

DESIGN AND PERFORMANCE ANALYSIS OF BIDIRECTIONAL TWDM-PON EMPLOYING QAM-OFDM FOR DOWNSTREAM AND RE-MODULATION FOR UPSTREAM

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Mode of Study : F. Time

ABSTRACT

The estimate made by Cisco Forecast Project highlights that explosive rise in worldwide internet traffic will scale up to petabytes (10^{15}) per minute from 2011 to 2016 which includes large share of video services forming millions (10^6) of bytes per second. So, this demand has forced the interest of researchers towards the deployment of next generation access (NGA) networks which offer higher data rate, in order to deal with ever rising future triple play service demand that requires huge bandwidth.

Passive Optical Networks (PONs) have received a lot of interest these days, from not only network providers but researchers also, owing to their enormous economic advantages for application in last mile of network. No doubt that the wavelength division multiplexing based passive optical network (WDM-PON) is a capable architecture to provide broadband access for the next generation networks as it provides number of desired features as high bandwidth, large split ratio or number of users, increased transmission distance and unsophisticated network design. These WDM-PON systems if combined with TDM-PON can work wonders in developing a high capacity and spectral efficient network called Hybrid Passive Optical Network. While implementing practical Hybrid PON system, the major issue is to reduce the expenses associated with installation and maintenance as the expenses associated with wavelength specific optical components and frequency-stable transceivers is still quite large. A costly transmitter present in ONU operating at a distinct wavelength has actually slowed the deployment of PON. The main challenge for these networks is to eliminate the need of costly laser operating at fixed wavelength as the inventory associated with these lasers would rather be difficult to manage. Re-modulating the received wavelength, thus realizing source-free ONUs is a better alternative to cut down the cost of the whole architecture, enabling the TWDM-PON system to be more commercial, cost efficient and easily controllable. The current work carried out using OptisystemTM demonstrates TWDM- OFDM- PON with re-modulation scheme at the user side. Optical orthogonal frequency division multiplexing (OFDM) is the best competitor for future communication systems because of its inherent resistance to chromatic dispersion as well as polarization mode dispersion (PMD). OFDM modulation is used for four channels in downlink at 25 Gbps and re-modulation is done for 10 Gbps NRZ upstream channels. At ONU, the downstream optical carrier is re-modulated by upstream data using an Electroabsorption modulator (EAM). The modulated upstream traffic is then sent to the Central Office or OLT. Performance analysis in terms of BER, received power and constellation diagram optimized the largest reach for 60 Km corresponding to the reference BER of 10^{-12} . A considerable improvement over previous work was obtained for BER and the maximum reach. Simulation of single channel Passive Optical Communication Link using co-simulation with OptiSPICE software was done which allows greater control over component parameters resulting in the improvement of 14% and 99% in Q-factor and BER respectively as compared to the design simulated in Optisystem software only.