T- and O-band Optical Communication Networks Based on Arrayed Waveguide Gratings

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Thesis Abstract

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Thesis Title

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Thesis Summary

Although optical communication networks conventionally utilize the C- and L-bands (1530 nm – 1625 nm), the T-band (1000 nm – 1260 nm) has recently been proposed as a possible wavelength resource through recent developments of quantum dot (QD) tunable lasers for this frequency band. The T-band combined with the relatively developed O-band (1260 nm – 1360 nm) offers more than 79 THz of bandwidth, which is 7 times of the C- and L-bands combined, and would be useful in realizing short-reach wavelength division multiplexing (WDM) networks with high capacity using simple transmission formats. In this study, the scalability of arrayed waveguide grating (AWG), which is a key component in WDM systems, is investigated for application in these bands. Highly scalable AWG configurations as well as large scale WDM systems employed in the T-band are proposed and demonstrated.

Chapter 1 summarizes the development of optical communications technologies in general, and the prospect of T-band optical communications in particular. The research objectives are also stated.

Chapter 2 describes in detail the operating principle of AWGs as well as cyclic AWGs, and summarizes previous works done on improving its performances. The main cause to its scalability limitation is investigated in detail. Calculations for determining the basic parameters in T-band AWG designing are also presented.

Chapter 3 explores the approach of engineering a standalone cyclic AWG with enhanced scalability. Several techniques are discussed and AWGs are fabricated and evaluated as proof of concepts.

Chapter 4 investigates a WDM access network employed in the T-band using QD lasers, QD semiconductor optical amplifiers (SOAs), and AWGs. Preliminary transmission experiments are presented as a proof of concept, and to confirm the feasibility of T-band communication using QD active devices.

Chapter 5 explores the approach of cascading multiple AWGs in realizing a highly scalable wavelength router able to support the entire T- and O-bands. Transmission and wavelength routing demonstration using QD active devices are presented as a proof concept.

Chapter 6 summarizes the results of this study and discusses unresolved issues as well as future works to be done on realizing T-band optical communications.