

Video over Mobile Networks



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Video is a major challenge for the future mobile Internet as it is foreseen to account for close to 70 percent of consumer mobile traffic by 2016. Already, mobile network operators are suffering from the exploding number of subscribers accessing high-volume mobile data services, and this trend is expected to intensify even further in the near future. The enormous proliferation of multimedia-capable portable devices — such as smart phones, tablets, and laptops equipped with 3G and WLAN interfaces — has increased the volume and variety of multimedia digital content and related services.

A large portion of portable devices benefit today from cellular flat rates, offered by mobile operators as a response to the increasing users' demand for ubiquitous and seamless access to content. This demand is mainly caused by the exponential growth of the popularity of multimedia web-based services, such as Netflix, YouTube, Flickr, and Facebook, which has ultimately created a large pool of mobile multimedia consumers. Moreover, user portable devices are typically equipped with integrated cameras, enabling people to create multimedia content in a simple way, and thus dramatically enlarging the population of multimedia producers as well.

Current network infrastructures are not prepared to deal with this traffic increase. The mobile Internet was not designed with video requirements in mind, and consequently, its architecture is not tailored to efficiently handle a large volume of video traffic.

This Special Issue is intended to present research efforts on the design, adaptation, and enhancement of IP-based mobile network architectures aimed at providing efficient video traffic support. In response to the open call, we were pleased to receive 24 submissions from which six articles were accepted for this issue. The large number of submissions is a proof of the high level of interest in advanced topics in mobile communications.

Different solutions for improving the efficient network resource utilization and quality of experience (QoE) have been proposed in the literature. The first article in this

Special Issue, “Analyzing the Combination of Different Approaches for Video Transport Optimization for Next Generation Cellular Networks” by Fu *et al.*, addresses the optimization of video delivery over cellular networks. The authors first describe existing solutions, and then propose the interworking of three different solutions that can act simultaneously to achieve the best video performance from a QoE point of view.

The second article, “Mobile CDN Enhancements for QoE-Improved Content Delivery in Mobile Operator Networks” by Yousaf *et al.*, analyzes the challenges of providing quality of experience in mobile content delivery networks (mCDNs), and proposes a framework for deploying schedulers at CDN serving points that take into account locally available transport and application layer information, such as TCP session statistics and content encoding rates, to enable fair distribution of shared transport network capacity among mobile users.

The next article, “The Case for P2P Mobile Video System over Wireless Broadband Networks: a Practical Study of Challenges for a Mobile Video Provider” by Sun *et al.*, takes a different view on enhancing mobile video traffic delivery. It describes the challenges to implement a peer-to-peer (P2P) mobile video system over a commercial wireless cellular network. The architectural analysis conducted by the authors is supported by real measurements and feedback from an existing large-scale commercial P2P mobile video provider system, focusing on the mobile broadband specific issues.

The next two articles look into mobility related aspects. Currently deployed centralized IP mobility approaches are not well suited for video traffic. This is one of the main drivers for the efforts around a new mobility paradigm called distributed mobility management (DMM). In the article “Distributed Mobility Management for Efficient Video Delivery over All-IP Mobile Networks: Competing Approaches” by Shin *et al.*, the authors survey different DMM approaches proposed within the research and standards communities. The article focuses on three main types

of solutions and qualitatively evaluates them from the point of view of efficient mobile video delivery. Mobility aspects are considered from a different perspective in the article “Energy-Aware Mobile Video Transmission Utilizing Mobility” by Kolios *et al.*, in which the authors look into the issue of the energy consumption drain caused by the increase of mobile video traffic, and how mobility information can help alleviate this problem. The article reviews most popular video content delivery methods and proposes mobility assisted forwarding strategies aimed at maximizing the energy gains while meeting the target users’ QoE.

The last article addresses layer 2 specific video optimizations. In “Video Multicast over WLANs: Power Saving and Reliability Perspectives” by Shin *et al.*, the authors study how video traffic can be multicast over IEEE 802.11 wireless networks, assessing the power saving and reliability capabilities of commercial devices and comparing the observed performance with the expected behaviors from the standard. The authors also review the reliable multicast schemes defined in the emerging IEEE 802.11v and 802.11aa standards, and compare them by simulation.

We would like to thank all the authors who submitted their research to this special issue. As Guest Editors, we thank all the peer reviewers for their time and the excellent job they did, which was of tremendous help to ensure the high quality of this Special Issue. We are also grateful to the Editor-in-Chief, Prof. Sherman Shen, for his continuous and prompt support in the development of this Special Issue. Last but not least, we hope that all readers will find the articles in this issue informative, interesting, and useful.

Biographies

CARLOS J. BERNARDOS (cjb@it.uc3m.es) received a telecommunication engineering degree in 2003, and a Ph.D. in telematics in 2006, both from the University Carlos III of Madrid (UC3M), where he worked as a research and teaching assistant from 2003 to 2008 and, since then, has worked as an associate professor. His Ph.D. thesis focused on route optimization for mobile networks in IPv6 heterogeneous environments. His current work focuses on vehicular networks and IP-based mobile communication protocols. He has published over 40 scientific papers in prestigious international journals and conferences, and he is also an active contributor to the Internet Engineering Task Force (IETF). He served as TPC Chair of WEEDEV 2009 and as TPC Co-Chair of the Mobility track of NTMS 2011.

He has also served as a Guest Editor of IEEE Network.

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JOERG WIDMER [M’06, SM’10] (joerg.widmer@imdea.org) is a chief researcher at Institute IMDEA Networks in Madrid, Spain. His research expertise covers computer networks and distributed systems, ranging from MAC layer design, sensor networking, and network coding to transport protocols and future Internet architectures. From 2005 to 2010, he was manager of the Ubiquitous Networking Research Group at DOCOMO Euro-Labs in Munich, Germany, leading several projects in the area of mobile and cellular networks. Before joining DOCOMO Euro-Labs, he worked as post-doctoral researcher at EPFL, Switzerland, on ultra-wideband communication and network coding. He received his M.S. and Ph.D. degrees in computer science from the University of Mannheim, Germany, in 2000 and 2003, respectively. In 1999 and 2000 he was a visiting researcher at the International Computer Science Institute in Berkeley, California. He has authored more than 90 conference and journal papers, holds several patents, serves on the Editorial Board of *IEEE Transactions on Communications*, and regularly participates in program committees of several major conferences. He is a Senior Member of ACM.

MICHELE ZORZI [F’07] (zorzi@dei.unipd.it) received his Laurea and Ph.D. degrees in electrical engineering from the University of Padova, Italy, in 1990 and 1994, respectively. During academic year 1992–1993, he was on leave at the University of California, San Diego (UCSD). After being affiliated with the Dipartimento di Elettronica e Informazione, Politecnico di Milano, Italy, the Center for Wireless Communications at UCSD, and the University of Ferrara, in November 2003 he joined the faculty of the Information Engineering Department of the University of Padova, where he is a professor. His present research interests include performance evaluation in mobile communications systems, random access in mobile radio networks, ad hoc and sensor networks, energy constrained communications protocols, and underwater communications and networking. He was Editor-in-Chief of *IEEE Wireless Communications* from 2003 to 2005, Editor-in-Chief of *IEEE Transactions on Communications* from 2008 to 2011, and serves on the Editorial Board of Wiley’s *Journal of Wireless Communications and Mobile Computing*. He has also been a Guest Editor for Special Issues in *IEEE Personal Communications* and *IEEE Journal on Selected Areas in Communications*. He served as a Member-at-Large of the Board of Governors of the IEEE Communications Society from 2009 to 2011.