

# Adaptive Streaming of Traditional and Omnidirectional Media

## Abstract

This tutorial consists of three main parts. In the first part, we provide a detailed overview of the HTML5 standard and show how it can be used for adaptive streaming deployments. In particular, we focus on the HTML5 video, media extensions, and multi-bitrate encoding, encapsulation and encryption workflows, and survey well-established streaming solutions. Furthermore, we present experiences from the existing deployments and the relevant de jure and de facto standards (DASH, HLS, CMAF) in this space. In the second part, we focus on omnidirectional (360°) media from creation to consumption. We survey means for the acquisition, projection, coding and packaging of omnidirectional media as well as delivery, decoding and rendering methods. Emerging standards and industry practices are covered as well. The last part presents some of the current research trends, open issues that need further exploration and investigation, and various efforts that are underway in the streaming industry.

## Target Audience and Prerequisite Knowledge

This tutorial includes both introductory and advanced level information. The audience is expected of understanding of basic video coding and IP networking principles. Researchers, developers, content and service providers are all welcome.

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- Part II: Omnidirectional (360°) Media
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- Part III: Open Issues and Future Directions
  - Common issues in scaling and improving quality, multi-screen/hybrid delivery
  - Ongoing industry efforts

## Speakers



Ali C. Begen recently joined the computer science department at Ozyegin University. Previously, he was a research and development engineer at Cisco, where he has architected, designed and developed algorithms, protocols, products and solutions in the service provider and enterprise video domains. Currently, in addition to teaching and research, he provides consulting services to industrial, legal, and academic institutions through Networked Media, a company he co-founded. Begen holds a Ph.D. degree in electrical and computer engineering from Georgia Tech. He received a number of scholarly and industry awards, and he has editorial positions in prestigious magazines and journals in the field. He is a senior member of the IEEE and a senior member of the ACM. In January 2016, he was elected as a distinguished lecturer by the IEEE Communications Society. Further information on his projects, publications, talks, and teaching, standards and professional activities can be found at <http://ali.begen.net>.



Christian Timmerer received his M.Sc. (Dipl.-Ing.) in January 2003 and his Ph.D. (Dr.techn.) in June 2006 (for research on the adaptation of scalable multimedia content in streaming and constrained environments) both from the Alpen-Adria-Universität (AAU) Klagenfurt. He joined the AAU in 1999 (as a system administrator) and is currently an Associate Professor at the Institute of Information Technology (ITEC) within the Multimedia Communication Group. His research interests include immersive multimedia communications, streaming, adaptation, Quality of Experience, and Sensory Experience. He was the general chair of WIAMIS 2008, QoMEX 2013, and MMSys 2016 and has participated in several EC-funded projects, notably DANAE, ENTHRONE, P2P-Next, ALICANTE, SocialSensor, COST IC1003 QUALINET, and ICoSOLE. He also participated in ISO/MPEG work for several years, notably in the area of MPEG-21, MPEG-M, MPEG-V, and MPEG-DASH where he also served as standard editor. In 2012 he cofounded Bitmovin (<http://www.bitmovin.com/>) to provide professional services around MPEG-DASH where he holds the position of the Chief Innovation Officer (CIO).