DESIGNING OF ELASTIC OPTICAL NETWORK USING RECONFIGURABLE OPTICAL ADD DROP MULTIPLEXER (ROADM) METHODOLOGY

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Abstract:- As bandwidth consumption continues to explode in a challenging economic environment, service providers and enterprises need to maximize their network's efficiency – deliver more with less. Effective use of Reconfigurable Optical Add Drop Multiplexers (ROADMs) is key to this strategy. Increasing the flexibility, scalability and remote configurability of a network lowers Operational Expenses (OPEX). Using ROADMs, a bandwidth provider can quickly turn up new services, alter networks as needed, protect his revenue stream and reduce truck rolls through remote management ROADM, short for reconfigurable optical add-drop multiplexer, is a form of optical add-drop multiplexer that adds the ability to remotely switch traffic from a wavelength-division multiplexing (WDM) system at the wavelength layer. WDM technology has brought more than an order-of-magnitude increase in the amount of bandwidth that can be transported over fiber In the fiber optic network which uses wavelength division multiplexing (WDM), reconfigurable optical add-drop multiplexer (ROADM) is used to remotely add, block, pass or redirect modulated light emissions-infrared and visible-within a range of wavelengths. With ROADM devices, signal switching doesn't need optical-to-electric and electric-to-optical conversions. Instead, outgoing light beams can be generated, incoming beams could be terminated or beams could be passed through the device unmodified. This is achieved through wavelength-selective switch (WSS) components within the device.

IndexTerms—Bandwidth variable transponder, Bandwidth variable cross-connect, Optical add/drop multiplexer, Hybrid optical network, OptiSystem,EON.

I. INTRODUCTION

Growth of the users' bandwidth demand has caused the fast and reliable provisioning of the optical paths to be a main objective of the optical communications service providers. DWDM technology, [1], emerged to help the service providers to handle the users' increasing traffic. Introduction of the new communication services like e-health and e-gaming exacerbates the need of being equipped by a mechanism for remote and reliable provisioning of the optical paths. For this purpose, Reconfigurable Optical Add/Drop Multiplexers, ROADMs, provide various facilities for optical network managers to reconfigure the network, remotely.

The optical transmission networks have become one of the most important parts in the telecommunication hierarchy, whose seamless integration with conventional network applications and services forces a further development and a broader deployment of optical networks in all telecommunication areas. Making a classification of different optical transmission networks, it can be distinguished between Access, Metro and Core (or back-bone) networks (Figure 1-1:) [4]. This is the most convenient network

classification made regarding the transmission distance or network diameter. Access networks as the base of the telecommunication hierarchy, are characterized by the interaction between numerous different network technologies based on different transmission media e.g. wire, wireless or fiber.

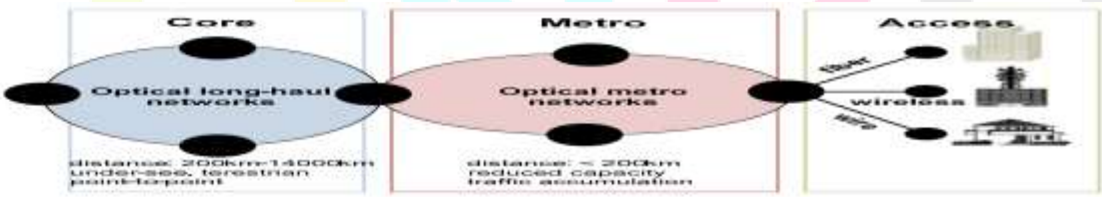

Figure 1- Network classification

1.2.1 Optical network components

Figure 1-2 shows a generic block diagram of a typical WDM optical communication system. It consists of a transmitter, a communication channel, and a receiver, the three elements common to all communication systems

Figure 2 Block diagram of an optical communication system

In optical networks the only difference being that the communication channel is an optica fiber cable. The other two components, the optical transmitter and the optical receiver, are designed to meet the needs of such a specific communication channel

1.2.1.1 Optical transmitters
The role of an optical transmitter is to convert the electrical signal into optical form and to launch the resulting optical signal into the optical fiber. It consists of an optical source, a modulator, and a channel coupler. Semiconductor lasers or light-emitting diodes are used as optical sources. The optical signal is generated by modulating the optical carrier wave. Two types of modulation methods exist: the direct modulation and the external modulation.

1.2.1.2 Optical fibers
The evolution of optical communication was strongly correlated by the evolution of optical fibers since its loss was the main bottleneck of such systems. The availability of low-loss fibers led to a revolution in the field of lightwave technology and started the era of fiber-optic communications.

1.2.1.3 Optical amplifiers
Optical amplifiers represent one of the crucial components in an optical transmission system. Despite of the minimum attenuation at 1550 nm, fiber losses significantly limit the transmission performance with increased transmission distance. Optical amplification can be realized using different amplifier concepts and mechanisms e.g. semiconductor optical amplifiers (SOA), rare-earth doped fiber amplifiers or more recently Raman amplifiers.

1.2.1.4 Optical Nodes
.However, due to considerations of cost and scalability, different node architectures are deployed in reality that have less than perfect switching capability. Considering WDM architecture where multiple wavelengths are multiplexed into one carrier optical fiber. If a node is able to add and drop some of the channels in all-optical way it is so called optical Add-Drop-Multiplexer (OADM). In contrast to OADMs, which usually have predetermined add/drop wavelengths, Reconfigurable OADMS (ROADMs) allow a network administrator or operator to dynamically select what wavelengths to drop or by-pass

II. LITERATURE REVIEW

Some of the common optical modules that may exist in the ROADM structure are Optical Multiplexer/Demultiplexer, Optical Power Splitter/Coupler, Tuneable Optical Filter and Optical Switch. One major building block of some ROADMs is Wavelength Selective Switch, WSS, [2]. Using this module, any channel of any input port can be switched to any output port [2]. The existing ROADM architectures which are used in various applications have different characteristics. One of the properties of ROADMs is "Colourlessness". It means that any port of add/drop structure can add or drop any wavelength [3]. When a ROADM is "Directionless", any port of add/drop structure can add/drop a channel to/from any degree of ROADM [3]. In "Contentionless" ROADMs, one can add/drop channels of the same wavelengths to/from any degree of ROADM [3]. "Multicast" means that a channel can also be routed to some output degrees, while it is dropped. It is called "drop and continue", also. "Scalability" is the ability to increase the number of ROADM degrees [4]. "Modularity" is a key feature of ROADMs to provide the upgradability and reconfigurability [4]. Different ROADM architectures are investigated in literature [3-6]. One of the ROADM architectures is coloured in which the add/drop function is not colour blind [3]. It has one WSS in the output port of each degree. Other architecture is coloured with WSS in input and output port of each degree [4]. A colourless architecture with WSS in each degree is stated in [3]. The other ROADM structure is Colourless and Directionless, CD, in order to avoid a separate add/drop structure for each degree, [3]. A Colourless, Directionless and Contentionless, CDC, architecture is presented in [3] in which m*n WSS module is used. Another CDC architecture, using Switch, Filter and Power Splitter is proposed in [3] because m*n WSS is not available commercially. A CDC architecture is proposed in [5] that is designed based on (De)Multiplexer and Photonic Cross Connect, PXC, [7]. The other structure which is proposed in [6] is CDC that uses WSS in each output port and Coupler in input ports. One can use PXC and Coupler in output ports and WSS in input ports of ROADM, as presented in [5]. The other architecture is based on Coupler and WSS in both input and output ports to reduce the PXC size [5]. One important issue in ROADM-based DWDM networks is the network management in terms of

III. METHODOLOGY

The proposed EON (Elastic optical network) architecture employs a different set of four transmitter, receiver, wavelength splitter and an oadm switch in both directions to increase the network capacity as shown in Fig. 2. DWDM technology technique is used in proposed system because of following advantages:

1) Less fiber cores to transmit and receive high data.
2) A single core fiber cable could be divided into multiple channels instead of using fiber core.
3) DWDM systems are capable of longer span lengths

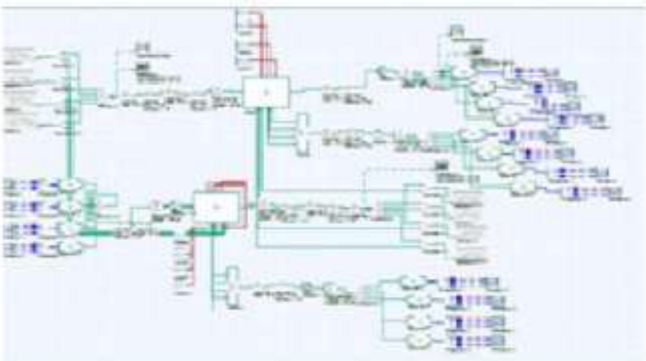

Figure. 3: Proposed Elastic Optical Network

An OADM consists of three stages: an optical de-multiplexer, an optical multiplexer and between them a way of reconfiguring the paths between the multiplexer, de-multiplexer and a pair of ports for adding and dropping signals. The de-multiplexer splits wavelengths in an input fiber onto ports. The reconfiguration can be accomplished by optical switches which govern the wavelengths to the multiplexer/drop ports.

Then, the wavelength channels are multiplexed by the multiplexer that are to continue on from de-multiplexer ports with those from the add ports, onto a single output fiber OptiSystem version 7 software is used forsimulating the proposed system design

IV. CONCLUSION

This paper represents the design of a Hybrid Optical Network using OptiSystem software. The Q-factor, BER (Bit error rate), Eye height, BER pattern and spectral efficiency have been calculated and from the simulation we have achieved the BER of this network is approx. 1.2x10-15, Q-factor is approx. 7.8, eye height is 3.8x10-12, the power obtained is -22.5dBm and from the following results it can be seen that the proposed design has a suitable affinity.

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