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IP-ORIENTED OPERATIONS AND MANAGEMENT

IP-based networking is growing at a phenomenal rate. While IP networks currently carry mostly data traffic on a best-effort basis, there is increasing demand for other services such as real-time audio and video. For example, voice over IP (VoIP) is becoming an important new service and would benefit from quality of service (QoS) guarantees. The same applies to interactive data services such as Web access. With QoS support and multicast, services such as audio and video telephony, multimedia multiparty conferencing, collaborative virtual environments, and so on will become reality, turning the global Internet into a ubiquitous multiservice network.

There is in fact work underway to provide end-to-end QoS support in IP through the emerging differentiated services (DiffServ) framework; to combine IP with path-based layer 2 technologies such as asynchronous transfer mode (ATM) in the form of multiprotocol label switching (MPLS) for traffic engineering; and to put IP directly over the emerging dense wavelength-division multiplexing (DWDM) optical physical layer technology. Planning, operating, and managing such networks are becoming important challenges. For example, service level agreements will have to be mapped to appropriate traffic engineering and management mechanisms and QoS policy parameters at various levels. Planning and provisioning will need to take place together with dynamic control and reconfiguration through feedback from monitoring mechanisms. With more sophisticated services being provided, accounting and billing based on usage metering will become necessary, together with other service management aspects such as electronic subscription, service customization, QoS complaints, and so on.

It is clear that new paradigms for the management of those environments are needed, borrowing concepts from telecommunications management approaches and moving away from the centralized management (mostly monitoring) paradigm of IP-based private networks. A new evolving paradigm in the Internet Engineering Task Force (IETF) for the management of multiservice IP networks is policy-based management, with telecommunications management network (TMN)-influenced hierarchical distributed management also gaining ground. While new approaches are considered for the management of emerging IP networks, IP-based technology is also becoming dominant for managing any type of network. For example, for TMN-based management of telecommunication networks, Common Information Management Service/Protocol (CMIS/P) for network management, and Common Object Request Broker Architecture (CORBA) for service management are used over TCP/IP protocol stack profiles. In addition, there is ongoing discussion in the International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) of endorsing Simple Network Management Protocol (SNMP) as a valid technology for TMN interfaces. Finally, Web-based management techniques are gaining acceptance.

In order to discuss relevant emerging research issues and potential solutions, the IEEE Workshop on IP-Oriented Operations and Management was formed, being cosponsored by the IEEE Communications Society. IPOM 2000 was held in Cracow, Poland, September 4–6, 2000, hosted by the Department of Telecommunications, University of Mining and Metallurgy (AGH), and supported by a number of communications-related companies. The workshop was very successful, gathering participants from five continents representing telecommunication operators, Internet service providers, software and equipment suppliers, and research organizations. IPOM 2001 is planned to be held in Dallas, Texas, December 3–4, 2001; for information contact G. S. Kuo (gskuo@ieee.nccu.edu.tw).

This feature topic presents a number of articles related to IP-oriented operations and management. Most of the articles submitted were based on selected papers from the IPOM 2000 proceedings. Two additional submissions were based on relevant papers that were not ready in time for IPOM 2000. Finally, we invited a submission on the current state of IETF activities in the operations and management area. All articles were peer-reviewed by three experts, while we reviewed the invited article. For one of the articles in which one of the guest editors is a co-author, the other guest editor handled the reviews. The following articles were finally selected.

The first article, by Trimintzios *et al.*, presents a management and control framework to support differentiated services in networks supporting MPLS-based explicit routed paths. The article proposes first an approach for IP-based service level specifications (SLSs) with various

parameters, and then presents an architecture that includes SLS subscription and admission control, traffic forecasting, network dimensioning, and dynamic control.

The second article, by Braun *et al.*, presents a TMN-influenced approach to the management of IP-based QoS-enabled virtual private networks (VPNs) provided through potentially secure MPLS-based paths. The proposed hierarchical architecture includes customer-facing aspects and a policy-driven service broker that performs resource management, configures devices, and collects usage data for billing.

The third article, by Park *et al.*, presents an approach to IP resource management for VoIP and VPN service level agreements (SLAs) based on a utility model. While the two previous articles present architectures for IP service and network management, this article focuses on an algorithmic approach to perform resource management for a particular type of SLA. The fourth article, by Pras *et al.*, presents aspects related to Internet accounting, discussing the state of related work in the IETF, IRTF, and other projects. Finally, the fifth (invited) article, by Wijnen, gives an overview of IETF standardization activities in the operations and management area.

We hope these articles help readers understand emerging issues and proposed solutions in this challenging new area. We also take this opportunity to thank the authors for their contributions and the reviewers for their precious work.

BIOGRAPHIES

ANDRZEJ JAJSZCZYK [F] (jajszczyk@kt.agh.edu.pl) is a professor at the University of Mining and Metallurgy (AGH), Cracow, Poland. He received his M.S., Ph.D., and Dr Hab. degrees from Poznan University of Technology in 1974, 1979, and 1986, respectively. He is author or co-author of six books and over 150 scientific papers, as well as 19 patents in the areas of telecommunications switching, high-speed networking, and network management. He was the founding editor of *IEEE Global Communications Newsletter* and an editor for *IEEE Transactions on Communications*. From 1998 until the end of 2000 he was Editor-in-Chief of *IEEE Communications Magazine*. He also served on technical program and steering committees of numerous conferences. He is a member of the Association of Polish Electrical Engineers.

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