# OPTICAL VORTICES IN WAVELENGTH DIVISION MULTIPLEXED PASSIVE OPTICAL NETWORKS

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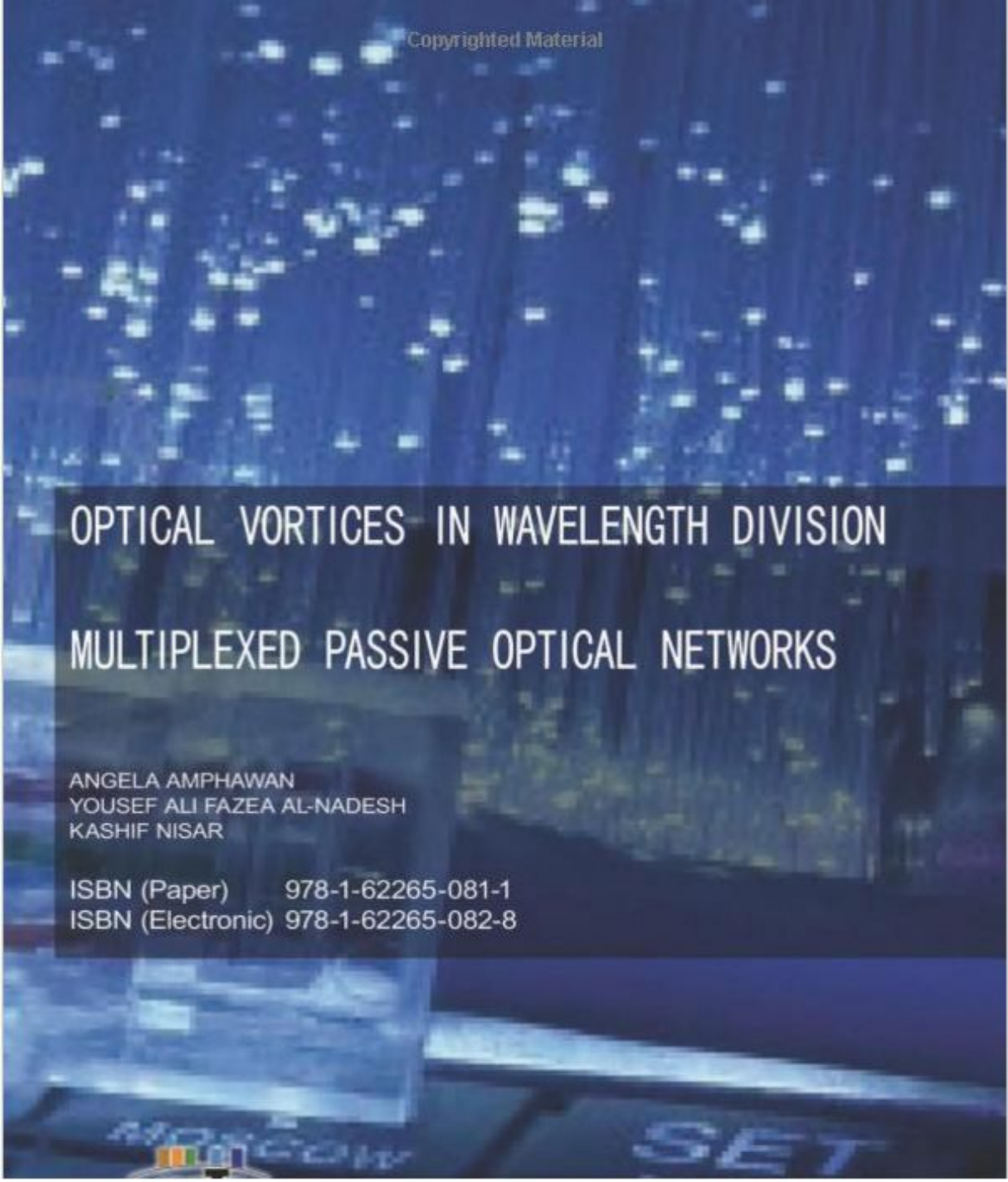
ISBN (Paper) 978-1-62265-081-1
ISBN (Electronic) 978-1-62265-082-8



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# LIST OF ABBREVIATIONS

| | |
|---|---|
| AWG | Arrayed Waveguide Grating |
| BER | Bit Error Rate |
| BPON | Broadband Passive Optical Network |
| BR | Back Reflection B |
| CO | Central Office |
| CPR | Coupled Power Ratio |
| CR | Coupling Ratio |
| CWDM | Coarse Wavelength Division Multiplexing |
| DEMUX | De-multiplexer |
| DSL | Digital Subscriber Line |
| DWDM | Dense Wavelength Division Multiplexing |
| EPON | Ethernet Passive Optical Network |
| FTTH | Fiber-To-The-Building |
| FTTC | Fiber-To-The-Curb |
| FTTH | Fiber-To-The-Home |
| FTTx | Fiber- Local Area Network |
| LED | Light Emitting Diode |
| MMF | Multi Mode Fiber |
| MUX | Multiplexer |
| NRZ | Non-Return to Zero |

| | |
|---|---|
| OLT | Optical Line Terminal |
| P2MP | Point-to-Multi-Point |
| P2P | Point-to-Point |
| PON | Passive Optical Network |
| PRBS | Pseudo Random Binary Sequence |
| SMF | Single Mode Fiber |
| TDM | Time Division Multiplexing |
| TDMA | Time Division Multiple Access |
| VCSEL | Vertical Cavity Surface Emitting Laser |
| WDM | Wavelength Division Multiplexing |

# INTRODUCTION

## LANDSCAPE

Copper cable connection has been sufficient and effective between the central office (CO) and end user for many years. Due to the rapid advance of technology, the traditional network access technology has no longer met the demand on network, which hinders the development of communication technology (Weihua Yu, 2008).

According to European Telecommunication Network Operators' Association Press corner (June 24, 2008) and Shinohara (2005) the provided bandwidth and transmissible distance on traditional access networks are subject to twisted pairs. Network managers have been left with no choice but to build up the fiber to the home (FTTH) access network. "The delivery of triple play services (video, voice and data) has become a requirement of today's network access (Park et al, 2004). The first/last mile bottleneck in between high capacity network and customer premises of small and medium size can be resolve as well by FTTH (Kitayama et al, *2006*).

Fiber structures promise to be suitable for requirements of today and also for a further increase of bandwidth demand in the future (Cheng et al, 2011). Fiber can be a candidate to provide substantially more bandwidth, carry signals further, is more reliable and secure, and has a longer life span than any other transmission

medium. Optical fiber till now is the only candidate to provide much more bandwidth than the current access network, and held the signals much farther.

Fiber networks come in many types depending on the termination point: premise (FTTP), home (FTTH), curb (FTTC) or node (FTTN). For simplicity, FTTX is commonly referred to by the majority. x stands for the termination point. In the last few years, network operators started installation of Fiber to the building (FTTB) and Fiber to the Home (FTTH) architecture. In a point to multipoint architecture, PON is the most suitable to resolve the first/last mile between the communication infrastructure between carrier and CO, head end or point-of-presence, and business or residential customer premises (green, P. 2002; Kitayama et al, *2006*). PON technology along with the adoption of WDM technology enhances the transmission efficiency and multiplexing rate by many ways in optical field (Zhuang et al, 2011).

Modal multiplexing is a promising technology for exploiting the untouched capacity of multimode fiber (MMF) for FTTH to increase the bandwidth-distance product. In modal multiplexing, specific mode or mode groups having similar propagation constants are used to transmit distinct data streams through each channel in a multimode fiber, resulting in different parts of the spectrum utilized for each channel. This research analyzes the novel use of VCSEL arrays for the independent transmission of parallel data streams over optical vortices to increase the degrees of freedom in a WDM-PON.

ISBN 9781622650811