Guest Editorial

Smart and interactive ubiquitous multimedia services

Welcome to this special issue of the Elsevier Computer Communications Journal. This special issue is devoted to the topic of the latest research and development on smart and interactive ubiquitous multimedia devices (SIUMS). Due to fast developments in technologies and amazing growth of consumer demands, media are increasingly ubiquitous: more and more people are immersed in a world of Internet pop-ups and streaming television, mobile phone texting and video clips, etc. The future trend of providing people with media-aware contents that are available anywhere and anytime requires network services to be smarter and more interactive. Thus, the design of smart and interactive ubiquitous multimedia services (SIUMS) has drawn substantial attention from the research community by considering the aspects of ubiquitous networking, ambient intelligence, embedded multimedia systems, and smart environments. SIUMS are intended to be a novel component for the Internet of Things (IoT) that will greatly enhance its efficiency and effectiveness, and impact everyone’s life in every facet, including entertainment, socialization, business, healthcare and education. This special issue brings together state of the art research contributions that focus on networking and communication aspects for enabling SIUMS. In response to the call for contributions, we have received 52 paper submissions from both academia and industries that covered a variety of interesting topics. Two rounds of careful reviews by the guest editors and experts in the field led to the selection of 16 papers for inclusion in this issue. The selected papers may be classified into five categories: ubiquitous services management, cloud-assisted multimedia, smart multimedia transmission, secure multimedia gathering and sharing, and multimedia localization. A detailed overview of the selected works is given below.

Ubiquitous services management

The first paper “MINDiT: A Framework for Media Independent Access to Things” by D. Corujo et al. proposes MINDiT, a framework providing common control and information accessing mechanisms in heterogeneous IoT scenarios. MINDiT addresses the different characteristics provided by devices and services in these scenarios, which are composed by different kinds of elements such as access network technology support, application programming interfaces, processor and memory capacity, amongst others, and exposes them to controlling entities using a common interface. Inspired by cross-layer approaches, MINDiT defines and employs media independent mechanisms suitably modified to facilitate and optimize deployment in scenarios featuring both high-level and low-powered network restricted entities. These mechanisms were compared with existing solutions, evaluating their performance in a multi-technology multimedia scenario, allowing a controlling entity to access and optimize video operations, in mobile wireless environments and in real-time. The paper verifies that the proposed framework not only incorporates common mechanisms for accessing and controlling devices and services, but also enhances efficiency by lowering signaling overhead and battery consumption.

In “Part-Whole Dissemination of Large Multimedia Contents in Opportunistic Networks”, N. Belblidia et al. address large content dissemination among ubiquitous multimedia devices. In such a situation, users must slice data and send fragments separately, which allows better use of short contacts and progressive disseminations of data pieces in large contents. The main question here is to design the best strategy for deciding which piece(s) to transmit whenever nodes meet. In addition, although small pieces imply a better use of short contacts, they generate more overhead due to the headers required at each piece.

Cloud-assisted multimedia

This part describes cloud-assisted multimedia services, including streaming, image processing, and flow scheduling schemes.

The first paper “Dynamic Adjustable Multimedia Streaming Service Architecture over Cloud Computing” by S. Chang et al. proposes a novel cloud multimedia streaming architecture for providing dynamic adjustable streaming multimedia services under the constraints of mobile device resources, multimedia codec characteristics and current network environments, and presents the design of the stream dispatcher that employs the adaptable codec approach to calculate the most suitable segment for streaming to mobile devices at any time. This paper also proposes a Dynamic Adjustable Multimedia Streaming (DAMS) algorithm within mobile multimedia service to deliver multimedia content over cloud network immediately, decrease the loading of content storage servers substantially and reduce power consumption of mobile devices effectively. Experimental results prove that the proposed architecture decreases the loading of content storage servers substantially and reduces the power consumption of mobile devices effectively.

In “Cloud-based Image Processing System with Priority-based Data Distribution Mechanism”, T. Wu et al., implement MapReduce on an integrated 2D to 3D multi-user system. When several users compete simultaneously to acquire data from MapReduce for 2D to 3D applications, data waiting to be processed by Map will be delayed by the current user and Reduce has to wait until the completion of all Map tasks to generate the final result. Therefore, a novel scheduling scheme, Dynamic Switch of Reduce Function (DSRF)
Algorithm, is proposed in this paper for MapReduce to switch dynamically to the next task according to the achieved percentage of tasks and reduce the idle time of Reduce. Experimental results reveal that the proposed scheduling scheme efficiently enhances MapReduce performance in running 2D to 3D applications.

The paper “Distributed Media-Aware Flow Scheduling in Cloud Computing Environment” by J. Rodrigues et al., proposes a novel media-aware flow scheduling architecture that is helpful and important to the design of SIUMS. The proposed method is proven to improve the multimedia quality and decrease the transmission delay in a controllable manner, and thus the tradeoffs between network Quality of Service (QoS), network lifetime, and multimedia delay requirements can be achieved in the context of SIUMS.

**Smart multimedia transmission**

This part describes smart multimedia techniques over wireless networks for improving the quality of service, including QoE-provisioned image transmission, VBR video streaming, QoE in Mobile IPTV, and SVC video transmission, and real-time multimedia via WiMAX.

The first paper entitled “A Majorization Approach to Downlink Multituser VBR Video Streaming” by Y. Huang et al. tackles the important problem of streaming variable bit rate (VBR) videos in legacy and future cellular networks. The authors adopt a deterministic model for the highly dynamic VBR video traffic, and develop a stochastic optimization problem formulation. They show that the formulated problem can be transformed to fit the majorization theory, and then develop a majorization-based solution approach. The authors show that this approach can be applied to support interactive video streaming with tight delay constraints. VCR controls, and new types of exploratory online interactive videos and video click-through. The proposed schemes are validated with trace-driven simulations and are shown to outperform an existing lazy approach with considerable gains.

The paper “Depth-color based 3D Image Transmission over Wireless Networks with QoE Provisions” by Z. Song et al. surveys various remarkable techniques toward 3D image transmissions over wireless networks, and discusses current research challenges for improving 3D media Quality of Experience (QoE) performance. To address these challenges, the authors propose a QoE-driven wireless 3D image transmission scheme with depth-color source coding adaptations based on wireless network conditions. Specifically, this scheme includes: (1) a patch-pixel based source coding scheme for 3D image transmission; (2) a 3D image quality model; (3) and a quality-driven 3D image transmission approach based on the quality model. The proposed research in this paper opens a new research vista in the field of 3D video transmissions over wireless networks.

In “Multiple-layer Scalable Video Coding Technology basing on MB-level Data Partition for Wireless Sensor Networking”, X. Liu et al. propose a novel ML-MLSVC algorithm for video transmissions through wireless sensor networks. According to the requirements of sensor networking, such as bandwidth limitation, multiple transmission paths validity and so on, multiple sub-bitstreams are generated and transmitted via various paths from the sender to the receiver instead of the original single video bitstream. Different from existing technologies, the MB-Level data partition is considered to construct the multiple layer coding and produce multiple output sub-bitstreams. With the proposed algorithm, the original single bitstream is divided into multiple sub-bitstreams legitimately, and the traffic load over the original signal transmission path is shared by multiple paths.

The paper “A Network Management Algorithm and Protocol for Improving QoE in Mobile IPTV” by J. Lloret et al. presents a network management algorithm and protocol that use the information received by the user in order to select the best video server to stream IPTV contents (from a farm of servers) and choose the video features and codec to provide the highest QoE to the customer. The authors explain the designed algorithm and presented the protocol operation. Finally, they show the algorithm performance in UMTS and WiFi when different coding techniques are employed in the server and the network performance is varied in terms of jitter, delay and lost packets.

In “A Learning Automata-Based Uplink Scheduler for Supporting Real-time Multimedia Interactive Traffic in IEEE 802.16 WiMAX Networks”, S. Misra et al. propose a learning automata (LA)-based scheduling algorithm for WiMAX uplink real-time multimedia interactive traffic in a point to multipoint architecture. The authors design an efficient algorithm for providing QoS to real-time uplink traffic. Simulation studies show that the proposed algorithm results in an increase of throughput and decrease in delay and packet loss for real-time service flows compared to non-real-time traffic.

The paper “A Multi-criteria Network-aware Service Composition Algorithm in Wireless Environments” by Y. Luo et al. proposes a novel service composition algorithm for wireless networking environments, which considers not only the application-layer QoS such as price, reputation, etc., but also network-layer QoS parameters such as network availability and network delay. This cross-layer QoS guarantee proves to be important for providing smart and interactive ubiquitous multimedia services. The QoS-aware service composition is formulated as a multi-dimension multi-choice 0–1 knapsack problem (MMKP).

In the paper “Understanding the Impact of Neighboring Strategy in Peer-to-Peer Multimedia Streaming Applications”, X. Zhang and H. Hassanein investigate Peer-to-peer (P2P) file sharing applications, and study packet propagation behavior and the impact of neighboring strategies on system performance in P2P multimedia streaming applications. It is found that in the swarm-based scheme, packets propagate along short paths (in terms of hops) on the neighboring overlay, while in the tree-based scheme, peers select parents randomly with respect to their hop counts to the source peer.

**Secure multimedia gathering and sharing**

The first paper “Research on Secure Data Collection in Wireless Multimedia Sensor Networks” by K. Lin et al. seeks to establish a safe multimedia data interactive environment. Due to the vulnerability of smart multimedia devices to attacks, the authors propose a trust evaluation model for detecting intrusion and recognizing compromised nodes. Comparison to traditional security schemes, the proposed model can find the compromised nodes even if the attacker gets all the keying materials. In such a model, each node performs local trust management by computing the trust values of its neighbors based on their behaviors. Moreover, an energy-efficient secure routing is designed to realize safe and energy-efficient data collection for ubiquitous multimedia service. Simulation results show that the proposed trust evaluation model and routing scheme have high performance in terms of detection ratio of compromised nodes and energy efficiency.

The paper “HealthShare: Achieving Secure and Privacy-preserving Health Information Sharing through Health Social Networks”, X. Liang et al. introduce an attribute-oriented authentication scheme and a secure transmission scheme for secure health applications that are built on online social networks. The authentication scheme enables users to prove that they indeed have some health-related attributes, while the secure transmission scheme supports fine-grained access control on health information where the access policy is designed by the users themselves. Extensive security analysis shows that the proposed schemes can effectively resist forgery attacks, attribute-trace attacks, eavesdropping attacks, etc.
and collusion attacks. Simulation results show the satisfactory performance of the proposed schemes in terms of effective and efficient communications.

**Multimedia Localization**

The last part describes two papers for localization problems for multimedia contents.

In “An Interactive Cluster-based MDS Localization Scheme for Multimedia Information in Wireless Sensor Networks”, M. Shon et al. present the cluster-based multi-dimensional scaling (CMDS) localization scheme that enables accurate localization for multimedia services without additional positioning devices. In general, the topographical location information of data acquired by a sensor is applied for smart, interactive multimedia services. Localization for multimedia services in a wireless sensor network using the well-known MDS-MAP localization method results in a computational overhead of $O(n^3)$ and larger localization errors in an environment with holes. CMDS performs the MDS algorithm by locally generating clusters, resulting in a relatively lower computational overhead than MDS-MAP and improves localization accuracy, even in an environment with holes. Simulations demonstrate that the proposed CMDS approach provides up to 23% improvement in localization accuracy compared to the newest version of conventional MDS-MAP, hierarchical MDS (HMDS) in a sensor network environment with holes.

In the last paper entitled “Understand Traffic Locality of Peer-to-Peer Video File Swarming”, H. Wang et al. examine the BitTorrent video file swarms in regard to the locality issues through large-scale measurements. The authors suggest that video files are obviously very popular in BitTorrent networks. Most of these video file swarms contain very large files and great numbers of peers that pose significant pressure to the Internet service providers. However, the distribution of the autonomous system (AS) clusters (a set of peers belonging to the same AS) follows the Mandelbrot-zipf law. This indicates that only the peers in a few ASes are likely to form large AS clusters. Most ASes on the Internet do not have enough local resources to optimize this video traffic. Therefore, a selective locality mechanism is proposed to address the problem based on a novel prediction method.

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