x_{ARI}: umber of active RIs in WN-x, where NxA RI 6 Nx RI.
- $P(N^x_{ARI})$: power consumption of WN-x with NxARI active RIs.

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5.2 EEOM: energy savings in optical back-end

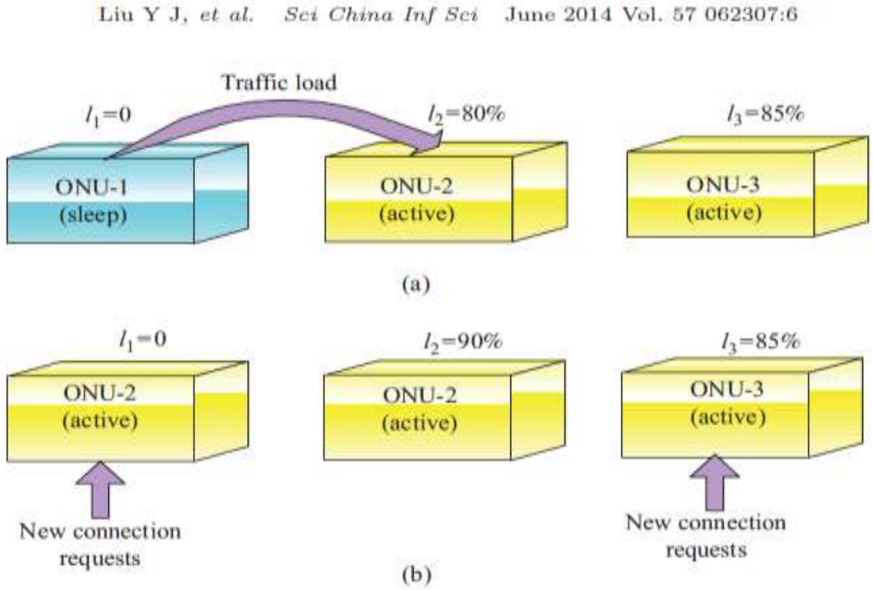

Figure 5.1 (Color online) Illustration of LT and HT in the EEOM module (LT=10% and T=90%). (a) Putting ONU-1 into sleep state (current period); (b) putting ONU-1 into active state (next period).

In our WOES scheme, we develop the EEOM module for the energy savings in the optical back-end ofFiWi. According to EEOM, the OLT will maintain a pair of thresholds LT and HT to control the ONUstate. Each ONU needs to transmit the bandwidth request to the OLT periodically. The bandwidthrequest is an indicator for the traffic load of the ONU. Thus, the OLT has the knowledge of the trafficload of all ONUs in the network. In a periodic way, the OLT will iteratively detect the active ONU,e.g., ONU-i, whose normalized traffic load is lower than or equal to LT and transmit the sleep triggersignal to it. Upon receiving the sleep trigger signal from OLT, ONU-i will first broadcast the sleepnotification to its source wireless routers whose traffic is sent to ONU-i, and then ONU-i goes into sleepstate. Accordingly, the source wireless routers of ONU-i need to reroute their traffic to other activeONUs. When any active ONU has the normalized traffic load higher than or equal to HT, one of thesleeping ONUs will be activated in order to alleviate the traffic load of the active ONUs and preventthem from traffic overflow.

5.3 EATC: energy savings in wireless front-end

Aiming at the energy savings in the wireless front-end, we develop another module EATC in the WOESscheme to put the idle RIs into standby state as more as possible. In this subsection, we first state theoptimization problem of RIs standby in EATC. Then, we propose the Genetic Algorithm (GA) basedapproach for this optimization problem.Constraint of active RI number

$$1 \leqslant N^{x}_{\mathrm{ARI}} \leqslant N^{x}_{\mathrm{RI}}, \quad \forall x \in S_R,$$

$$N^{x}_{\mathrm{ARI}} = \sum_{k=1}^{N_{\mathrm{RI}}} \mu^{k}_{x} \lambda_k, \quad \forall x \in S_R.$$

Considering the end-to-end delay requirement, we also introduce the constraint of wireless path lengthinto EATC. It should be noted that, when all RIs in the network are active, each wireless router

WNx(x ∈ SR) has the shortest wireless path to the wireless gateway connected with any active ONU in thecase of the w^{th} OSS. Thus, the average length of the shortest wireless path Hw is calculated as

$$\overline{H^w} = \frac{1}{|S_R|} \sum_{x \in S_R} H_x^w, \quad \forall w.$$

5.4 GA based approach

GA has been demonstrated to be an efficient approach to solve the nonlinear optimization problem.For the first time, we propose a GA based approach to compute the best RIs standby solution for eachOSS in EATC. Given the w^{th} OSS, the proposed GA represents each of the RIs standby solutions for thew^{th} OSS as an individual. We iteratively implement the genetic operators including selection, crossoverand mutation on the parent individuals to bear the new individuals. The new individuals usually havehigher fitness than that of the parent individuals. Thus, the RIs standby solution for the w^{th} OSS willevolve towards better with lower wireless energy consumption. Finally, we obtain the best RIs standbysolution for the w^{th} OSS when the iteration of GA terminates.

6. CONCLUSION

The area of FiWi networks is central to the current evolution path of networks but presents significant challenges, in particular in integrating disparate systems. This project provides a cogent and highly useful exposition of the main technologies in FiWi, including not only traditional techniques, but also very recent developments such as network coding. This project is a tool both for working engineers and for researchers entering the FiWi area from the optics or from the wireless domains.

REFERENCE

[1] F. Aurzada, M. Scheutzow, M. Reisslein, and M. Maier, “Towards a fundamental understanding of the stability and delay of offline WDM EPONs,” IEEE/OSA J. Optical Communications and Networking, vol. 2, no. 1, pp. 51–66, Jan. 2010.

[2] Frank Aurzada, Martin L´evesque, Martin Maier and Martin Reisslein,” FiWi Access Networks Based on Next-Generation PON and Gigabit-Class WLAN Technologies: A Capacity and Delay Analysis (Extended Version)”, IEEE transaction paper, Pg.No:1-15

[3] N. Antunes, C. Fricker, P. Roberts, and J. Roberts, “Traffic capacity of large WDM passive optical networks,” in Proc., Int. Teletraffic Congress, Sep. 2010.

[4] X. Liu, E. Chong, and N. Shroff. Transmission scheduling for efficient wireless resource utilization with minimum-utility guarantees. In *IEEE Vehicular Technology Conference*, Atlantic City, October 2001.

[5] M. Xiao, N. Shroff, and E. Chong. Utility-based power control in cellular wireless systems. In *Proceedings of IEEE INFOCOM 2001*, volume 1,2001.

[6] Kazovsky L G, Ayhan T, Ribeiro M R N, et al. Energy efficient optical-wireless residential access/in-house networks. In: Proceedings of International Conference on Transparent Optical Networks (ICTON), Stockholm, 2011. 1–4

[7] Chieochan S, Hossain E. Channel assignment for throughput optimization in multichannel multiradio wireless mesh networks using network coding. IEEE Trans Mobile Comput, 2013, 12: 118–135

[8] Zhang Z, Long K, Zhao M, et al. Joint frame synchronization and frequency offset estimation in OFDM systems. IEEE Trans Broadcast, 2005, 51: 389–394