Large Scale Cooperative Virtual Environments

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EDITORIAL

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The recent advances in networking have determined an increasing use of information technology to support interactive networked cooperative applications. Several novel applications have emerged in this area: social networks, distributed virtual environments (DVEs), collaborative learning systems, large-scale crowd-based applications, and mobile collaborative platforms. This kind of applications can be generally referred as Large Scale Cooperative Virtual Environments. The definition of these applications requires affording several challenges such as the design of user interfaces, coordination protocols, mobility models, and proper middleware and architectures supporting distributed cooperation. Collaborative applications may greatly benefit from the support of different kinds of platforms, both cloud and peer to peer and also platforms recently proposed for the Internet of things (IoT) like fog computing. Integration of different platforms, for instance, mobile and cloud environments, is currently a challenge. Furthermore, the analysis and validation of the huge amount of content generated by these applications asks for proper data analysis and processing techniques. The special issue's aim is to investigate open challenges for such applications, related to both the applications' design and the definition of proper architectures. Some important challenges are, for instance, collaborative protocols design, large-scale processing of user information, privacy and security issues, state consistency/persistence, and efficient support definition.

This special includes six high-quality papers, five of them are extended versions of the papers accepted and presented at the 4th Workshop on Large Scale Distributed Virtual Environments on Clouds and P2P held in conjunction with Euro-Par 2016 in Grenoble, France, in August 2016. In the following, we give a brief description of each paper.

De Salve et al in the paper *Predicting the availability of users devices in decentralized online social networks*[1] investigate whether availability patterns of users in online social networks (OSNs) can be predicted. The paper proposes a flexible linear predictor whose goal is to estimate the future availability of a user (ie, online or offline) by taking into account only the availability history of that user. The information returned by the predictor is useful to support information allocation/diffusion in distributed OSNs (DOSNs). The predictor may be configured by setting a set of parameters like the size of the period of time in the future to predict and the size of the elapsed period of time exploited for the prediction. Furthermore, the paper proposes several selection strategies to choose users more likely to be online in a time interval. These strategies can be exploited to select the peers which host data replica in a DOSN.

The paper *Efficient and scalable execution of smart city parallel applications*[2] presents an analysis and prediction of internet traffic generated by vehicle and pedestrian devices moving across a "smart avenue". The authors consider smart city applications requiring that the computation regarding a region of the city is performed using the information received from a subset of neighbor regions. This approach is based on a local synchronization paradigm that enables restricting the synchronization of the computation only among a limited number of parallel nodes, without the need for a central coordinator node. The paper analyzes the advantage of this approach when compared to the all-to-all one, where all the nodes need to synchronize before proceeding to the next computation step. The paper uses a Petri net approach to model and analyze the smart avenue and can be easily adapted to different scenarios.

In the paper *Distributed environment for efficient virtual machine image management in federated Cloud architectures*,[3] a set of novel approaches for the efficient management of distributed virtual machine image (VMI) repositories in federated Cloud environments, is presented. The paper presents a set of tools to simplify the creation of lightweight and highly optimized VMIs tuned for specific application requirements. Furthermore, the paper presents efficient mechanisms for streamline support of complex VMI operations. The new proposals are implemented as essential components of the ENTICE environment whose main aim is to provide a universal backbone architecture for efficient support of VMI management operations, regardless of the administrative boundaries between multiple distributed repositories.

Brambilla et al in *An open Web application framework for peer-to-peer location-based services*[4] present a framework for location-based services (LBSs), which rely not upon centralized infrastructure but on a decentralized, peer-to-peer solution. The paper presents an Adaptive Distributed Geographic Table (ADGT) overlay scheme and assesses the proposal both by simulations and by field tests carried out in the University Campus by sets of students. The framework is based on Adgt.js, a novel and truly cross-platform, for the development of ADGT-based peer-to-peer LBSs. One of the main features of Adgt.js is that it provides software interoperability between all possible and heterogeneous devices to make sure that the adoption is high. For this reason, Adgt.js has been developed by using advanced cross-platform technologies such as WebRTC, WebSocket, and JavaScript.

Bujari et al[5] present *Optimal configuration of active and backup servers for augmented reality cooperative games*, a hybrid architecture combining online games and mobile devices. In these architectures, gamers endowed with augmented reality visors connected as wireless nodes in an ad hoc network can interact with each other while immersed in the game. The authors propose a hybrid architecture where one of the player nodes acts as the server of the game, whereas other backup server nodes are ready to become active servers in case of network disconnection, ie, due to low

energy level of the currently active server. This allows having a longer gaming session before a disconnection occurs due to energy exhaustion. In particular, the paper discusses the server election strategy with the aim of maximizing network lifetime and, to this end, a Mixed Integer Linear Programming model is considered.

The last paper, *Model driven generation of mobility traces for distributed virtual environments with TRACE*,[6] presents TRACE, a Java software library for the generation of avatar movement traces for DVEs, which can be easy integrated in different systems. TRACE enables an easy embedding of already designed mobility models for the evaluation of DVE architectures. TRACE is able to generate mobility traces for a wide variety of DVE- and human-based mobility models and provides interfaces for the definition of personalized mobility models. Furthermore, the environment is designed to be fully configurable in order to adapt to heterogeneous approaches and scenarios. The environment includes many additional tools, for instance, it gives the possibility to combine multiple models in the same trace. Furthermore, the paper includes a comprehensive related work study on mobility models and mobility traces analysis for DVE. Finally, the integration in TRACE of a new mobility model for Multiplayer Online Battle Area is presented.

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