ABSTRACT

This chapter introduces advances in fog computing technology for involving various participants—either small or large in capacity, either local or remote—into the service construction. Non-typical computational devices (compared with traditional computers, for example, laptops, desktops, servers)—such as smartphones, wireless routers, multimedia equipment, and consumer electronics—become aware of information processing in order to construct services essentially based on local resources of the IoT environment.

INTRODUCTION

Modern digital environments include many networked computational devices representing the Internet edges (Shi, Cao, Zhang, Li, & Xu, 2016). Such devices become “smart objects” experienced by users as real participating entities due to the intelligent activity of software agents running on the devices (Augusto, Callaghan, Cook, Kameas, & Satoh, 2013). The new opportunities
are utilized with the emerging concept of Smart Spaces (SmS) (Korzun, 2014) and its underlying network connectivity layer of Internet of Things (IoT) (Kortuem, Kawser, Sundramoorthy, & Fitton, 2010). In a smart space, its devices are able to discover each others’ resources. Many devices in the IoT environment are mobile and heterogeneous in respect to their resources and provided functions (Kamilaris & Pitsillides, 2016), although the number of edge devices can be relatively low compared to IoT environments with large wireless sensor networks.

Edge (or localized) IoT environments become surrounding humans in their everyday lives and work. New applications are deployed using SmS based on fusion of resources from the physical (surrounding reality), information (virtual or cyber space), and social (human activity) worlds (Korzun, Balandin, Kashevnik, Smirnov, & Gurtov, 2017). The semantics of resources are shared using ontological models for representation. The resources become open for service construction performed by involved local and remote participants.

Now IoT leads to appearance of dedicated connection boxes and computational equipment (e.g., embedded in many homes), personal mobile devices (e.g., smartphones and tablets carried by users), and ubiquitous wireless networks (e.g., in many public places). The dependability suffers since the service construction moves from remotes servers to local surroundings—the Internet edge (Korzun, Varfolomeyev, Shabaev, & Kuznetsov, 2018). Some data processing is performed by intermediary devices, i.e., on network data transfer paths to the servers (cloud infrastructure). Furthermore, social computing explicitly involves humans to the computation and decision making loop. This vision is supported with the two emerging IoT-enabled paradigms: Edge-centric computing (Garcia Lopez et al., 2015) and Fog computing (Dastjerdi & Buyya, 2016).

Generally, IoT environments are becoming large, highly dynamic, hyperconnected, and functionally distributed (Korzun, Balandin, & Gurtov 2013). Typically, an IoT environment consists of multiple heterogeneous networks with a large number of networked elements and users’ devices. Further evolution of the IoT concept envisions increasing of the number of connections by yet another order of magnitude from currently connected approximately 10 billion “things”. This will result in unprecedented challenges in network scalability, resource efficiency, privacy considerations, and overall management of this multitude of “things”. The traditional models of networks organization would have serious problems to deal with it, so more and more often some alternative ways to network virtualization are considered (Patouni, Merentitis, Panagiotopoulos, Glentis, & Alonistioti, 2013).
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