2007

Future development trends of optical transport network infrastructure: an infrastructual framework for metropolitan-based optical transport networks - a field test of a Chinese ISP and a case study of a Chinese Electric Power Company

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Future Development Trends of Optical Transport Network Infrastructure

**An Infrastructural Framework for Metropolitan-based Optical Transport Networks –
a field test of a Chinese ISP and a case study of a Chinese Electric Power Company**

**A thesis submitted in fulfilment of the
requirements for the award of the degree**

Master of Information and Communication Technology by Research

from

UNIVERSITY OF WOLLONGONG

by

SHENG CHEN, MInfoTech *UOW*, B.E. *ECUST*

School of Information Technology and Computer Science
2006

Certification

I, Sheng Chen, declare that this thesis, submitted in fulfilment of the requirements for the award of Masters by Research, in the School of Information Technology and Computer Science, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications as any other academic institution.

Sheng Chen

18 December 2006

Dedication

Dedicated to

my family

and to the memory of my maternal grandfather

Pinxian, Wang (1924-2006)

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Abstract

Optical Transport Networks (OTNs) play a foundational role in current and future telecommunication infrastructure. However, the development and implementation of OTNs have been restrained since the bursting of the dot-com bubble. Many service providers and large companies are confused in the development directions of future OTN infrastructure, as there are several standards organisations with differing positions. On the other hand, there is a lack of large scale testing, as well as practical implementation cases due to the emerging nature of the OTN. Therefore, this thesis develops a framework demonstrating a landscape of current and future development steps of OTN infrastructure from both theoretical and commercial standpoints. The key concept of the framework is the integration of the IP-oriented data transmission layer and the WDM-based optical transport layer. Traditional telecommunication infrastructure focuses on long-haul, point-to-point optical transmission with ultra broadband carrier capacity. Nevertheless, the next generation OTN systems will emphasis the delivery of IP-oriented multifunctional data services, instead of legacy simplex TDM-based services across a metropolitan span with sufficient reliability and efficiency. Thus, this thesis gives a systematic validation of the proposed framework from two angles. Firstly, it provides in-depth research on the evolution of protection technologies in metro core optical networks, along with a MPLS-based network fast recovery field test to validate the framework from the network reliability aspect. The field test was conducted using a large Chinese ISP test bed and demonstrated the practical performance of the advanced OTN protection technology from the perspective of a service provider. Secondly, this research presents a comprehensive case study based on a large commercial metro OTN upgrade project of Shanghai Municipal Electric Power Company (SMEPC). The outcome of the case study is an evolutional roadmap, which illustrates the infrastructural development trends of this ongoing project. The roadmap can be considered as another evaluation of the framework in terms of network efficiency from an industrial-based dimension. The outcome of this research is to clarify future development trends in OTN infrastructure for the purpose of informing the design and implementation of commercial OTN applications.

Acknowledgements

I would like to acknowledge a number of individuals who made this thesis possible.

Firstly, I would like to thank my parents, who encouraged me to do further research. I cannot find the words to express my gratitude to you for my twenty-three years of growth. This thesis is dedicated to you.

Secondly, to my supervisors, Dr Katina Michael and Ms Gene Awyzio, without whom this thesis would never have been completed. You always emphasised the importance of critical thinking in conducting real world research. I appreciate your help from the bottom of my heart.

Thirdly, a special thanks to Mr. Ma Jian, who is a systems engineer in Cisco Systems, and other companions when I was collecting data on the SMEPC project. Working with you is the most honourable and exciting experience in my life. You remain always my close friends.

Finally, thank you to the University of Wollongong, in particular the School of Information Technology and Computer Science, for partially funding my attendance at three IEEE/IEE sponsored conferences overseas. Your financial assistance was paramount in gaining timely feedback from renowned academics in the field of OTN.

Publications

The following papers were published during my candidature at the University of Wollongong. The conferences where these papers appeared were IEEE/IEE sponsored.

1. Sheng Chen, "Evolution of protection technologies in metro core optical networks", *International Conference on Networking and Services (ICNS 06)*, IEEE Computer Society Press, July 16~19, 2006, Silicon Valley, USA.

2. Sheng Chen, "An Overview on the integrated IP Optical data control plane in the Optical Transport Network", *International Conference on Communications, Circuits and Systems (ICCCAS 06)*, IEEE Press, June 25~28, 2006, Guilin, China.

3. Sheng Chen, "A case study based on an optical communication engineering project of the system upgrade for Shanghai Power Telecommunication Network (ShPTnet)", *Advances in Power System Control, Operation and Management (APSCOM 2006)*, Power and Energy section of IEE , 31 Oct~ 2 Nov, Hong Kong, China.

I have also been invited to be a member of the technical committee of *The Third International Conference on Networking and Services (ICNS 07)*.