Radhakrishna Valiveti

System Architect

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Summary

- Extensive experience in optical transport network architecture (e.g. OTN, SONET), network element architecture, design, and implementation of carrier-grade transmission products.
- Extensive experience in developing requirements for ASICs/FPGAs used in OTN network elements
- Regular contributor to ITU-T SG15 in the following areas: OTN Equipment, OTN Signal Formats & OTN Network Element Management.
- Co-authored IETF drafts related to GMPLS Extensions to support Beyond 100G OTN links, FlexE connection signaling.
- Hands on experience with the design & implementation of protocol software for Layers 2-5 of the OSI stack (e.g. LAPD, CLNP, IS-IS, ES-IS, TP4), IP/ATM, MPLS based L3VPNs
- In-depth understanding of networking protocols, and their applications

Work Experience

Oct 2006 – Present

System Architect (Distinguished Engineer), *Infinera Corp*, Sunnyvale, USA

- Developed (white-box) requirements for various generations of Infinera ASICs in these areas: G.709 OTN tributary interfaces, FlexE, FlexO, Infinera Proprietary Signals/Formats (used on the line-side interfaces), Overhead processing, Alarm Propagation. Supported the ASIC development team through all stages of development to ensure full compliance to applicable standards.
- Developed requirements for Layer 1 encryption (AES-GCM, AES-CTR modes) in INFN ASICs: at the ODU layer (in mapper ASIC) & bulk encryption (DSP ASIC). These requirements addressed the following aspects: algorithmic compliance, support for minimizing the cryptographic boundary (for FIPS 140-2 validation)
- Developed the End-2-End mechanism for Shared Mesh Protection (SMP) for ODU connections. This mechanism has been presented in various contributions to ITU-T SG15 Q9 (OTN Equipment). This work contributed to the ITU-T recommendation G.783.3.
- Defined the mechanism to support hitless ODUFlex resizing (specific to DTN-X networks). Working with ASIC & Software teams to get the mechanism implemented.
- Developed requirements related to control channel realization (e.g. trib & line side GCC channels) for several generations of Infinera's Network Elements.
- Developed DTN-X Network Architecture Specification. This specification takes a top-down view of DTN-X networks, and contains an in-depth coverage of these aspects: Layers (i.e. SignalsFormats), Adaptations, OTN atomic function realization, and Defect propagation. This document is used as the basis to derive requirements for the ASICsFPGAs.
- Developed DTN Network Element requirements for these areas: GMPLS, L1VPN, Datapath recovery (protection, and restoration).

May 2005 – Oct 2006

System Architect, *Fujitsu Network Communications*, Richardson, USA

- Participated in the architecture definition of the FW9500 hybrid platform that supported TDM & Packet services (e.g. Point-to-Point Ethernet, VPLS) based on MPLS Pseudowires
- Developed System Level Requirements for VPLS/H-VPLS, Control Plane High-Availability.

Dec 2003 – May 2005 **Contractor (SW development)**, *Nortel*, Richardson, USA

- RSVP-TE for GGSN node: Wrote Functional Spec, Detailed Design & Designer Test plan. Worked on design changes support for a redundant control processor.
- BGP/MPLS VPNs for GGSN node: Wrote the Designer Test plan, Added support for MPLS & VRF historical statistics.

Oct 2003 – Nov 2003 **Contractor (SW development)**, *Avici*, Billerica, USA

- Resolved software issues related to: PPP, SONET Link Aggregation, MPLS LSP Protection (Fast Reroute).

Dec 2002 – May 2003 **Contractor (Systems Arch)**, *Ciena*, San Jose, USA

- Specified the functional requirements for the CoreDirector features: Connection Test Access, Connection Loopback, OSI/DCC, 1GE/10GE tunneling with SONET/SDH VCAT/LCAS).

May 1998 – Aug 2002 **Systems Architect**, *Fujitsu Network Communications*, Richardson, USA

- Part of the team tasked with developing the architecture for the first TDM/Packet Hybrid. Primarily responsible for Layer 2 and Layer 3 VPN support over MPLS networks.
- Investigated protection of Point-to-Multipoint (P2MP, or multicast) MPLS LSPs, for the purposes of offering a fully protected TLS service.
- Specified the optical UNI (O-UNI) interface between an MPLS LER (Label Edge Router), and the Optical Network Element (ONE).
- Specification of Network Element Management Information models, and protocol specific realizations (in terms of TL-1 and SNMP)

Jun 1984 – May 1998 **Member of Scientific Staff**, *Nortel*, Ottawa, Canada

- Part of a team defining the End-to-end architecture of a system offering Broadband access.
- Developed various features for the HFC Cable Modem. E.g. Lightweight ATM signaling protocol, IP NAT (to support multiple attached PCs), Software Upgrade
- Designed & Developed software for the following layers in the OSI Stack: LAPD (with QoS), Layer 3 (CLNP, IS-IS, ES-IS), and Layer 5 (Session Layer). Implemented performance enhancements at Layers 2 through 4 of the OSI stack
- Implemented various STREAMs modules (e.g. TPI, Line Discipline Module, Serial Drivers)
- Implemented a bridge for interconnecting IBM Token Ring LANs via a Frame Relay WAN
- Analysis, Design, and Implementation of transparent access to (XMS based) remote file servers (via X.25 networks), file transfer utilities.

Apr 1981 – Jun 1984 **SW Designer**, *Micom*, Montreal, Canada

- Designed and Implemented software for data communication protocols (e.g. BISYNC, SDLC, ISO Transport Layer 4/0, Session/Transport layers for Teletext service)

Education

Sep 1987 – Jan 1991 **Ph.D. (Electrical Engineering)**, *Carleton University*, Ottawa, Canada

Jan 1979 – Apr 1981 **M. Sc. (Computer Science)**, *McGill University*, Montreal, Canada

Jul 1973 – May 1978 **B. Tech. (Electronics and Electrical Communication)**, *Indian Institute of Technology*, Kharagpur, India

Honors/Awards

May 2009 Infinera President's Award.

May 1991 Carleton University Medal for Outstanding Graduate Work at the Ph.D. level. Awarded the best thesis of the year

Sep 1987 – Jan 1991 Post-Graduate Scholarship from Nortel. Awarded for the duration of the Ph.D. program

Sep 1987 – Aug 1990 Post-Graduate Scholarship from the Natural Sciences and Engineering Research Council (NSERC) of Canada. Awarded for the duration of the Ph.D. program

May 1978 President of India silver medal. Awarded for best academic performance in the graduating batch of the B. Tech program in the Electronics & Communication Engineering (ECE) department

Jun 1973 Stood fourth in the state of West Bengal in Higher Secondary Examination. The state recognizes the top ten students who appeared for the Higher Secondary Board Examination every year.

Publications

Journal Publications

[1] R. S. Valiveti and B. J. Oommen. "Adaptive Linear list Reorganization Under a Generalized Query System". In: *Journal of Applied Probability* 32 (1995), pp. 793–804.

[2] R. S. Valiveti and B. J. Oommen. "Determining Stochastic Dependence for Normally Distributed Vectors Using the Chi-Squared Metric". In: *Pattern Recognition* 26.6 (1993), pp. 975–987. ISSN: 0031-3203. DOI: https://doi.org/10.1016/0031-3203(93)90062-2. URL: http://www.sciencedirect.com/science/article/pii/0031320393900622.

[3] R. S. Valiveti and B. J. Oommen. "Self-organizing Doubly-linked Lists". In: *Journal of Algorithms*, 14.6 (1993), pp. 88–114. ISSN: 0196-6774. DOI: https://doi.org/10.1006/jagm.1993.1005. URL: http://www.sciencedirect.com/science/article/pii/S0196677483710059.

[4] R.S. Valiveti and B.J. Oommen. "On using the chi-squared metric for determining stochastic dependence". In: *Pattern Recognition* 25.11 (1992), pp. 1389–1400. ISSN: 0031-3203. DOI: https://doi.org/10.1016/0031-3203(92)90151-8. URL: http://www.sciencedirect.com/science/article/pii/0031320392901518.

[5] B. Oommen and R. Valiveti. "Recognizing Sources of Random Strings". In: *IEEE Transactions on Pattern Analysis & Machine Intelligence* 13.04 (Apr. 1991), pp. 386–394. ISSN: 0162-8828. DOI: 10.1109/34.88575.

[6] B. J. Oommen, R. S. Valiveti, and J. R. Zgierski. "An adaptive learning solution to the keyboard optimization problem". In: *IEEE Transactions on Systems, Man, and Cybernetics* 21.6 (Nov. 1991), pp. 1608–1618. ISSN: 0018-9472. DOI: 10.1109/21.135704.

[7] Stavros A. Argyropoulos, Radhakrishna S. Valiveti, and Bernard M. Closset. "A Facility for Local and Remote Acquisition and Data Process Control in Metallurgy". In: *Journal of Metals* 35.10 (Oct. 1983), pp. 30–35. ISSN: 1543-1851. DOI: 10.1007/BF03338387. URL: https://doi.org/10.1007/BF03338387.

Conference Publications

[1] A. Sadasivarao et al. "Demonstration of Advanced Open WDM Operations and Analytics, Based on an Application-Extensible, Declarative, Data Model Abstracted Instrumentation Platform". In: *2019 Optical Fiber Communications Conference and Exhibition (OFC)*. Mar. 2019, pp. 1–3.

[2] M. Anand, R. Subrahmaniam, and R. Valiveti. "POINT: An Intent-Driven Framework for Integrated Packet-Optical In-Band Network Telemetry". In: *2018 IEEE International Conference on Communications (ICC)*. May 2018, pp. 1–6. DOI: 10.1109/ICC.2018.8422785.

[3] Madhukar Anand, Ramesh Subrahmaniam, and Radhakrishna Valiveti. "Unifying Real-Time Telemetry for Fun and Profit in Packet-Optical Networks". In: *Advanced Photonics 2017 (IPR, NOMA, Sensors, Networks, SPPCom, PS)*. Optical Society of America, 2017, JTu4A.28. URL: http://www.osapublishing.org/abstract.cfm?URI=Networks-2017-JTu4A.28.

[4] Madhukar Anand et al. "Extending Segment Routing into Optical Networks". In: *Optical Fiber Communication Conference*. Optical Society of America, 2017, Th1I.3. DOI: 10.1364/OFC.2017.Th1I.3. URL: http://www.osapublishing.org/abstract.cfm?URI=OFC-2017-Th1I.3.

[5] F. Dehne et al. "Construction of d-Dimensional Hyperoctrees on a Hypercube Multiprocessor". In: *Proc. of 30th Allerton Conference on Communication, Control and Computing*. Sept. 1992, pp. 373–381.

[6] R. S. Valiveti and B. J. Oommen. "A Doubly-Linked List Reorganization Heuristic with Stochastic Move-to-End operations". In: *Proc. of the Twelfth SCCC Intl. Conf. on Computer Science*. Santiago, Chile, Oct. 1992, pp. 249–257.

[7] R. S. Valiveti and B. J. Oommen. "A Syntactic-Statistical Pattern Recognition Approach to Distinguishing between Encryption Keys". In: *Proc. of IASTED Intl. Symp. on Artificial Intelligence Applications and Neural Networks*. Zurich, Switzerland, July 1991, pp. 122–124.

[8] R. S. Valiveti and B. J. Oommen. "New absorbing and Ergodic Doubly-Linked Reorganizing Heuristics". In: *Proc. of Eleventh SCCC Intl. Conf. on Computer Science*. October 15-18. Santiago, Chile, Oct. 1991, pp. 170–181.

[9] R. S. Valiveti and B. J. Oommen. "On Measuring Presortedness in Ensembles of Data Sequences". In: *Proc. of Twenty-ninth Allerton Conf. on Communication, Control, and Computing*. Urbana Champaign, IL, Oct. 1991, pp. 518–523.

[10] R. S. Valiveti and B. J. Oommen. "The Move-to-Front Heuristic for Non-stationary Query Distributions". In: *Proc. of Sixth Intl. Symp. on Computer and Information Sciences (ISCIS VI)*. Antalya, Turkey, Oct. 1991, pp. 105–114.

[11] R. S. Valiveti, B. J. Oommen, and J. R. Zgierski. "Adaptive linear list reorganization for a system processing set queries". In: *Fundamentals of Computation Theory*. Ed. by L. Budach. Berlin, Heidelberg: Springer Berlin Heidelberg, 1991, pp. 405–414. ISBN: 978-3-540-38391-8.

[12] B. J. Oommen, R. S. Valiveti, and J. Zgierski. "A Fast Learning Automaton Solution to the Keyboard Optimization Problem". In: *Proc. of the Third International Conf. on Industrial Engineering Applications of Artificial Intelligence and Expert Systems (IEA/AIE-90)*. IEA/AIE '90. July 15-18. Charleston, South Carolina, USA: ACM, July 1990, pp. 981–990. ISBN: 0-89791-372-8. DOI: 10.1145/98894.99108. URL: http://doi.acm.org/10.1145/98894.99108.

[13] R. S. Valiveti and B. J. Oommen. "On the Problem of Recognizing Sources Which Generate Random Strings". In: *Proc. of the 24th Conference on Information Systems and Sciences*. March 21-23. Princeton, NJ, Mar. 1990, pp. 972–977.

[14] R. S. Valiveti and B. J. Oommen. "The Optimality of the Chi-squared statistic for Determining Dependence in Normal Vectors". In: *Proc. of Intl. Symp. on Inform. Theory and its applications (ISITA 90)*. November 27-30. Hawaii, Nov. 1990, pp. 375–378.

[15] R. S. Valiveti and B. J. Oommen. "A New Metric for Determining Dependence Trees for Pattern Recognition". In: *Proc. of International Conference on Computer Architecture and Digital Signal Processing (CA-DSP)*. Oct.11-14. Hong Kong, Oct. 1989, pp. 474–479.

[16] S. A. Argyropoulos, R. S. Valiveti, and B. M. Closset. "Development of a Microprocessor Based System for Mining and Metallurgical Applications". In: *CIM Bulletin*. Vol. 77. 870. Oct. 1984, pp. 92–94.

[17] S. A. Argyropoulos, K. Ananthanarayanan, and R. S. Valiveti. "Microprocessors and Arithmetic Processors in Metallurgical Applications". In: *Proc. of IFAC, 4th MMM Symposium on Automation in Mining Mineral and Metal Processing*. Ed. by T.Westerlund. Finland, 1983, pp. 537–552.

Patents

[1] Kannan Raj et al. "In-service data plane encryption verification". Pat. req. US20200280566A1. Patent Application. Feb. 2020. URL: https://patents.google.com/patent/US20200280566A1/.

[2] Rajan Rao et al. "Sd-fec defect propagation across regeneration nodes in support of single and multi-carrier super channel protection in ROADM networks". Pat. req. US20210226697A1. Patent Application. Aug. 2020. URL: https://patents.google.com/patent/US20210226697A1/.

[3] Madhukar Anand, Ramesh Subrahmaniam, and Radhakrishna Valiveti. "Packet-optical in-band telemetry (point) flow tracing and proof-of-transit". U.S. pat. 10,455,303 B2. Oct. 2019. URL: https://patents.google.com/patent/US10455303B2/.

[4] Madhukar Anand et al. "Packet-optical in-band telemetry (point) framework". U.S. pat. 20190014394 A1. July 2019. URL: https://patents.google.com/patent/US20190014394A1/en.

[5] Snigdho Bardalai et al. "Te-link bandwidth model for ODU switch capable otn interfaces". U.S. pat. 2012/0082455 A1. 2019. URL: https://patents.google.com/patent/US20120082455A1/en.

[6] Iftekhar Hussain, Radhakrishna Valiveti, and Khuzema Pithewan. "FlexE GMPLS signaling extensions". U.S. pat. 10,505,655B2. Dec. 2019. URL: https://patents.google.com/patent/US10505655B2/en.

[7] Madhukar Anand, Ramesh Subrahmaniam, and Radhakrishna Valiveti. "Reliable telemetry". Pat. req. US20190014395A1. Patent Application. Apr. 2018. URL: https://patents.google.com/patent/US20190014395A1/en.

[8] Madhukar Anand, Ramesh Subrahmaniam, and Radhakrishna Valiveti. "Elastic timestamping". Pat. req. US20190013954A1. Patent Application. Dec. 2017. URL: https://patents.google.com/patent/US20190013954A1/en.

[9] Iftekhar Hussain et al. “Optical layer protection switching applications”. U.S. pat. 9.258,215 B2. Feb. 2016. URL: https://patents.google.com/patent/US9258215B2/en.

[10] Ping Pan et al. “Encoding and processing of signaling messages for ODU SMP”. U.S. pat. 9,385,943 B2. July 2016. URL: https://patents.google.com/patent/US9385943B2/en.

[11] Radhakrishna Valiveti, Rajan Rao, and Robert G. Bryttegard. “Super optical channel data unit signal supported by multiple wavelengths”. U.S. pat. 9,236,969 B2. Jan. 2016. URL: https://patents.google.com/patent/US9236969B2/en.

[12] Radhakrishna Valiveti, Rajan Rao, and Robert G. Bryttegard. “Super optical channel transport unit signal supported by multiple wavelengths”. U.S. pat. 8,934,479 B2. Jan. 2015. URL: https://patents.google.com/patent/US8934479B2/en.

[13] Edward E. Sprague et al. “Providing access to client overhead while transparently transmitting the client signal”. U.S. pat. 8,446,906 B2. May 2013. URL: https://patents.google.com/patent/US8446906B2/en.

[14] Radhakrishna Valiveti and Biao Lu. “In-band control plane and management functionality in optical level one virtual private networks”. U.S. pat. 8,582,582 B2. Nov. 2013. URL: https://patents.google.com/patent/US8582582B2/en.

[15] Radhakrishna Valiveti et al. “Method and apparatus for mapping traffic using virtual concatenation”. U.S. pat. 8,412,040. Apr. 2013. URL: https://patents.google.com/patent/US8412040B2/en.

[16] Man H. Hui et al. “Remote interconnection of local area networks”. Pat. CA1294347C. Canadian Patent. Jan. 1992.

[17] Man H. Hui et al. “Remote interconnection of local area networks”. U.S. pat. 4901312. Feb. 1990. URL: https://patents.google.com/patent/US4901312A/en.