Design of efficient routing and wavelength allocation in passive optical networks

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***Abstract*— This paper proposes aefficient routing and wavelength allocation in wavelength-division-multiplexed passive optical network (WDM-PON) subject to requirements of fairness, efficiency, and cost. Routing in the optical networks needs to be dynamic as the wavelengths and its parameters are changing frequently. This paper presents a brief survey about the existing approaches in the Routing and Wavelength Assignment (RWA) using Wavelength Division Multiplexing (WDM). An Optical Line Terminal (OLT)-centric bandwidth allocation model is proposed which employs a credit pooling technique combined with a weighted-share policy to partition the upstream bandwidth among different classes of service, and to prevent Optical Network Units (ONUs) from monopolizing the bandwidth. We propose a multi-objective network design problem for the traffic grooming and routing in WDM networks. While designing WDM system, we must consider the physical layer impairments (PLIs) incurred by non-ideal optical transmission media, accumulates along the optical path. For high transmission speed Dispersion become a considerable degradation factor and in this work we have concentrated on the effects of dispersion on fiber design parameters such as bandwidth, delay and bit rate.A dynamic subcarrier assignment algorithm that respects quality of service by offering decreased average delay is proposed. Moreover, effective methods to improve its performance and reduce its complexity are provided. In this work we have concentrated on the effects of bandwidth, delay and bit rate. This work discusses the improvement in blocking probably for incoming requests while performing routing by proposed algorithm and the traditional shortest path algorithm.**

***Keywords*— WDMPON (wavelength division multiplexing passive optical network, optical network unit (ONU), Routing**.

I. INTRODUCTION

An optical network connects computers (or any other device which can generate or store data in electronic form) using optical fibers. Optical networks are based on the emergence of the optical layer in transport networks provide higher capacity and reduced costs for new applications such as the internet, video and multimedia interaction and advanced digital services. Fiber optics communication has provided us very high speed communications with enormous bandwidth potential. Although fibers can support very high data rates, the associated electronic processing hardware will typically not be able to keep up with such speeds. Hence electronic handling of data network nodes basically limits the throughput of the network. Further, electronic processing is required because optical storage and processing technologies are not mature yet. Hence a packet that must be stored or processed at an intermediate node has to be converted to its electronic form and stored in an electronic buffer memory.

Optical Networks

Optical network are high-capacity telecommunication network based on optical technologies and components that provide routing, grooming and restoration at the wavelength level as well as wavelength-based services. It uses Optical Fibers for data transmission. The header is then extracted, processed and a routing decision is made based on the information provided in the header and the routing protocol. The packet is then queued at the output port, converted back into its optical form and transmitted towards its final destination.To improve the throughput of the network and to minimize transmission delay, the network architecture must both reduce the number of times a message is processed by the intermediate nodes and must streamline the processing at each node. But because of many real world constraints, a regular uniform pattern in building a network may not be feasible. In optical network customers are demanding more services and options and are carrying more and different types of data traffic.

Passive Optical Networks:

Passive optical networks have high bandwidth Point-to-Multipoint (P2MP) optical fiber network based on the Asynchronous Transfer Mode (ATM), Ethernet or TDM.PONs rely on light waves for data transfer.Only passive optical components are used such as optical fiber, splices and splitters.PONs minimizes the fiber deployment in both the local exchange office and the local loop. PONs provides higher bandwidth due to deeper fiber penetration, offering gigabit per second solutions.
The PON is an access network based on Optical Fiber. It is designed to provide virtually unlimited bandwidth to the

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subscriber. A passive Optical network is a single, shared optical fiber that uses a passive optical splitter to divide the signal towards individual subscribers. PON is called passive because other than at the central office there is no active element within the access network.

A PON enables an service provider to deliver a true triple play offering of voice, video and data, an important component of the data offering can be IPTV.PON are getting more widespread in rollout of Fiber To The Home(FTTH) infrastructure.

2PON Architecture: The elements of a PON are

(i) Optical Line Terminal(OLT)

(ii) Passive Optical Splitter and

(iii) Optical Network Unit(ONU).

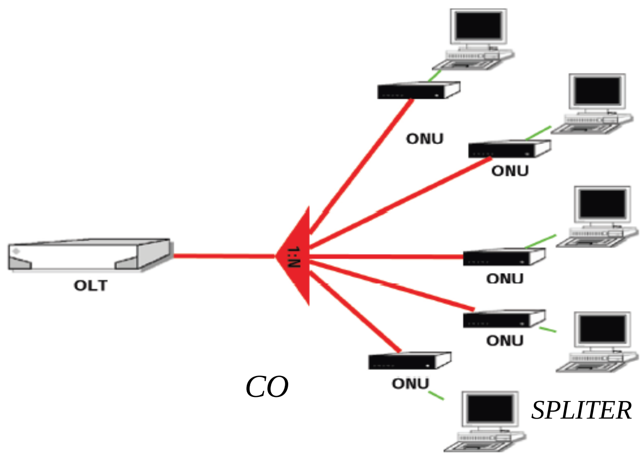

Figure1.1: PON architecture

The Optical Line Terminal is the main element of the network and is usually placed in the Local Exchange. It is a network element with PON line card, basically a aggregation switch. Optical Splitter is a passive device with single input and multiple output. Optical power at input is split evenly between outputs. Not only signal travels from input to the outputs, signal can also travel from the output to the input. Splitters can be placed anywhere in between CO and Subscriber premises. It is used to connect an optical port of OLT with multiple subscribers.

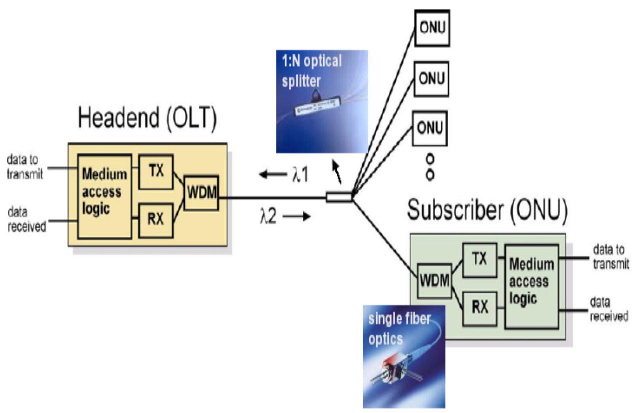

Figure1.2:PON configuration

It provides several interfaces for accessing triple play services and in the upper side it connects with the OLT via optical splitter. Although PONs caPON uses 1490 nm for the downstream wavelength and 1310 nm for the upstream wavelength. Signals are inserted or extracted from the fibre using a coarse wavelength division multiplexer (CWDM) filter at the CO and subscriber premises.

The communication path from the OLT to the ONU is referred to as downstream and reverse path as upstream. The downstream and upstream signal is carried over the same fiber.In the downstream direction the signal sent by the OLT arrives at the splitter's input and later the same signal reaches every ONU.

II. LITRETURE SURVEY

Eric Kerhervé et.al[1] concluded that With the use GaAs pseudo orphic high electron-mobility transistor technology, the band width performances of Cherry–Hooper driver amplifiers need to be improved. To fulfill these requirements, propose an original driver circuit topology dedicated to 40-Gb/s optical communication systems. To flatten the transducer gain response of the circuit, passive networks have been added in the design. These networks have been optimized by means of the real frequency technique (RFT). A modified procedure of the classical RFT is introduced to perform the optimization in the presence of an overall resistive feedback.

Thanh-Nga Duong et.al [2] experimentally investigate the transmission performance of a novel modulation based on a recently proposed technique of adaptively modulated optical orthogonal frequencydivisionmultiplexing (AMOOFDM) for next-generation passive optical network (NG-PON). This signal was generated by direct modulation of cost-effective and low-bandwidth commercially available distributed-feedback and vertical-cavity surface-emitting lasers. Using the Levin–Campello adaptive bit-loading algorithm for channel capacity optimization over AMOOFDM modulation to reach maximum transmission performance and experimentally demonstrated that high bit rate can be transmitted in optical access network without the need for chromatic dispersion compensation and optical amplification on the link.

AshwinGumaste, et.al [5]concluded that a network architecture for the realization of a pragmatic framework for optical packet transport called the light-frame (LF) framework is proposed. The architecture enables the transport of packets over optical media. While doing so, it relaxes the need for address recognition as well as high-speed switching, which are the two key hindering factors that have prevented contemporary optical packet transport solutions from being deployed. Using this framework, tradeoff was achieved between cost (maturity in deployment)and performance (network efficiency). The idea is to create logical topology that enables *N*2 connectivity, yielding sub lambda granularity, and thereby facilitating packet transport. Methods for topology discovery and conflict resolution are proposed. This paper also discusses stochastic as well as optimization analysis of the framework. The fiber resource requirements ofthis network solution are compared to a leading access networking solution—passive optical networks (PONs)—and cost benefits are shown. The LF concept due to its finely granular application, despite a present technological bottleneck, presents a good implementation case that allows it to be pushedfor next-generation optical packet transport, especially in the access area

Gangxiang Shen et.al [7] plan Greenfield PON networks to minimize their total deployment costs and propose an efficient heuristic called the Recursive Association and Relocation Algorithm (RARA) to solve the optimization problem. This algorithm can significantly reduce PON network deployment costs compared to an intuitive random-cut sectoring approach. To further tune down the costs, we also exploit the opportunity of cable conduit sharing by proposing an extension to RARA. Our case studies show that there are saturating trends for the PON deployment costs with the increase of the three system parameters, including maximal optical split ratio, maximal transmission distance, and maximal differential distance.

Werner Hofmann [8]concluded that InP-based, vertical-cavity surface-emitting lasers (VCSELs) utilizing a buried tunnel junction (BTJ) emitting at 1.55 _m with improved active region and reduced parasitic are demonstrated. A superior modulation bandwidth 9 10 GHz is achieved up to 85 _C. The VCSEL device is investigated in detail, analyzing all bandwidth-limiting elements. With their improved temperature range, these VCSELs are especially qualified for uncooled operation in passive optical networks. These lasers show open eyes and error-free transmission up to25-Gb/s modulation speed at room temperature. Uncooled error-free operation over a wide temperature range under constant bias conditions for ultra-low-cost systems is demonstrated at a 12.5-Gb/s data rate up to 85 _C. Due to a well-tailored mode-gain detuning, the laser characteristics are practically invariant with temperature at fixed bias conditions. Further possible design optimizations targeting at data rates well above 25 Gb/s are
discussed.

Franco Davoli [9] concluded that In an access node to a multiservice network [e.g., abase station in an integrated services cellular wireless network other optical line terminal (OLT) in a broad-band passive optical network (PON)], the output link bandwidth is adaptively assigned to different users and dynamically shared between isochronous(guaranteed bandwidth) and asynchronous traffic types. The bandwidth allocation is effected by an admission controller, whose goal is to minimize the refusal rate of connection requests as well as the loss probability of cells queued in a finite buffer. Optimal admission control strategies are approximated by means of back propagation feed forward neural networks, acting on the embedded Markov chain of the connection dynamics; the neural networks operate in conjunction with a higher level bandwidth allocation controller, which performs a stochastic optimization algorithm. The case of unknown, slowly varying input rates is explicitly considered. Numerical results are presented that evaluate the approximation and the ability to adapt to parameter variations.

III. PROBLEM FORMULATION

We utilize the wavelength which we assign to network.

1 We have to provide efficient routing in optical networks.
2 We have to find the shortest path in a graph and also calculate the route for shortest path.
3 Then estimate blocking probability BER and and delay of network.
4 Blocking probability is also find to every node.

IV. WORK DONE

Using the MATLAB the parameter which are calculated using single fiber length L also

i. Nodes are assigned according to routing table.
ii. To create a shortest path using routing.
iii. To assign the wavelength.
iv. To calculate the different parameters.
   a. blocking probability
   b. b. delay
   c. c load d BER

V. CONCLUSION AND FUTURE SCOPE

Conclusion

This paper investigated the routing and wavelength assignment in WDM network with optical carrier regeneration. It assigns upstream bandwidth in rectangles trying to minimize the average delay of each reservation. It is to prove that the results for the transmission through the two hop networks are successful with reduced BER. The bandwidth of the system can be increased by increasing the capacity of the system. The capacity of the system can be increased by increasing the number of users without disturbing the working of another user. In this, a heuristic multicasting traffic grooming algorithm for metro-WDM network and a QoS-promoted scheme for network upstream transmission has been proposed.

Future Scope

In this thesis, The TDM/WDM models are to investigate on the basis of quality of services that are BER (bit error rate) Q.F (quality factor) eye patterns &jitter performance. The investigated model in this thesis is for downstream transmission, so for the upstream transmission is extended for future work. Although it is conceptually simple, the use of AWG optical passive network has many problems of its own. For example, since AWGs are very sensitive to temperature changes, this puts severe constraints on channel spacing. Otherwise it would be necessary to monitor the pass band wavelengths of the AWG and to tune the DWDM sources. So the research study needs to be done over this area. I recommend to use passive splitter than using AWG because many losses are there when using AWG in WDM Scenario.

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