

Tutorial 1: Optical Networking: Recent Developments, Issues, and Trends

Raj Jain

Nayna Networks and The Ohio State University

The year 2002 has brought a turn around in the optical networking. Several technologies that were hot until last year are no longer so. Beginning with networking trends and recent DWDM records, a sample of recent optical networking products and applications will be presented. Key technological developments that made optical networking a hot topic will be explained. Upcoming optical technologies will also be briefly described. The role of 10 Gigabit Ethernet standard in unifying the local and wide area networks will be presented.

While Ethernet is trying to replace SONET/SDH in the carrier networks, SONET itself is changing to better meet the new demands of data traffic. The features that make Next Generation SONET a tough competitor for Ethernet in the carrier networks will be explained. The latest debate on all-optical switching along with the introduction of IP control plane will be presented. Multiprotocol Label Switching (MPLS), Multiprotocol Lambda Switching, and Generalized Multiprotocol Label Switching (GMPLS) will be explained. New standards activities to change IP protocols to enable optical networking will be presented.

Syllabus

- Networking Trends: Life Cycles of Technologies, Traffic vs Capacity Growth, Ethernet Everywhere, Technology Failures vs Successes, LAN-WAN Convergence, Ethernet vs SONET, Everything over IP.
- Carrier Networking Technologies: SONET, SONET Components, Protection, Rings, Virtual Concatenation, Generic Framing Protocol (GFP), Link Capacity Adjustment Scheme (LCAS), SDH, OTN.
- Gigabit and 10 Gb Ethernet: Distance-B/W Principle, 10 GbE: Key Features, PMD Types, 1G/10G Ethernet Switch Features, Flow Control, Link Aggregation, Jumbo Frames, Resilient Packet Ring (RPR), Beyond 10 GbE.
- Recent Developments in Optical Networking: Recent DWDM Records and Product Announcements, All-Optical Networking, IP over DWDM, Changes in IP, UNI, ASON, MPLS, MPL(lambda)S, GMPLS, Martini Drafts, Upcoming optical technologies.

Raj Jain is a Co-founder and Chief Technology Officer of Nayna Networks, Inc.—an optical systems company in Milpitas, CA. He is currently on a leave of absence from Ohio State University in Columbus, Ohio, where he is a Professor of Computer and Information Sciences.

He is a Fellow of IEEE and a Fellow of ACM. He is currently a Distinguished Lecturer for the IEEE Communications Society. He is on the Editorial Boards of *Computer Networks: The International Journal of Computer and Telecommunications Networking*, *Computer Communications (UK)*, *Journal of High Speed Networks (USA)*, *Mobile Networks and Applications*, and *International Journal of Wireless and Optical Communications (Singapore)*.

Raj Jain is on the Board of Technical Advisors to EdgeNet Communications Corporation, Burlingame, CA, Corona Networks, Inc., Milpitas, CA, Chip Engines, Inc., Sunnyvale, CA, Teradiant Networks, San Jose, CA, Tivre Networks, San Jose, CA, Irvine Networks, Irvine, CA, Beacon Telco, Boston, MA, Avatar Networks, Fremont, CA, Rhonet Systems, Columbus, OH, and on the Board of Research Advisors to iBEAM Broadcasting Corporation, Sunnyvale, CA. Previously, he was also on the Board of Advisors to Nexabit Networks, Westboro, MA, which was acquired by Lucent Corporation and to Amber Networks, Fremont, CA, which was acquired by Nokia.