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Editorial

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The successful offering of IP VPN services, in particular network-based or MPLS VPN services, and the rapid deployment of optical networks motivate the consideration of optical virtual private networks (OVPNs) as a promising value added service that would extend the concept of virtual private network (VPN) into the optical space. Three converging trends, namely (1) the market penetration of IP-VPN services, (2) the rapid deployment of optical networks, and (3) the emergence of intelligent IP-centric control and management of those optical networks, make oVPNs an intriguing concept and a commercial proposition with high potential. Furthermore, the dynamic interaction between the IP and optical networks create the possibility for yet-to-be-defined end-to-end value added and VPN-type services. A wide range of new network engineering and design choices dealing with interoperability of networks and platforms for integrated control and management is made possible. As recognized by the standardization bodies (e.g., IETF, ITU-T), this is particularly important in order to achieve seamless internetworking and support for end-to-end services.

The first trend of interest to this special issue is that of traditional IP VPNs. Fundamentally, network-based VPNs, allow customers to achieve secure connectivity between dispersed enterprise locations over public (provider) networking infrastructure, that is without the expense of owning their own network, and to manage changes to that connectivity with minimum management overhead and impact to users and applications. Another important type of VPN service is the access VPN, which allows roaming users to connect into their company virtual private network.

At the same time, wavelength-division multiplexed (WDM)-based mesh network infrastructures that route optical connections using intelligent optical cross-connect or switches are emerging as the technology of choice to implement the next generation core optical network. The deployment of such optical networks is the second trend behind the current interest in OVPNs. By deploying optical services over such an optical mesh architecture, carriers can meet current SONET/SDH ring service level agreements (SLAs), but at a significantly lower cost. Carriers are furthermore provided with additional service options by enabling multiple tiers of protection over linear, ring, and mesh topologies, such as shared, dedicated, unprotected, or pre-emptible services.

Finally, the third important trend is the emergence of intelligent IP-centric control and management of optical networks. The Internet transport infrastructure is moving towards a model of high-speed routers interconnected by intelligent optical core networks. Architectural choices for the interaction between IP and optical network layers, specifically, the routing and signaling aspects, are maturing. A consensus is emerging in the industry on utilizing IP-centric control plane within optical networks to support dynamic provisioning and restoration of lightpaths. Specifically, it is believed that IP routing protocols and generalized multi-protocol label switching (GMPLS) signaling protocols could be adapted for optical networking needs. At the same time, there are divergent views on how IP routers must interact with optical core networks to achieve end-to-end connectivity.

In the context outlined above, we believe that optical networks are a promising infrastructure for deploying and offering OVPN services made of ''optical pipes'' with different quality-of-service, resilience, and management. In particular, the IP-centric control and management capabilities can support automatic and dynamic management of bandwidth, in support of services such as bandwidth-on-demand and time-of-day scheduling, in the so-called ''switched optical networks''. In fact, a wavelength-routed path is a natural way to ''tunnel''. It is a dedicated service with options for different levels of guaranteed bandwidth, resilience, and management. The optical infrastructure that will enable the successful offering of OVPN services is expected to be an intelligent, automatically switched and service-differentiating optical WDM-based network with IP-centric control plane mechanisms, such as those based on GMPLS.

This special issue, originally prepared for optical network magazine, now included in Kluwer Photonic Communications Networks Journal, seeks to give an overview of OVPNs in their relationship to IP VPNs, to present early commercial offerings, and to highlight the network architecture and design challenges faced by the research and development community at large.

The first paper by Z. Zhang, X. Chu, B. Li, and Y.-Q. Zhang provides a comprehensive overview and survey of IP-based VPNs. Within the framework introduced for categorizing IP-based VPNs, the authors review several OVPN architectures, and some of the related on-going work in standard bodies. The second paper by S. French and D. Pendarakis discusses applications, functionality and implementation aspects of the first commercially available Optical VPN services. T. Cinkler, in the third paper, refers to VPλN as another term for OVPNs, namely VPNs made of the wavelengths supported on an optical network. The author addresses the design (routing and wavelength assignment) of OVPNs for a customer demand in the following three cases. In the first case, there is no sharing of protection wavelengths between different customers. In the second case, there is sharing of protection but not working wavelengths among different customers. Finally, in the third case, there is sharing of both working and protection wavelengths among different customers. The fourth paper by J. Zheng, B. Zhou, and H. Mouftah, addresses the design (routing and wavelength assignment) as well as reconfiguration of optical VPNs as traffic changes in an all-optical WDM networks.

We sincerely hope that this special issue will be enjoyable for all to read. On behalf of the editorial board, we would like to thank all the authors who submitted papers to this special issue, and all the reviewers for their diligent work.

Admela Jukan received her B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Zagreb (Zagreb, Croatia), Polytechnic University of Milan (Milan, Italy) and Vienna University of Technology (Vienna, Austria), respectively. Currently, she is serving as the Program Director in Networking Research at National Science Foundation in Arlington, Virginia, and she is a Visiting Professor at the Georgia Institute of Technology in Atlanta. Since 1996, she has been with the Vienna University of Technology in Austria. Dr. Jukan has engaged in a variety of research activities, including the European Community projects ACTS, and Actions COST. She is the award winner for the best innovative research proposal of Vienna Academic Anniversary Foundation in Austria and she was also awarded by the FWF Austrian Science Fund in Vienna, Austria. Her research interests include protocols and architecture for broadband networks, next-generation services, control and management.

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Jean-Francois received his undergraduate degree in electrical engineering from l'Ecole Nationale Supérieure des Télécommunications in Brest, France. He holds a Ph.D. from Columbia University, where he was the recipient of the 1991 Eliahu I. Jury Award for best dissertation. He is a senior member of the Institute of Electrical and Electronics Engineers (IEEE) and a member of the Optical Society of America. He has numerous publications in the field of networking.