

Bibliography

- [1] Autonomous System: [http://en.wikipedia.org/wiki/Autonomous_system_\(Internet\)](http://en.wikipedia.org/wiki/Autonomous_system_(Internet))
- [2] Jennifer Rexford. Evolving Towards a Self Managing Network. Self Managing Networks Summit. June 2005.
<http://research.microsoft.com/en-us/um/redmond/events/smns Summit/techprogram.aspx>
- [3] ITU-T, Generic Functional Architecture of Transport Networks, Recommendation G.805, 2000.
- [4] Greg Bernstein, Bala Rajagopalan, Debanjan Saha. Optical Network Control. ISBN 0201753014, 2004.
- [5] Vishnu Shukla. Optical Control Plane Deployment – Lessons Learned.OIF Workshop on ASON/GMPLS Implementations, Oct 2006
<http://www.oiforum.com/public/documents/061016-Verizon.pdf>
- [6] Tier 1 and Tier 2 ISPs: http://en.wikipedia.org/wiki/Tier_1_network
- [7] Cisco Visual Networking Index: Forecast and Methodology, 2010 – 2015.
http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/w hite_paper_c11-481360.pdf
- [8] Personal communication with Curtis Villamizar, Infinera.
- [9] Charles Fraleigh, Fouad Tobagi, and Christophe Diot. Provisioning IP Backbone Networks to Support Latency Sensitive Traffic. Infocomm 2003.
- [10] Benjamin Chen, Fouad Tobagi. Optical network design to minimize switching and transceiver equipment costs. Optical Switching and Networking 2009.

- [11] Saurav Das, Guru Parulkar, Nick McKeown. Unifying Packet and Circuit Switched Networks. Below IP Networking Workshop in association with Globecom, November 2009.
- [12] Nick McKeown, Tom Anderson, Hari Balakrishnan, Guru Parulkar, Larry Peterson, Jennifer Rexford, Scott Shenker, and Jonathan Turner. OpenFlow: Enabling Innovation in Campus Networks. ACM SIGCOMM Computer Communication Review, Volume 38, Number 2, April 2008.
- [13] Saurav Das, Guru Parulkar, Nick McKeown. Simple Unified Control for Packet and Circuit Networks. Future Global Networks Workshop, IEEE Photonics Society Summer Topicals, June 2009.
- [14] OpenFlow <http://www.openflow.org/index.php>
- [15] Natasha Gude, Teemu Koponen, Justin Pettit, Ben Pfaff, Martin Casado, Nick McKeown, Scott Shenker. NOX: Towards an Operating System for Networks. ACM SIGCOMM Computer Communication Review, July 2008.
- [16] Nick McKeown. Software Defined Network and OpenFlow. Structure 2010. <http://gigaom.com/2010/06/23/structure-2010-reinventing-the-internet-get-ready-for-software-defined-networks/>
- [17] Scott Shenker, Martin Casado, Teemu Koponen, Nick McKeown et al. The Future of Networking and the Past of Protocols. June 2011. http://www.slideshare.net/martin_casado/sdn-abstractions?from=ss_embed
<http://opennetsummit.org/talks/shenker-tue.pdf>
- [18] Martin Casado. Architectural Support for Security Management in Enterprise Networks. PhD Thesis, Stanford University, August 2007.
- [19] E. Mannie. Generalized Multiprotocol Label Switching (GMPLS) Architecture. IETF RFC 3945, Oct. 2004.
- [20] IETF CCAMP working group <http://datatracker.ietf.org/wg/ccamp/charter/>
- [21] ITU-T. Architecture for the Automatically Switched Optical Network (ASON). Rec. G.8080/Y.1304, Nov. 2001 (and rev., Jun. 2006).
- [22] Optical Internetworking Forum <http://www.oiforum.com/public/impagreements.html#UNI>

- [23] Adrian Farrel, Igor Bryskin. GMPLS Architecture and Applications. ISBN 0120884224, 2006.
- [24] Ayan Banerjee, John Drake, Jonathan Lang, Brad Turner, Daniel Awduche, Lou Berger, Kireeti Kompella, Yakov Rekhter. Generalized Multiprotocol Label Switching: An Overview of Signaling Enhancements and Recovery Techniques. IEEE Communications Magazine, July 2001.
- [25] Ayan Banerjee, John Drake, Jonathan Lang, Brad Turner, Kireeti Kompella, Yakov Rekhter. Generalized Multiprotocol Label Switching: An Overview of Routing and Management Enhancements. IEEE Communications Magazine, January 2001.
- [26] Monique J. Morrow, Mallik Tatipamula, Adrian Farrel. GMPLS: The Promise of the Next-Generation Optical Control Plane. Guest Editorial, IEEE Communications Magazine, July 2005.
- [27] Opinion: http://www.lightreading.com/document.asp?doc_id=208072
- [28] OpenFlow Switch Specification v1.0
<http://www.openflow.org/documents/openflow-spec-v1.0.0.pdf>
- [29] Saurav Das, Guru Parulkar, Nick McKeown. Why OpenFlow/SDN Can Succeed Where GMPLS Failed. European Conference on Optical Communications (ECOC), September 2012.
- [30] Spectral grids for WDM applications: ITU-T G.694.1
<http://www.itu.int/rec/T-REC-G.694.1-200206-I/en>
- [31] Link Layer Discovery Protocol (LLDP) IEEE 802.1AB
- [32] D. Katz, D. Ward. Bidirectional Forwarding Detection (BFD). RFC 5580.
- [33] Infinera DTN: <http://www.infinera.com/products/dtn.html>
- [34] Fujitsu Flashwave 9500: <http://www.fujitsu.com/us/services/telecom/products/>
- [35] pac.c webpage: <http://www.openflow.org/wk/index.php/PAC.C>
- [36] Experimental extensions to the OpenFlow v1.0 in support of circuit switching (v0.3)
http://www.openflow.org/wk/images/8/81/OpenFlow_Circuit_Switch_Specification_v0.3.pdf
- [37] Vinesh Gudla, Saurav Das, Anujit Shastri, Guru Parulkar, Shinji Yamashita, Leonid Kazovsky, Nick McKeown. Experimental Demonstration of OpenFlow Control of

Packet and Circuit Switches. Optical Fiber Communications / National Fiber Optics Engineers Conference (OFC/NFOEC), March 2010.

- [38] Demo video: OpenFlow control of packet and wavelength switches
http://openflow.smugmug.com/OpenFlow-Videos/pacc-demos/11583800_tCEwT#895139512_E8jA3-A-LB
- [39] OpenFlow Reference Switch: <http://www.openflow.org/wp/downloads/>
- [40] Quad-Port Gigabit NIC
http://netfpga.org/foswiki/bin/view/NetFPGA/OneGig/Guide#Reference_NIC_Walk_through
- [41] NetFPGA website: <http://netfpga.org/>
- [42] OpenFlow v1.0 Implementation in NetFPGA
<http://netfpga.org/foswiki/bin/view/NetFPGA/OneGig/OpenFlowNetFPGA100>
- [43] Trendnet GE-SFP convertor
http://www.trendnet.com/products/proddetail.asp?prod=110_TFC-1000MGB&cat=22
- [44] Ciena CoreDirector: <http://www.ciena.com/products/core-director/>
- [45] SuperComputing2009 demo: <http://www.openflow.org/wp/2009/11/openflow-demo-at-sc09/>
- [46] Saurav Das, Guru Parulkar, Preeti Singh, Daniel Getachew, Lyndon Ong, Nick McKeown. Packet and Circuit Network Convergence with OpenFlow. Optical Fiber Communications / National Fiber Optics Engineers Conference (OFC/NFOEC), March 2010.
- [47] ENVI <http://www.openflow.org/wp/gui/>
- [48] Quanta LB4G/ Pronto 3240: <http://www.prontosys.net/test/pronto3240.htm>
- [49] Indigo: OpenFlow for Hardware Switches
<http://www.openflowhub.org/display/Indigo/Indigo+-+OpenFlow+for+Hardware+Switches>
- [50] Rob Sherwood, Glen Gibb, Kok-Kiong Yap, Guido Appenzeller, Martin Casado, Nick McKeown, Guru Parulkar. Can the Production Network Be the Testbed? Operating System Design and Implementation (OSDI), October 2010.
- [51] NOX distribution: http://noxrepo.org/noxwiki/index.php/Main_Page

- [52] GEC 8 <http://groups.geni.net/geni/wiki/GEC8DemoSummary>
- [53] Saurav Das, Yiannis Yiakoumis, Guru Parulkar, Preeti Singh, Dan Getachew, Premal Dinesh Desai, Nick McKeown, Application-Aware Aggregation and Traffic Engineering in a Converged Packet-Circuit Network, OFC/NFOEC, March 2011.
- [54] Yiannis Yiakoumis, Dynamic Flow Aggregation
http://www.youtube.com/watch?feature=player_embedded&v=nFzpdXl521Y
- [55] http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers
- [56] Personal communication with Stuart Elby, Verizon.
- [57] Christopher Metz. Ingredients for Better Routing? Read the Label. IEEE Internet Computing, Vol. 2, Issue 5, September/October 1998.
- [58] Daniel Awduche, Yakov Rekhter. Multiprotocol Lambda Switching: Combining MPLS Traffic Engineering Control with Optical Crossconnects. IEEE Communications Magazine, March 2001.
- [59] Lines of code wiki http://en.wikipedia.org/wiki/Source_lines_of_code
- [60] CLOC <http://cloc.sourceforge.net/>
- [61] PBR http://en.wikipedia.org/wiki/Policy-based_routing
- [62] RFC4124 – DiffServ-aware MPLS Traffic Engineering
- [63] Quagga project: <http://www.quagga.net/about.php>
- [64] IST Tequila project: <http://www.ist-tequila.org/>
- [65] RSVP-TE Daemon: <http://dsmpls.atlantis.ugent.be/>
- [66] IST-MUPBED project: <http://www.ist-mupbed.org/>
- [67] GMPLS UNI: <http://sourceforge.net/projects/rsvp-agent/>
- [68] DRAGON: <http://dragon.maxgigapop.net/twiki/bin/view/DRAGON/WebHome>
- [69] DRAGON LSR: <http://dragon.east.isi.edu/twiki/bin/view/DRAGON/VLSR>
- [70] <http://www.networkworld.com/news/2008/041708-cisco-juniper-operating-systems.html>
- [71] http://www.openflow.org/wk/index.php/Aggregation_on_a_Converged_Packet-Circuit_Network

- [72] <http://www.oiforum.com/public/documents/OIF-UNI-02.0-Common.pdf>
- [73] Saurav Das. Virtualizing the Transport Network - Why it Matters and How OpenFlow Can Help. OFELIA Workshop on OpenFlow extensions towards multi-layer and multi-domain networks. European Conference on Optical Communications (ECOC), September 2011.
- [74] <http://www.networkworld.com/news/2007/051607-cisco-routers-major-outage-japan.html>
- [75] Jean-Philippe Vasseur, Mario Pickavet, Piet Demeester. Network Recovery: Protection and Restoration of Optical, SONET-SDH, IP, and MPLS. ISBN 012715051X, 2004.
- [76] Personal communication with Ori Gerstel, Cisco.
- [77] Guangzhi Li, Dongmei Wang, Jennifer Yates, Robert Doverspike, Charles Kalmanek. IP over Optical Cross-Connect Architectures. IEEE Communications Magazine, February 2007.
- [78] Rocketfuel Project: <http://www.cs.washington.edu/research/networking/rocketfuel/>
- [79] Jane Simmons. Optical Network Design and Planning. ISBN-10: 0387764755, 2008.
- [80] KMI Research. North American National and Regional Fiber Optic Long Haul Routes Planned and In Place. June 2002.
- [81] A. Medina, N. Taft, K. Salamatian, S. Bhattacharya, C. Diot. Traffic Matrix Estimation: Existing Techniques and New Directions. SIGCOMM 2002.
- [82] Ralf Huelsermann, Matthias Gunkel, Clara Muesburger, Dominic Schupke. Cost Modeling and Evaluation of Capital Expenditures in Optical Multilayer Networks. Journal of Optical Networking, Vol. 7, No. 9, September 2008.
- [83] R. Batchellor, O. Gerstel. Cost Effective Architectures for Core Transport Networks. Optical Fiber Communications Conference, OFC 2006.
- [84] Sudipta Sengupta, Vijay Kumar, Debanjan Saha. Switched Optical Backbone for Cost-Effective Scalable Core IP Networks. IEEE Communications Magazine, June 2003.
- [85] Ciena: http://www.lightreading.com/document.asp?doc_id=182351
- [86] Juniper-NSN: http://www.lightreading.com/document.asp?doc_id=178407

- http://www.lightreading.com/document.asp?doc_id=193988
- [87] Alcatel-Lucent: http://www.lightreading.com/document.asp?doc_id=181849
- [88] Ericsson: http://www.lightreading.com/document.asp?doc_id=187674
- [89] http://www.heavyreading.com/details.asp?sku_id=2464&skuitem_itemid=1216
- [90] http://www.lightreading.com/document.asp?doc_id=174032
- [91] ITU Recommendation G.709. Interfaces for the Optical Transport Network
- [92] Eric Osborne, Ajay Simha. Traffic Engineering with MPLS. ISBN-10: 1587050315, July 2002.
- [93] ATM opinion: <http://staff.washington.edu/gray/papers/whynotatm.html>
- [94] Guangzhi Li, Dongmei Wang, Charles Kalmanek, Robert Doverspike. Efficient Distributed Path Selection for Shared Restoration Connections. IEEE/ACM Transactions on Networking, Vol. 11. No. 5, Oct 2003.
- [95] Matthieu Clouqueur, Wayne Grover. Quantitative Comparison of End-To-End Availability of Service Paths in Ring and Mesh Restorable Networks. National Fiber Optics Engineers Conference, NFOEC 2003 (see footnote #1)
- [96] ODU0 and ODUflex: <http://documents.exfo.com/appnotes/anote242-ang.pdf>
- [97] Pierre Francois, Clarence Filsfils, John Evans, Olivier Bonaventure. Achieving Sub-Second IGP Convergence in Large IP Networks. SIGCOMM CCR, Vol. 35, No. 2, July 2005.
- [98] Panita Pongpaibool, Robert Doverspike, Matthew Roughan, Joel Gottlieb. Handling IP Traffic Surges via Optical Layer Reconfiguration. Optical Fiber Communications Conference, OFC 2002.
- [99] Cisco CRS-1:
http://www.cisco.com/en/US/prod/collateral/routers/ps5763/prod_brochure0900aecd800f8118.pdf
- [100] Ciena 5400 series: <http://www.ciena.com/products/category/packet-optical-switching/>
- [101] <http://michaelbluejay.com/electricity/cost.html>
- [102] <http://www.pge.com/tariffs/electric.shtml>
- [103] <http://en.wikipedia.org/wiki/OAMP>

- [104] Operator Hourly Rate:
http://www.payscale.com/research/US/Job=Network_Control_Technician/Hourly_Rate
- [105] Rack Rentals:
http://www.intercom.com/index.php?option=com_content&view=article&id=75&Itemid=85
- [106] RFC 5036: LDP Specification
- [107] MPLS with OpenFlow and Software Defined Networking
http://www.openflow.org/wk/index.php/MPLS_with_OpenFlow/SDN
- [108] Saurav Das, Ali Reza Sharafat, Guru Parulkar, Nick McKeown, MPLS with a Simple OPEN Control Plane, invited talk at Packet Switching Symposium at OFC/NFOEC'11, Los Angeles, March 2011.
- [109] Ali Reza Sharafat, Saurav Das, Guru Parulkar, Nick McKeown, MPLS-TE and MPLS VPNs with OpenFlow, demonstration at SIGCOMM, Toronto, August 2011.
- [110] Juniper Application Note: Using MPLS-Autobandwidth
http://s-tools1.juniper.net/solutions/literature/app_note/350080.pdf
- [111] RFC 4090: Fast Re-Route extensions to RSVP-TE for LSP Tunnels
- [112] RFC 2205: Resource Reservation Protocol (RSVP)
- [113] RFC 5921: A Framework for MPLS in Transport Networks (MPLS-TP)
- [114] RFC 5586: MPLS Generic Associated Channel
- [115] RFC 2475: An Architecture for Differentiated Services.
- [116] http://www.cisco.com/en/US/docs/ios/12_2s/feature/guide/fsdserv3.html
- [117] OpenFlow Specification v.1.1
<http://www.openflow.org/documents/openflow-spec-v1.1.0.pdf>
- [118] Open vSwitch: <http://openvswitch.org/>
- [119] http://openvswitch.org/cgi-bin/gitweb.cgi?p=openvswitch;a=blob_plain;f=PORTING;hb=HEAD
- [120] <http://yuba.stanford.edu/git/gitweb.cgi?p=movs.git;a=summary>
- [121] <http://www.openflow.org/wk/index.php/OFTestTutorial>

- [122] <http://yuba.stanford.edu/git/gitweb.cgi?p=mofest.git;a=summary>
- [123] <http://yuba.stanford.edu/git/gitweb.cgi?p=mnox.git;a=summary>
- [124] Mininet: <http://yuba.stanford.edu/foswiki/bin/view/OpenFlow/Mininet>
- [125] Bob Lantz, Brandon Heller, and Nick McKeown. A Network on a Laptop: Rapid Prototyping for Software-Defined Networks. 9th ACM Workshop on Hot Topics in Networks, October 20-21, 2010, Monterey, CA
- [126] <http://en.wikipedia.org/wiki/MPLS-TP>
- [127] RFC 5654: Requirements of an MPLS-TP – Requirement #48
- [128] Glenn Wellbrock. The Convergence of L1/2/3 Functionality in Next Generation Network Elements: A Carrier’s Perspective. OFC/NFOEC 2011.
- [129] Teemu Koponen, Martin Casado, Natasha gude, Jeremy Stirbling, Leon Poutievski, Min Zhu, Rajiv Ramanathan, Yuichiro Iwata, Hiroaki Inoue, Takayuki Hama, Scott Shenker. Onix: A Distributed Control Platform for Large-scale Production Networks. Operating Systems Design and Implementation (OSDI), October 2010.
- [130] Martin Casado. Performance, Scalability and Reliability in OpenFlow Networks. A Primer...Stanford CS 244 lecture, Winter 2011.
- [131] Amin Tootoonchian, Yashar Ganjali. A Distributed Control Plane for OpenFlow Networks. In Proceedings of NSDI Internet Network Management Workshop/Workshop on Research on Enterprise Networking (INM/WREN), April 2010.
- [132] Jeffrey C. Mogul , Jean Tourrilhes , Praveen Yalagandula , Puneet Sharma , Andrew R. Curtis , Sujata Banerjee, DevoFlow: cost-effective flow management for high performance enterprise networks, Proceedings of the Ninth ACM SIGCOMM Workshop on Hot Topics in Networks, p.1-6, October 20-21, 2010, Monterey, California.
- [133] Nate Foster, Rob Harrison, Matthew L. Meola, Michael J. Freedman, Jennifer Rexford, and David Walker. Frenetic: A high-level language for OpenFlow Networks. Proc. Workshop on Programmable Routers for the Extensible Services of Tomorrow, December 2010.
- [134] Open Networking Foundation (ONF) <http://opennetworkingfoundation.org>

- [135] G. Wang, D. G. Andersen, M. Kaminsky, D. Papagiannaki, T. S. E. Ng, M. Kozuch, and M. Ryan. c-Through: Part-time optics in data centers. In ACM SIGCOMM, Aug. 2010.
- [136] N. Farrington, G. Porter, S. Radhakrishnan, H. Bazzaz, V. Subramanya, Y. Fainman, G. Papen, and A. Vahdat. Helios: A hybrid electrical/optical switch architecture for modular data centers. In ACM SIGCOMM, Aug. 2010.
- [137] Hamid Hajabdolali Bazzaz, Malveeka Tewari, Guohui Wang, George Porter, T. S. Eugene Ng, David G. Andersen, Michael Kaminsky, Michael A. Kozuch, Amin Vahdat. Switching the Optical Divide: Fundamental Challenges for Hybrid Electrical/Optical Datacenter Networks. ACM SOCC 2011.
- [138] Albert Greenberg, Gisli Hjalmytsson, David A. Maltz, Andy Meyers, Jennifer Rexford, Geoffrey Xie, Hong Yan, Jibin Zhan, and Hui Zhang. "A clean slate 4D approach to network control and management," ACM SIGCOMM Computer Communications Review, October 2005
- [139] Nick Feamster, Hari Balakrishnan, Jennifer Rexford, Aman Shaikh, and Jacobus van der Merwe, "The case for separating routing from routers," Proc. ACM SIGCOMM workshop on Future Directions in Network Architecture, August 2004.
- [140] Generic Switch Management Protocol (GSMP)
<http://datatracker.ietf.org/wg/gsmpp/charter/>
- [141] RFC 3292: GSMP v3
- [142] Forwarding and Control Element Separation (ForCES)
<http://datatracker.ietf.org/wg/gsmpp/charter/>
- [143] Controller performance comparison
http://www.openflow.org/wk/index.php/Controller_Performance_Comparisons

