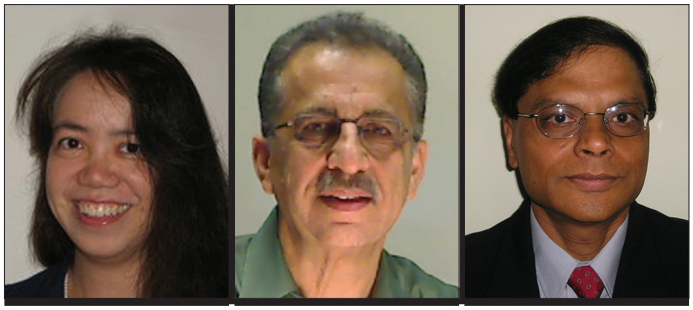
CONVERGENCE OF APPLICATION SERVICES IN NEXT-GENERATION NETWORKS



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The next-generation network is based on an all-IP end-to-end network-layer infrastructure that comprises access, backbone, and egress, using different underlying wired or wireless technologies, and is enabled with quality of service (QoS) capabilities. An ever expanding set of sophisticated application services will take advantage of the QoS-enabled connectivity infrastructure of next-generation networks. These application services, their variety, their ease of use through a large variety of intelligent end-user devices, and their convergence and interworking across multiple domains will constitute the hallmarks of success in the next-generation service universe. Rudimentary forms of some of these application services are already deployed over the Internet. They range from communication services (e.g., VoIP, video, IM, email), to entertainment services that involve content delivery (e.g., music on demand, low to medium quality video on demand, gaming), to a vast array of data and information services (browsing, searching, e-commerce, information retrieval, software distribution, etc.). Since the Internet currently is not QoS-enabled, these services are typically offered on a best effort basis, often with inconsistent or unpredictable quality and fragmented end-user experience. Furthermore, most applications today have a "stovepipe" nature; that is, they are offered independent of one another, each typically with its own user interface and other ancillary features like authentication, charging, and session management. This paradigm will begin to change in next-generation networks, first by enabling the applications to use the QoS capabilities of the underlying connectivity infrastructure to provide a consistently high-quality user experience. More significantly, however, applications will progressively lose their stovepipe nature to become increasingly more intertwined and composite, thereby becoming far more attractive and useful to the end user. This convergence, mash-up, blending, composition, and brokering of application services, and the reusable components or enablers that form the foundational building blocks for their realization across the domains of communication (IMS), entertainment (IPTV), information (web), and others, will constitute a defining, as well as differentiating, attribute of service architecture in next-generation networks.

Another crucial aspect of next-generation service architecture relates to the ability of third parties, including end users, to inject features, enhancements, and/or capabilities into, or on top of, baseline services provided by traditional service providers. The trend toward public exposure of application programming interfaces (APIs) is rapidly accelerating as it is realized it is way beyond a single service provider's ability to create and deploy all the application services that meet the increasingly more sophisticated and demanding end-user community demands. Thus, as enablers and service components are introduced into the network, API access to their capabilities is provided to both the service providers that deploy them and, through them, third parties. This emerging paradigm, although rich in terms of service creation, nonetheless poses unique challenges to the service providers, not only from a security perspective but also from the perspective of "feature interaction" that may result from the mashup or composition of otherwise standalone services. Even though the service interaction challenges of yesteryear have not gone away and, in fact, have become more sophisticated, the methodologies and associated tools that are emerging for cross-domain service composition are likely to help ameliorate the problems to a considerable extent. This, however, remains one of the challenges of convergence in next-generation networks.

In this issue of *IEEE Communication Magazine*, we are pleased to have assembled six diverse high-quality articles addressing the topic of "Convergence of Application Services in Next-Generation Networks." The articles' themes range from providing a framework for intelligent service adaptation, to providing models for service construction and service exposure, to provisioning novel services, to implementation mechanisms that help end users compose services, to addressing the complex issue of incorporating application intelligence in transport services.

In the first article, "Framework for Intelligent Service Adaptation to Users' Context in Next-Generation Net-

works" by Baladrón *et al.*, the authors propose a converged context management solution that brings together otherwise fragmented user context information from diverse sources into an integrated framework for easy, centralized exposure to applications. This framework is intended to incorporate "context awareness" in applications to allow services to intelligently adapt themselves to the user context.

Having acquired insights into an intelligent "context-aware" service adaptation framework, the reader will learn from the next two articles an interesting 4D model for service creation and a model for service exposure. In the article "Augmented Reality — Service Construction via a 4D Communication Model," Wang and Brenner add a fourth dimension of information to the 3D communications model of voice, video, and text (today's tele-reality). Information such as people, place, time, weather, and significant and applicable recent social events and local news can be utilized to augment tele-reality to provide end users a feature-rich enhanced service delivery. The next article, "A Semantic Enhanced Service Exposure Model for Converged Service Environment" by Huang *et al.*, describes a semantic-enhanced, converged service-exposure model that enables services from different domains to be integrated into new composite services in a manner that is easy for non-professionals to use.

In the fourth article, "Subscriber Data and Semantic Web for Provisioning Novel End User Services in Telecommunication Networks," Belqasmi *et al.* propose an architecture for the federation of valuable subscriber data across multiple telecommunications networks, providing a single unified interface to that data for new value-added services.

The next article, "Widgets and Composition Mechanism for Service Creation by Ordinary Users" by Laga *et al.*, proposes a service creation environment for novice users. The service creation environment consists of a widget layer with reusable graphical user interfaces that offers user-friendly interfaces to customize composite services.

Finally, given all of the rich features and framework at the application or middleware level proposed by the preceding five articles, the question arises: how much intelligence is needed at the network layer in next-generation networks to facilitate the delivery of innovative services? Addressing this issue is the article "Application Scenarios for Cognitive Transport Service in Next-Generation Networks" by Callegati *et al.*, which explores a new transport services layer that would enable network awareness in applications, allowing for rich, intelligent self-management of QoS and resources between the applications and the network.

BIOGRAPHIES

ANNE Y. LEE (anne.lee@alcatel-lucent.com) is a Bell Labs Fellow and CTO of Advanced Communications Solutions Innovations at Alcatel-Lucent. Prior to this position, she was director in the IMS Solutions organization leading the IMS Ecosystem program. The goal of this program is to create a comprehensive portfolio of 3rd-party application solution vendor partners to complement and enhance the Alcatel-Lucent IMS solution for Alcatel-Lucent's customers. Previously, she worked in the IMS CTO and Wireless CTO organizations. She has more than 24 years of experience at Alcatel-Lucent (AT&T, Lucent, and Alcatel-Lucent), spending more than 17 years in the wireless organization. She began her wireless career as a developer for the early analog systems, later transitioning to the GSM project. Moving from development to systems engineering, she led teams to define requirements for major TDMA projects and was the systems engineering/architecture lead for GSM EDGE. She is the original IMS technical team leader for Lucent Technologies, leading teams of systems engineers and architects in requirements and architecture definition as well as in working with the standards team for a multi-access IMS system. She is the recipient of the 2005 Lucent Chairman's Award for "Creating IMS Leadership" and the 2010 Alcatel-Lucent Asian American Award for "Innovation and Technical Excellence." She has been Guest Editor for the *Bell Labs Journal* and is also the author of many papers on IMS, including in the area of IMS applications. She also has a number of granted patents. She became a Bell Labs Fellow in 2005. She received her Bachelor's degree in electrical engineering and Master's degree in computer science from the Illinois Institute of Technology in Chicago.

ABDI MODARRESSI (abdi.modarressi@att.com) received his B.S. degree in electrical engineering from the American University of Beirut, and his M.S. and Ph.D. degrees, both in electrical engineering, from the University of Pittsburgh. He is a Distinguished Member of Technical Staff at AT&T, working on service architecture definition and realization, particularly as it relates to cross-domain converged application services, service composition, and reusable components or enablers. Prior to that, he worked at the BellSouth Science and Technology organization in Atlanta, focusing on DSL architecture, next-generation services, and application of reusable components across multiple domains. Abdi started his industry career at Bell Labs in Holmdel, New Jersey, in the mid-1980s working on areas related to routing optimization in AT&T's toll network, SS7 modeling and performance analysis, broadband signaling architecture, next-generation network architecture, and object-oriented realization of signaling systems. He was promoted to DMTS in 1989 and continued his contributions to the signaling evolution and network architecture at Bell Labs in Holmdel and Columbus until 1996, when he joined BellSouth Science and Technology in Atlanta. Prior to his industry career, he held academic positions at the University of Pittsburgh and the National University of Iran, teaching control, circuit and communication theory courses. He is the author or co-author of numerous conference and journal papers on multi-dimensional system theory, non-linear control, congestion control performance, SS7 protocols, signaling evolution, performance analysis, next generation service architecture, session management and control, and so on. He has also published chapters in the Communications Handbook and served as guest editor of two special issues of *IEEE Communications Magazine*. He has been the recipient of several patents, and was awarded multiple awards including BellSouth Network Services Excellence Award in 2005 and AT&T Science and Technology Medal in 2009.

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