NEXT GENERATION TRANSPORT NETWORKS

Data, Management, and Control Planes

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Preface

Are transport networks important? To society? To communications engineering as a field? What about the “fiber glut”? Isn’t bandwidth already essentially abundant and free? Despite these and other popular misconceptions, metropolitan, national and international fiber-optic based transport networks are actually one of the engineering marvels of 20th century and have become fundamental infrastructure, crucial to current and future economies and societies. Like many basic civil infrastructures, such as water, roads, power, public health, such engineered systems are almost invisible to the layperson, especially when they work nearly perfectly. But major and unexpectedly severe economic, personal, and societal impacts arise if these systems are removed even temporarily. Like these other basic infrastructures, the fiber optic transport network is now of fundamental importance to our economy, lifestyles, education, entertainment, finance and so on. Advances in computing, wireless, mobility, multi-media, HDTV, the Internet, all come to a halt if it were not for the capabilities of the underlying transport network on which they all ride. The public sometimes asks “What about wireless and cell phones, with them we don’t need fiber,” but this is based only on technical unawareness that every cell-phone call relies on fiber optic transport for trunking between switches and base stations to complete the calls. Similarly, every DSL and cable modem user of high speed Internet access is also a user of the fiber transport backbone. These “access” technologies, to which we can add phone and bank ATM machines, are best known to us all as users because it is these systems that are “in our face.” But all of them rely on a single, ubiquitous, relatively unseen transport network operating behind the scenes.

But there are also important ways in which the transport network differs from the older utility infrastructures mentioned above. Intelligence, survivability, and flexibility is one set of features, but the potential for productivity and wealth impact is an enormous differentiator. In a recent report by the Allen Consulting Group [1], it was estimated that achieving the goal of “true broadband” networking (over 10 Mbps to every home and office) can result in national productivity growth of 10-12%. They comment that this is the fundamental reason why governments should make investment in research networks, ICT, and competitive telecom their number one priority. In their view no other technology, even nanotechnology or bio-informatics is seen as having such a direct and measurable impact on national and global productivity. This means jobs. This means wealth creation. This means a plethora of still unimagined new educational, business, research, recreational, and entertainment possibilities. Transport networks are thus of fundamental importance to a society that wants to reach high and grasp this “prize.”

There are many different ways to approach the topic of transport networks. Books typically focus on either the transport (data) plane or the control and management planes, depending the authors’ expertise. In order to reduce overhead costs and increase the speed and flexibility of offering new services, however, carriers continually look to automate their operations, administration, maintenance, and provisioning (OAM&P) tasks. The result is an increasingly closer linkage between the transport, management, and control plane technologies. New transport plane technologies are unlikely to be adopted unless they offer OAM&P savings, and new OAM&P tools are unlikely to be adopted unless they can work with the current transport plane infrastructure. One of the objectives of this book is to provide a comprehensive, balanced overview of the transport, management, and control plane technologies. The book is organized with one section devoted to each of these three planes.

Another objective of this book is to provide a useful tutorial and reference information for current and next generation telecommunications network technologies. Since it is not practical for carriers to replace their existing infrastructure, even new equipment and network deployments will need to be compatible with the existing technologies such as SONET/SDH. Both the boom and bust in the telecommunications industry spawned a number of new technologies that are expected to become important in the coming years. Many of these technologies are not covered in existing books. This book provides a detailed tutorial overview of these new technologies, seeking to put them into the proper context with respect to interworking with existing networks and technologies. Examples include the Generic Framing Procedure (GFP), the Link Capacity Adjustment Scheme (LCAS), the

Resilient Packet Ring (RPR) protocol, Automatic Switched Optical Network (ASON), and XML/SOAP (Simple Object Access Protocol) based management technologies. Since TL1 and OSMINE are important for many North American carriers and vendors, a brief discussion of both is included in the management section. Also, discussion of multi-stage switching used in modern digital cross-connects and other switching equipment can be found in Chapter 2 as part of transport technologies. The critical, related topic of network protection is also covered extensively in Chapter 8 to round the book.

What do the four of us especially have to offer on the topic? The authors that Manohar assembled for this book have each been recognized by their peers for their contributions in their respective areas. Each of us has more than 20 years of experience in telecommunications research, product development, and/or standards. Steve and Lakshmi are both recipients of the Committee T1 Alvin Lai Outstanding Achievement Award for their standards contributions. Wayne is an IEEE Fellow for his contributions to survivable and self-organizing broadband transport networks. (More complete biographies of each author appear near the end of the book prior to the Index.) We divided the chapter responsibilities as follows: Manohar – Chapters 2, 7 and 9; Steve – Chapters 1, 3, and 4 (and contributing to 8); Lakshmi – Chapters 5 and 6; and Wayne – Chapter 8.

Due to the multiple authors, the book may have some inconsistencies in style, despite our best efforts to harmonize. If our readers identify any editorial or other types of errors that escaped us, please bring them to our attention - we will update our companion website with corrections to typographical or technical errors as soon as we discover them. This being a very detailed book - we are bound to have some errors and the companion website should be helpful for those looking for corrections. For any questions related to this book, please email Steve Gorshe (sgorshe@ieee.org).

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[1] Allen Consulting Group, "True Broadband: Exploring the economic impacts," An Ericsson contribution to public policy debate, September 2003, available online: http://www.ericsson.com.au/broadband/true_broadband.asp

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