ANALYZING THE ONLINE OPTIMIZATION OF HYBRID NETWORK

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Abstract—The hybrid (Optical-Wireless broadband) network with the backbone as optical networks, Passive Optical Networks (PON), and wireless access networks have been proposed to provide good Quality of service (QoS). A Dynamic network solution for adopting both wired and wireless networking methods need to be updated. A Multicast based network coding technique is introduced for improving total network utility and minimizing the deployment cost and also to improve the distance coverage of the Hybrid Network using Long-Reach Passive Optical Network (LRPON).

Index Terms— EPON, LR-PON, passive optical networks, QoS

I. INTRODUCTION

The hybrid wireless-optical broadband access network (WOBAN) can be employed to capture the best of both worlds — the reliability, robustness, and high capacity of wireless optical communication, and the flexibility (“anytime-anywhere” approach) and cost savings of wireless network. A WOBAN consists of a wireless network at the front end, and it is supported by an optical network at the back end. Optical networks are aimed at high-bandwidth long-distance communications whereas wireless networks are intended for flexible communications in local areas. In recent years the telecommunications backbone has experienced substantial growth however, little has changed in the access network. The tremendous growth of Internet traffic has accentuated the aggravating lag of access network capacity. The “last mile” still remains the bottleneck between high-capacity Local Area Networks (LANs) and the backbone network.

The most widely deployed “broadband” solutions today are Digital Subscriber Line (DSL) and cable modem (CM) networks. Although they are an improvement compared to 56 Kbps dial-up lines, they are unable to provide enough bandwidth for emerging services such as Video-On-Demand (VoD), interactive gaming or two-way video conferencing. A new technology is required; one that is inexpensive, simple, scalable, and capable of delivering bundled voice, video and data services to an end-user over a single network. Long Reach-Passive Optical Networks (LR-PONs), which represent the convergence of low-cost equipment and low-cost fiber infrastructure, increases the bandwidth and also provides long distance communication, appear to be the best candidate for the next-generation access network.

II. RELATED WORKS

Wireless access from the Central Office (CO) to every end user may not be possible because of limited spectrum. Wireless takes over is an interesting engineering design and optimization problem. Base Stations (BS) and Optical Network Units (ONU) installation constraints, user assignment constraints, channel assignment constraints, capacity constraints, and signal-quality and interference constraints. To solve
this Primal Model (PM) with reasonable accuracy, they use “Lagrangean Relaxation” to obtain the corresponding “Lagrangean Dual” model. They also develop an algorithm (called the Primal Algorithm) to solve the PM, it was proposed and investigated the characteristics of an analytical model (called Primal Model) for optimum placements of BS and ONU, so that the WOBAN deployment cost is minimized.

The gateway placement problem for wireless networks is usually treated at the network planning stage. Several algorithms have been developed to solve this problem. A greedy method is proposed that iteratively picks a gateway that satisfies the maximum traffic demand, which provides no QoS or performance guarantees. The problem of minimizing the number of gateways is treated using a polynomial-time near-optimal algorithm. A heuristic algorithm is proposed to solve the gateway placement problem with QoS constraints. In this paper, we consider real-time online joint optimization of gateway selection, user assignment, and bandwidth allocation for wireless-optical networks.

III. RESEARCH CHALLENGES

The central office (CO) connects the core network and the access network, and implements layer 2 and layer 3 functions, e.g., resource allocation, service aggregation, management, and control. The local exchange resides in the local users’ area, which is close to the end customer equipment: ONU (within 10 km of drop section). The optical signal propagates across the fiber forming the feeder section (100 km and beyond) with the CO and the local exchange at its two ends; then the fiber is split and connected to a large number of ONUs. In order to compensate for the power loss due to long transmission distance and high split size, optical amplifiers are used at the OLT and the local exchange.

A. Upstream Resource Allocation

In LR-PON, the end users and the Central Office (CO) (through which users are connected to the rest of the Internet) are separated by a significant distance, typically 100 km and beyond. Hence, control-plane delays (ONUs send transmission request to CO, and transmit upstream data upon receiving acknowledgement from CO) are significant. Meanwhile, the delay budget in an access network is approx. 1-2 milliseconds for real-time applications. In order to mitigate the effect of the control-plane delay, efficient remote-scheduling algorithms (e.g., dynamic bandwidth allocations) need to be developed which overcome the large CO-user distance, which support different classes of service, and which are scalable in terms of the number of users supported as well.

B. Topology and Protection

Several candidate network topologies have been proposed for LR-PON. For example, the branch-and-tree topology has a feeder section of a strand of fibers of 90 km (tree) and is split to multiple users (branches) at the local exchange; while the ring-and-spur topology has the feeder section composed by a fiber ring and Optical Add-Drop Multiplexers (OADMs) on the ring, and up and downstream optical signals are added and dropped through OADMs and split to end users. As LR-PON exploits the huge transmission capacity of optical technology, and is oriented for long-range coverage to serve a large number of end users, any network failure may cause a significant loss for customers and the network operator. The LR-PON protection becomes necessary and important. Various protection schemes for PONs have been proposed by ITU-T (e.g., G. 983 and G. 984). But protection schemes on emerging topologies, such as ring-and-spur topology need further investigation. Section III.D will introduce a protection scheme for the ring-and-spur topology.

C. Signal Power Compensation

Optical amplification is indispensable in a LR-PON. Besides amplifying the signal, the amplifiers introduce two challenges: Optical amplifiers introduce amplified spontaneous emission (ASE). ASE is a side effect of the amplification mechanism, produced by spontaneous emission that has been optically amplified by the process of stimulated emission in a gain medium. The ASE may have a detrimental effect on cost associated with installation of an optical transmitter and receiver in the ONU at the customer premises. However, the uncooled transmitter is temperature dependent; as a result, it could transmit a wavelength with a possible drift of 20 nm. In a standard PON, the performance may be unaffected as no component is wavelength critical. But in a LR-PON which exploits WDM to satisfy the huge amount of traffic, the wavelength drift becomes crucial, especially for certain components such as optical filters. To counter the wavelength drift, more expensive cooled transmitters are considered to ensure a stable wavelength. A possible technology is called reflective ONU (R-ONU), which generates the upstream signal from the optical carrier feeding from outside (could be the downstream optical carrier or a shared optical source at the local exchange), using a reflective SOA (RSOA) modulator.
The transmitters in a traditional PON are usually designed for a transmission range which is less than 20 km. The challenge arises when applying them in a LR-PON where the signal needs to cover a range of 100 km and beyond.

IV. DESIGN TOOL AND SIMULATION

A. Network Simulator 2 Tool

NS2 uses two languages because simulator has two different kinds of things it needs to do. On one hand, detailed simulations of protocols require a systems programming language which can efficiently manipulate bytes, packet headers, and implement algorithms that run over large data sets. For these tasks run-time speed is important and turn-around time (run simulation, find bug, fix bug, recompile, re-run) is less important. On the other hand, a large part of network research involves slightly varying parameters or configurations, or quickly exploring a number of scenarios. In these cases, iteration time (change the model and re-run) is more important. Since configuration runs once (at the beginning of the simulation), run-time of this part of the task is less important. ns meets both of these needs with two languages, C++ and OTcl. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but can be changed very quickly (and interactively), making it ideal for simulation configuration. ns (via tclcl) provides glue to make objects and variables appear on both languages.

The figure shows the transmission of packets in the wired network with the packet loss. At first, the packet is transmitted from the node 0 to node 3 via node 2. After receiving the packets acknowledgement is sent to node 1. Similarly, from node 1 transmission of packets takes place to node 3 and receives the acknowledgement from node 3. Due to transmission of data from node 1 and node 2 takes place at the same time, the packets queuing occurs. When more packets get queued, then the overflow of packets takes place.

The transmission of packets in the wireless networks is shown in the following figure. Here, the node which needs the service from the host gets the registration from the central hub. Similarly, the other nodes also get the registration from the central hub for the service.

After the node gets registered, the service is established between the node and the host and transmission of packets takes place. An acknowledgement is sent from the node to host after receiving the packets. Similarly, the registered node gets the service established between them. The figure represents the process. The simulation is done by using Network Simulator 2 tool.
V. CONCLUSIONS

In this paper, the Hybrid Wireless-Optical Broadband Access Network is considered. In order to provide good QoS, high bandwidth, flexible and long distance communication we go for hybrid networks. Here, we have presented the flow of packets in wired and wireless networks using TCP protocol based on the EPON and also the packet loss are also considered. The packet flow are shown by using Network simulator 2 software. The EPON will be replaced by LR-PON for improving the transmission speed and increase the distance coverage.

REFERENCES