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Editorial

Middleware solutions for QoS in distributed multimedia services

Internet service provisioning interests a constantly growing number of users with an enlarging set of very heterogeneous access devices. Users call for the tailoring of distributed services, based on personal preferences and type of usage, e.g. for different business purposes and private utilization. Client access devices span from traditional workstations and PCs, to laptops, personal digital assistants and smart phones, with wired/wireless continuous/intermittent connectivity. Both user requirements and device heterogeneity further push the need for service provisioning with differentiated Quality of Service (QoS); any category of users/devices should be provided with its proper QoS level, also depending on distributed resource availability at provision time, with the corresponding different charges.

QoS differentiation is particularly relevant and challenging when dealing with classes of services that tend to be highly resource-consuming and that impose strict time constraints on provisioning, such as the distribution of multimedia flows over large-scale networks. In the recent years, service providers and network operators ask for mechanisms, tools and technologies to negotiate, differentiate, record, control and grant the multimedia QoS level provided at runtime, over both specific reservation-based networks and traditional best-effort ones. This involves to address very different and challenging issues that significantly increase the complexity of designing, developing and deploying multimedia services with differentiated QoS, especially in geographically distributed open environments such as the Internet.

It starts to be recognized that the intrinsic complexity of this scenario should be faced with middleware approaches covering different levels of abstraction, from the network layer to the application one, in order to simplify/accelerate the development and to leverage the market of multimedia services with differentiated QoS levels. Middleware solutions should enhance the traditional network infrastructure with new distributed support facilities for the QoS monitoring and control of multimedia flows, for the tailoring/adaptation of multimedia flows depending on user preferences, access device characteristics and provision-time resource availability, for the QoS-aware distributed caching of multimedia flows with differentiated quality levels, and for the dynamic installation and reconfiguration of QoS support components when and where needed in response to the exhibited patterns of service request locations.

The special issue is willing to introduce the readers to the up-to-date research results in the area of QoS-aware middleware for multimedia, by trying to span the most relevant different aspects involved in such a challenging scenario. It starts with a contribution entitled 'Total Quality of Service Provisioning in Middleware and Applications' that has the duty of introducing the general aspects of static and dynamic QoS provisioning. The paper illustrates how standard component-based middleware solutions should be enhanced for both static QoS tailoring and dynamic service adaptability and how to put together these capabilities to provide an integrated middleware solution for total QoS for distributed real-time and embedded systems.

The following paper from the University of Naples focuses on the architectural issues related to the design and implementation of multimedia servers over real-time operating systems. In particular, it discusses how it is possible to provide differentiated QoS levels in multimedia distribution while adopting the Rate Monotonic scheduling algorithm.

If the two first contributions reflect the significant results achieved by extending and specializing traditional middleware approaches coming from the research areas of real-time distributed components and operating systems, the following two articles from the University of Illinois at Urbana-Champaign and from the University of Bologna explore innovative approaches based on the distributed collaboration of dynamically deployed infrastructure peers. 'QoS-aware Middleware Support for Collaborative Multimedia Streaming and Caching Service' concentrates on collaborative techniques for streaming, scheduling and prefetching when provisioning multimedia services to heterogeneous client devices. 'Active Middleware for Internet Video on Demand: The QoS-aware Routing Solution in ubiQoS' presents an infrastructure of mobile agent proxies that dynamically install where needed to compose an active path for tailoring/adaptation of Video on Demand. In particular, the paper details how the active path is dynamically determined by exploiting a completely decentralized and QoS-aware peer-to-peer discovery.

Finally, the two last contributions from the University of Messina and from the Liverpool John Moores University address some of the new challenging requirements coming

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from the distribution of multimedia flows in mobile networks. 'QoS Management for MPEG-4 Flows in Wireless Environment' investigates the issues of a middleware architecture to allow mobile wireless devices to access multimedia services offered by the wired Internet. Finally, 'MNPA: A Basis for Privacy-Enhanced QoS in Mobile Networks' proposes solutions for supporting the full privacy of users who negotiate the preferred QoS levels in mobile networks.

I would like to thank all authors for the technical quality of their contributions and for their promptness and patience in following the suggestions raised by the reviewers and the guest editor. Many thanks go to all reviewers: their accurate work was crucial for the realization of the special issue. I also have hope that the paper collection as a whole can pleasantly introduce the readers to the composite and challenging arena of QoS middleware solutions for multimedia and can help in giving a fresh sketch of several state-of-the-art solutions in the field.

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