Optical Amplifier Number and Placement in the SuperPON Architecture

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***Abstract*-Three alternative optically amplified long reach, wide splitting ratio PON (SuperPON) amplifier placement strategies (i.e architectural configurations) are modelled using the Virtual Photonic Integration (VPI) simulation package. In particular optical power budgetary analysis is carried out on three SuperPON dimensions of 100 km, 110 km and 130 km for the three configurations with the range of splitting ratios from 256 to 131,072 optical network units (ONUs). From the simulations the optimum placement and the minimum number of optical amplifiers required for SuperPON architecture is determined and graphical data is discussed in relation to the different network sizes and dimensions. Using this approach it is demonstrated that a single amplifier is sufficient to provide for up to 1,024 ONUs and that this number increases to six amplifiers with three in cascade to service 131,072 ONUs.**

I. Introduction

At present most telecommunications fiber rings use synchronous optical network/synchronous digital hierarchy (SONET/SDH) technology. These rings, which require optical-to-electrical-to-optical conversion at each node, are optimized for long haul and metropolitan inter-exchange applications. They are not, however, an appropriate choice for the local access network. By contrast a passive optical network (PON) uses passive optical fiber splitters or couplers to route traffic, instead of the more expensive electro-optic required for SONET/SDH rings. As a result the PON offers the most cost-effective solution for upgrading the critical last mile infrastructure to provide an evolutionary path for the delivery of future broadband services [1]. It is also an attractive solution for optical access to solve the bottleneck by bringing the fiber closer to the curb, cabinet, building and home.

Figure 1 shows generic PON and SuperPON architectures. Basically both a PON and SuperPON consist of an optical line terminator (OLT) located at the central office (CO) or local telephone exchange and a set of optical network units (ONUs) or Optical Network Terminations (ONTs) located at the customer premises.

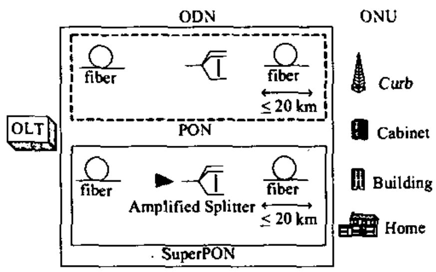

Figure 1 Generic PON and SuperPON architecture.

Between them lies the optical distribution network (ODN) comprising of fibers and passive optical splitters. The interface path between ODN and ONU is connected with a maximum fiber length of 20 km [2]. At present, however, there is no standard for specifying the distance between OLT and splitter or amplified splitter in the case of the SuperPON.

There are three active devices that can be used in a PON. At the CO, carriers install a special switch, called an OLT, which either generates light signals on its own or takes in SONET signals (such as OC-12) from a co-located SONET cross-connect. The OLT then broadcasts this traffic through one or more outgoing subscriber ports. Depending on where the fiber terminates, either an ONU or an ONT receives the optical signal and converts it into an electrical signal for use in the customer premises. The customer premises can be provided for by either a fiber to the curb (FTTC), fiber to the building (FTTB), fiber to the cabinet (FTTCab) or fiber to the home (FTTH). With the SuperPON, another active device, the optical amplifier is used to extend the optical power budget [3]. In the PLANET SuperPON the optical amplifier is located at the splitter in order to produce an amplified splitter [4]. This approach provides for a longer network span and increased splitting ratio to service a much larger number of ONUs.

The technical success of PONs commenced with 32 splitting ratio telephony over a passive optical networks (TPON) development by British Telecom (BT) in 1988 [5].