

Department of Computer Science and Software Engineering

Master Thesis Defense

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| Examining Committee: | Drs. Narayanan, Youssef and Dr. Harutyunyan (Chair) |
| Title: | Multichannel Optical Access Networks: Design and Resource Management |
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ABSTRACT

At present there is a strong worldwide push towards bringing fiber closer to individual homes and businesses. The next evolutionary step is the cost-effective all-optical integration of fiber-based access and metro networks. STARGATE is an all-optical access-metro architecture which does not rely on costly active devices, e.g., OXCs or FWCs, and allow low-cost PON technologies to follow low-cost Ethernet technologies from EPON access into metro networks, resulting in significantly reduced cost and complexity. It makes use of an overlay island of transparency with optical bypassing capabilities.

In this thesis we first propose ONU architectures, and discuss several technical challenges, which allow STARGATE EPONs (SG-EPONs) to evolve in a pay-as-you-grow manner while providing backward compatibility with legacy infrastructure and protecting previous investment. Second, and considering all the hardware constraints, we present the corresponding dynamic bandwidth allocation algorithm for effective resource management in these networks and investigate their performances (delay, throughput) through simulation experiments.

We further investigate the problem of transmission grant scheduling in multichannel optical access networks using a scheduling theoretic approach. We show that the problem can be modeled as an Open Shop and we formulate the joint scheduling and wavelength assignment problem as a Mixed Integer Linear Program (MILP) whose objective is to reduce the length of a scheduling period. Since the problem is shown to be NP-hard, we introduce a Tabu Search based heuristic for solving the joint problem. Different other heuristics are also considered and their performances are compared with those of Tabu and MILP. Results indicate that by appropriately scheduling transmission grants and assigning wavelengths, substantial and consistent improvements may be obtained in the network performance. For example, Tabu shows a reduction of up to 29% in the schedule length with substantial reduction in channel idle gaps yielding to both higher channel utilization and lower queuing delays. Additionally, when the number of channels in the network is not small, the benefits of performing appropriate wavelength assignment, together with transmission scheduling, are observed and discussed. We further perform a packet-level simulation on the considered network to study the benefits of efficient grant scheduling; significant improvements are shown both in terms of system utilization and packet queuing delays