Chapter 5

The Role of Autonomous Computing, Cloud Computing, and Multimedia in IoT

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ABSTRACT

Connecting a large number of physical objects equipped with sensors to the Internet generates what is called “big data.” Big data needs smart and efficient storage. The emerging and developing technology of cloud computing is defined by the US National Institute of Standards and Technology (NIST) as an access model to an on-demand network of shared configurable computing sources such as networks, servers, warehouses, applications, and services. The manual installation and management of IoT devices becomes impractical due to the large numbers involved. Specifically, there exists an inefficiency that can be resolved by minimizing user intervention. The manual maintenance of a large number of devices becomes inefficient, and demands the presence of intelligent and dynamic management schemes. In addition, Internet of Things systems cannot successfully realize the notion of ubiquitous connectivity of everything if they are not capable to truly include ‘multimedia things’.

INTRODUCTION

Internet of Things (IoT) is playing a major role in extending the reach of the existing communication systems to include resource constrained devices. Many exciting research works for IoT have been proposed for management of such devices such that human intervention is minimized. This is a challenge due to the high heterogeneity,
high complexity of the devices and the lack of dynamic management schemes (Ashraf & Habaebi, 2015). This chapter introduces the paradigm of autonomic computing to be used for such dynamic yet secure management in IoT. The adoption of the autonomy in IoT architecture can prove to be a valuable addition to IoT systems.

The IoT employs a large number of embedded devices, like sensors and actuators that generate big data which in turn requires complex computations to extract knowledge. Big data is so huge such that it exceeds the capability of commonly used hardware environments and software tools to capture, manage, and process them within an acceptable slot of time. Cloud computing enables researchers and businesses to use and maintain many resources remotely, reliably and at a low cost. Therefore, the storage and computing resources of the cloud present the best choice for the IoT to store and process big data.

Cloud computing has been established as one of the major building blocks of the Future Internet. New technology enablers have progressively fostered virtualization at different levels and have allowed the various paradigms known as “Applications as a Service”, “Platforms as a Service” and “Infrastructure and Networks as a Service” (Friess, 2013). Such trends have greatly helped to reduce cost of ownership and management of associated virtualized resources, lowering the market entry threshold to new players and enabling provisioning of new services. With the virtualization of objects being the next natural step in this trend, the convergence of cloud computing and Internet of Things will enable unprecedented opportunities in the IoT services arena (Hassan, Song & Huh., 2009). As part of this convergence, IoT applications (such as sensor-based services) will be delivered on-demand through a cloud environment. This extends beyond the need to virtualize sensor data stores in a scalable fashion. It asks for virtualization of Internet-connected objects and their ability to become orchestrated into on-demand services (such as Sensing-as-a-Service).

IoT systems cannot successfully realize the notion of ubiquitous connectivity of everything if they are not truly capable to include ‘multimedia things’. Sample use-cases include ambient assisted living and patient monitoring based on telemedicine, integrated monitoring systems of smart homes, advanced multimedia surveillance of smart cities involving real-time sensor data acquisition. However, the current research and development activities in the field do not mandate the features of multimedia objects, thus leaving a gap to benefit from multimedia content based services and applications. Besides, the so-called “Internet of Multimedia Things” (IoMT) (Alvi, Afzal, Shah, Atzori & Mahmood, 2015) introduces features and network requirements that are different from those of the typical resource-constrained IoT landscape. IoMT is a novel paradigm in which smart heterogeneous multimedia things can interact and cooperate with one another and with other things connected to the Internet to facilitate multimedia based services and applications that are globally available to the users.
Model Based Approach for QoS Constrained Communication and Data Integration among Multiple Agents
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