Chapter 19
Design and Development of Framework for Platform Level Issues in Fog Computing

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ABSTRACT

Fog computing is a paradigm that extends cloud computing services to the edge of the network. Fog computing provides data, storage, compute and application services to end users. The distinguishing characteristics of fog computing are its proximity to the end users. The application services are hosted on network edges like on routers, switches, etc. The goal of fog computing is to improve the efficiency and reduce the amount of data that needs to be transported to cloud for analysis, processing and storage. Due to heterogeneous characteristics of fog computing, there are some issues, i.e. security, fault tolerance, resource scheduling and allocation. To better understand fault tolerance, we highlighted the basic concepts of fault tolerance by understanding different fault tolerance techniques i.e. Reactive, Proactive and the hybrid. In addition to the fault tolerance, how to balance resource utilization and security in fog computing are also discussed here. Furthermore, to overcome platform level issues of fog computing, Hybrid fault tolerance model using resource management and security is presented by us.

INTRODUCTION

Fog computing has been seen as most prominent by overcoming recent challenges in IoT, Cloud and big data. Fog computing ensures quality of services, i.e. delay sensitive, data sensitive, low latency in daily life activities, data sensitive and real time applications. Fog puts all computation, storage and networking resources closer to the end users. Fault-tolerant scheduling technique that takes care of performance variations, resource fluctuations and failures in the environment is important. In addition to fault toler-

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ance, resource allocation, resource utilization and security inside fog computing platform level are other issues. Internet of Things (IoT) connects sensors, actuators, smart devices such as mobile phones, traffic controller, energy controller, wearable devices, connected vehicles etc., to internet to make everything smarter and linked. To deal with daily tasks, every organization and individual IoT device are immensely dependent on smart devices and computers. Cisco predicted that the average 50 billion ubiquitous devices will be connected by 2020. These kinds of smart devices are expected to generate 2.3 zettabytes (or 194 exabyte) data per year by 2020. The data generated by IoT devices and sensors has improved greatly. With the sudden immense in the volume of data being produced and inability of conventional databases to process various forms of structured and unstructured data. It is important to prioritize the analysis of collected data to extract useful insights to make important decisions. Conversely, due to the limited storage and computation on smart devices, Cloud computing is viewed as one of the most computing paradigm attractive choice to support such data storage, computation, communication, processing and distribution. Software as a service (SaaS), Platform as a service (PaaS) and Infrastructure as a Service (IaaS) are the most common services provided by cloud. All these services are heading towards Anything as a Service (XaaS). However, data generated from billions of sensors, referred as big data, cannot be transferred and processed in the cloud. In addition, some IoT applications need to be processed faster than the cloud's current capability. Increasing challenges in cloud computing to satisfy the IoT's application demands due to intrinsic problems, i.e. lack of mobility, unreliable latency, traffic congestion, network bandwidth constraints. These issues are caused by mainly due to more physical distance between cloud service provider's data centers such as Google, Amazon wed services, Facebook, etc.

Fog computing appears as an substitute solution to reduce the load of Data Centers in traditional cloud computing, support geographically distributed, latency sensitive and Quality of services aware IoT applications. Fog computing is a decentralized computing concept, which does not exclusively rely on any central component like cloud computing. It is able to overcome the high latency problem off the cloud by using idle resources of various devices near users. However, Fog computing relies on the cloud to do complex processing. Unlike cloud computing, fog computing is a decentralized computing concept, are utilized. Currently even a low specifications smart phone has processing capacity, sometimes with multiple cores. Hence, many devices like smart phones, switches, routers, base stations, and other network management devices equipped with processing power and storage capacity can act as Fog devices.

Fog computing is emerging to reduce many research challenges like ubiquitous connectivity and heterogeneous organization. The requirement and deployment are key issues driven by fog computing. This is because the devices that exist in Fog computing environment are heterogeneous. New challenges are resource management and failure handling in fog computing. So, the question arises: How will be tackle new challenges by fog computing? It is necessary to investigate essential requirements i.e. resource management, fault tolerance, service requirements, security and privacy requirements. Several reviewers have done several reviews on fog computing.

Fog computing concepts, definition, architecture, applications and various challenges are described in numerous study. Hierarchical architecture, which contains computing, storage, communication, resource management, security and privacy layers, is presented by Varshney and Simmhan (2017) and Perera, Qin, Estrella, Reiff-Marganiec, and Vasilakos (2017), present various dimensions of applications, architecture, challenges, Platform level perspectives of fog computing. Any fault or failures occurs during retrieving and processing of accurate sensor data, which may lead to serious problems for any applications. To ensure reliable data transmissions, some fault tolerance algorithm is necessary to be investigated. In addition to fault tolerance algorithms, how to balance resource utilization and security inside fog

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