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Editorial

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Multimedia—an integrated and interactive presentation of speech, audio, video, graphics, and text—has become a major driving force behind a multitude of applications. Increasingly, multimedia content is being accessed by a large number of diverse users and clients at anytime, and from anywhere, across various communication channels such as the Internet and wireless networks. As mobile cellular and wireless LAN networks are evolving to carry multimedia data, an all-IP-based system akin to the Internet is likely to be employed due to its cost efficiency, improved reliability, allowance of easy implementation of new services, independence of control and transport, and importantly, easy integration of multiple networks.

However, reliable transmission of multimedia over such an integrated IP-based network poses many challenges. This is not just due to the inherently lower transmission rates provided by these networks as compared with traditional delivery networks (e.g., ATM, cable networks, satellite), but also due to associated problems such as congestion, competing traffic, fading, interference, and mobility, all of which lead to varying transmission capacity and losses.

Consequently, to achieve a high level of acceptability and proliferation of networked multimedia, a solution for reliable and efficient transmission over IP and wireless networks is required. Several key requirements need to be satisfied.

(1) *Easy adaptability to rate variations* since the available transmission capacity may vary due to interference, overlapping wireless LANs, competing traffic, mobility, multipath fading, and so forth.
(2) *Robustness to data losses* since depending on the channel condition, partial data losses may occur.
(3) *Support for device scalability and user preferences* since various clients may be connected at different data rates and request transmissions that are optimized for their respective connections and capabilities.
(4) *Limited complexity implementations* for mobile wireless devices.

(5) *Adaptation to the quality-of-service* (*QoS*) provided by the network.
(6) *Efficient end-to-end transmission* over different networks exhibiting various characteristics and QoS guarantees.

To address the above-mentioned requirements, innovative solutions are needed for adaptive and error-resilient multimedia compression, error control, error protection and concealment, multimedia streaming architectures, channel models and channel estimation, packetization and scheduling, and so forth. Such solutions can best be developed by a combination of theory, tools, and methods from the fields of networking, signal processing, and computer engineering. This integrated and cross-disciplinary approach has led to the advent of a new research wave in compression, joint source-channel coding, and network-adaptive media delivery, and has motivated the emergence of novel compression standards, transmission protocols, and networking solutions.

Recently, both the academic and industrial communities have realized the potential of such integrated solutions for multimedia applications. Consequently, multimedia networking is evolving as one of the most active research areas. Despite the significant research efforts in this area, numerous problems related to the optimal design of source coding schemes aimed at transmission over a variety of networks, joint source-channel coding trade-offs, and flexible multimedia architectures remain open.

This special issue is an attempt to cover a wide range of topics under the broad multimedia networking umbrella by publishing twelve papers reporting on recent results in the above-mentioned research areas. The papers in this special issue correspond to advances in five different areas of multimedia networking:

(i) layered coding and transmission,
(ii) cost-effective and complexity-scalable implementations,
(iii) efficient end-to-end transmission using proxies,
(iv) quality of service,
(v) mechanisms for robust coding and transmission.

In the first area, Viéron et al., T. P.-C. Chen and T. Chen, Wu et al., and Thie and Taubman dedicate four papers, respectively, to robust video transmission using layered coding, covering various aspects such as joint source-channel coding, rate-shaping, and efficient streaming strategies. In the second area, Saponara et al. and Mietens et al. consider cost-effective and complexity-scalable implementations of the different video compression standards employed for multimedia communication applications. In the third area, Pei and Modestino, and Radha et al. consider the use of proxies for improving the video quality when transmitted over multiple-hop wireless or wired networks exhibiting different channel characteristics. In the fourth area, Song and Lee consider the effective mechanisms for QoS using renegotiating schemes for streaming video. In the fifth area, Taal et al., Song and Liu, and Jin et al. consider different mechanisms for robust video coding and transmission, such as source-channel rate allocation schemes, novel scheduling strategies for video distribution using parallel servers, and optimization of error-resilient video transmission using behavior models.

As this special issue illustrates, academic and industrial research in multimedia networking is becoming increasingly vibrant, and the field continues to pose new challenges that will require innovative approaches. Potential solutions will need to cross the boundaries between the fields of signal processing, networking, and computer engineering, and we believe that such cross-fertilization is likely to catalyze many interesting and relevant new research topics and applications.

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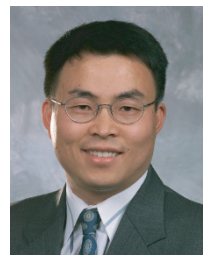
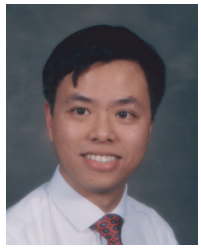


Zixiang Xiong received his Ph.D. degree in electrical engineering in 1996 from the University of Illinois at Urbana-Champaign. From 1997 to 1999, he was with the University of Hawaii. Since 1999, he has been with the Department of Electrical Engineering at Texas A&M University, where he is an Associate Professor. He spent the summers of 1998 and 1999 at Microsoft Research, Redmond, Wash and the summers of 2000 and 2001 at Microsoft Research in Beijing. His current research interests are distributed source coding, joint source-channel coding, and genomic signal processing. Dr. Xiong received a National Science Foundation (NSF) Career Award in 1999, an Army Research Office (ARO) Young Investigator Award in 2000, and an Office of Naval Research (ONR) Young Investigator Award in 2001. He also received Faculty Fellow Awards in 2001, 2002, and 2003 from Texas A&M University. He is currently an Associate Editor for the IEEE Transactions on Circuits and Systems for Video Technology, the IEEE Transactions on Signal Processing, and the IEEE Transactions on Image Processing.

Mihaela van der Schaar is currently an Assistant Professor in the Electrical and Computer Engineering Department at the University of California, Davis. She received her Ph.D. degree in electrical engineering from Eindhoven University of Technology, the Netherlands. Between 1996 and June 2003, she was a Senior Member Research Staff at Philips Research in the Netherlands and USA. In 1998, she worked in the Wireless Communications and Networking Department. From January to September 2003, she was also an Adjunct Assistant Professor at Columbia University. In 1999, she become an active participant to the MPEG-4 standard, contributing to the scalable video coding activities. She is currently chairing the MPEG Ad-hoc group on Scalable Video Coding, and is also cochairing the Ad-hoc group on Multimedia Test Bed. Her research interests include multimedia coding, processing, networking, and architectures. She has authored more than 70 book chapters, and conference and journal

papers and holds 9 patents and several more pending. She was also elected as a member of the Technical Committee on Multimedia Signal Processing of the IEEE Signal Processing Society and is an Associate Editor of IEEE Transactions on Multimedia and an Associate Editor of Optical Engineering.



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Eckehard Steinbach studied electrical engineering at the University of Karlsruhe, Germany, the University of Essex, UK, and ESIEE in Paris. From 1994 to 2000, he was a member of the research staff of the Image Communication Group at the University of Erlangen-Nuremberg, Germany, where he received the Engineering Doctorate in 1999. From February 2000 to December 2001, he was a Postdoctoral Fellow at the Information Systems Laboratory, Stanford University. In February 2002, he joined the Department of Electrical Engineering and Information Technology, Technische Universität München, Germany, where he is currently an Associate Professor of media technology. Dr. Steinbach served as a Conference Cochair of SPIE Visual Communications and Image Processing (VCIP '01) in San Jose, California, in 2001. He also served as a Conference Cochair of Vision, Modeling, and Visualization (VMV '03) held in Munich in November 2003. His current research interests are in the area of networked multimedia systems.

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Ming-Ting Sun received the B.S. degree from National Taiwan University in 1976, the M.S. degree from University of Texas at Arlington in 1981, and the Ph.D. degree from University of California, Los Angeles in 1985, all in electrical engineering. Dr. Sun joined the University of Washington in August 1996 where he is now a Professor. His research interests include video coding and networking, multimedia technologies, and VLSI for signal processing. Dr. Sun has been awarded 8 patents and has published more than 140 technical papers in journals and conferences. He has authored or coauthored 10 book chapters in the area of video technology, and has coedited a book on compressed video over networks. He has served in various leadership positions including the Chair of the IEEE CAS Standards Committee, the Editor-in-Chief of IEEE Transactions on Circuits and Systems for Video Technology (TCSVT), General Cochair of Visual Communication and Image Processing, and the Editor-in-Chief of IEEE Transactions on Multimedia. Dr. Sun has received many awards including the Award of Excellence from Bellcore, the *TCSVT* Best Paper Award, and the Golden Jubilee Medal from the IEEE CAS Society. Dr. Sun is a Fellow of IEEE.