Chapter 11
The Co-Evolution of Cloud and IoT Applications:
Recent and Future Trends

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ABSTRACT

Internet of things (IoT) is developed to enhance easy communication by creating a large network of billions and trillions of entities. It serves an important role in future technologies about vast attention from different organizations. IoT is integrating a number of software and applications from different cloud services. This chapter presents the current IoT application, current cloud applications, current cloud applications based on IoT, future trends of IoT, and IoT-based cloud applications and their future research challenges.

INTRODUCTION

In around 2000, the Auto-ID centre at MIT developed a community based on Radio-Frequency Identification (RFID), which is believed to be first use of the IoT concept (S. Li, Da Xu, & Zhao, 2015; Ray, 2015). The International Telecommunication Union (ITU) officially introduced IoT in early 2005 stating IoT as a new dimension to the world of information and communication technologies (ICTs). The IoT will create a new dynamic network of networks aiming to provide services anytime, anyplace connectivity for anyone and anything (Palattella et al., 2016).

The IoT is one of the most important technologies of this era. IoT intends to develop our daily life by accumulating the interconnectivity of an accumulated variation of fixed computing devices applying fundamentals of the current Internet infrastructure. IoT uses a unified Internet Protocol (IP) among all the next generation mobile networks and wireless systems (5G) to make communication more seamless. The 5G SIM cards or 5G connection packs can be put into gateway nodes which maintain interoperations among different networks of 'things' (or even put into every node). These 'things' can be accessed using their IP addresses. IoT already has an established network which is more useful for this situation. IoT which is strictly linked to the Internet of Service (IoS) aims at handling a large number of objects in the Internet to provide services to the application users (Nitti, Girau, & Atzori, 2014; Sheng, Mahapatra, Zhu, & Leung, 2015; Want, Schilit, & Jenson, 2015).

Content-oriented data, large number of use with portable devices, different communications among user and smart device with the need of connecting any people anywhere, anytime is the main objective of the future Internet. One of the main mechanisms of the future Internet is the IoS, which will be responsible to manage every internet-based service ranging from monitoring small device of the smart home to controlling the whole industrial manufacture procedure. For that to achieve, IoT will create connection between the device-to-device and human-to-device both. Soon, everything will be organized with small surrounded devices which can connect to the Internet. This device-to-device connectivity will bring huge benefit for different fields in our daily routine: i.e., construction works, capitalization, and surveillance system (Tuna, Örenbaş, Daş, Kogias, & Baykara, 2016).

The number of connected devices is in IoT are increasing day by day. The ever-increasing connected things are creating large data flow over the internet. This enormous number of connected devices and data requires high performance computing. To cater these services cloud is being evolving simultaneously with IoT. There have been substantial number of IoT application developed based on cloud platform. IoT applications and cloud-based services (e.g. Software as a Service, Information as a Service) will complement each other in terms of processing large data from large number of connected devices.

This chapter provides a holistic perspective on the IoT and cloud computing concept and development, including a review of application fields, future technologies and research challenges of IoT based cloud application.

IoT APPLICATIONS

IoT can be used in different organisations and can benefit those organizations by improving their data collection methods. Using real time or most up-to-date data, it can improve the way of using and accessing different hardware components including smart devices, and connect to the different online ICT technologies to increase the business value, efficiency and productivity of an organisation (Djahel, Doolan, Muntean, & Murphy, 2015). Acoustic sensor networks, used in various underwater and underground applications are increasingly becoming a part of IoT applications (X. Wang, Li, Zhen, & Zhang, 2016).

IoT services serve organisations by:

- **Enhancing data collection process:** The data that seems to be sophisticated today can be enhanced by IoT to become simpler for ease of use. This enhances supply chain management and restocking in an organisation. For instance, pay-as-you-go service can be expanded not to be limited to parking meters and vending machines but to be universally used in almost all applications.

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