Chapter 1
The Challenges, Technologies, and Role of Fog Computing in the Context of Industrial Internet of Things

Sasikala Chinthakunta
Srinivasa Ramanujan Institute of Technology, Anantapuramu, India

Shoba Bindu Chigarapalle
https://orcid.org/0000-0002-3637-507X
Jawaharlala Nehru Technological University, Anantapur, India

Sudheer Kumar E.
https://orcid.org/0000-0003-2752-0711
Jawaharlala Nehru Technological University, Anantapur, India

ABSTRACT

Typically, the analysis of the industrial big data is done at the cloud. If the technology of IIoT is relying on cloud, data from the billions of internet-connected devices are voluminous and demand to be processed within the cloud DCs. Most of the IoT infrastructures—smart driving and car parking systems, smart vehicular traffic management systems, and smart grids—are observed to demand low-latency, real-time services from the service providers. Since cloud includes data storage, processing, and computation only within DCs, huge data traffic generated from the IoT devices probably experience a network bottleneck, high service latency, and poor quality of service (QoS). Hence, the placement of an intermediary node that can perform tasks efficiently and effectively is an unavoidable requirement of IIoT. Fog can be such an intermediary node because of its ability and location to perform tasks at the premise of an industry in a timely manner. This chapter discusses challenges, need, and framework of fog computing, security issues, and solutions of fog computing for IIoT.

DOI: 10.4018/978-1-7998-3375-8.ch001

INTRODUCTION

The "Internet of Things (IoT) refers to embodiment of the continuous convergence between the physical aspects of human activities and its reflection on the data world " (Puliafito et al., 2019). The fast technological advancements have remodeled the industrial sector. They extended the industrial business to the automation of industrial processes by avoiding man power interaction in the industry. In the framework of IIoT, the operation of complex physical machines are interconnected with networked sensors and software applications. It is the technological enabler of significant improvements in the efficiency of modern industrial processes. It consist of sensor networks, machines, robots, actuators, machines, appliances and personnel. Here, the data acquired from the sensors and machines are analyzed to get the valuable data to run factory operations. Generally, industrial big data analysis is performed at the Cloud end.

Generally, Cloud involves Data-Centric Network's (DCNs), which provides resources for storage and computation to the clients. So every service request and demands of the customers are analyzed and processed within the remotely located DC's . However, with the increased number of devices associated with the internet and growing technological advances of the IoT, the data handled by the cloud DCs is significant.Both cloud computing and IoT have a gratuitous working relationship.The IoT produces large quantities of data while cloud computing provides a way for that data to reach its destination, thus it helps to make the work more effective (Xu, 2012).

Technological development in manufacturing refers to an advanced manufacturing model enabled by IoT,cloud computing, service-oriented technologies and virtualization that convert manufacturing resources into services that can be accessed and distributed extensively. Even though cloud computing offers several advantages for IoT, its approach normally disputes with

the framework of IIoT. Most often cloud DCs are remote, it may leads to undesirable latency on transmission when the network traffic is heavy. Another limitation of cloud computing is implicit dependency, also known as "vendor lock-in" from the book *Enterprise cloud computing for non-engineer*.

If the technology of IoT depends on cloud (Atlam et al., 2018)collected data from the trillions of devices in the network are enormous and the data should be processed within the cloud DCs for analysis or visualization.Because the IoT devices don't have enough storage,compute and networking resourcesand they are battery powered.Hence IoT uses powerful resources provided by the cloud for storage and computation(Ramli et al.,2019).

The heterogeneous devices on the IoT network may produces numerous data traffic, it leads to high service latency, network bottleneck and poor Quality.Because in the cloud environment computation,data storage and processing done within DCs,they are available remotely to the end users.

Moreover, in order to process many user requests, the DCs must be up and working 24x7 without fail, which eventually result in a huge amount of energy being used.The IIOT includes various sensor devicesd and machines, they produce the large volumes of data for analysis.The data may be time-dependent or sensitive. Therefore, to take some decisions very quickly the data should be processed locally rather than DCs. Machines in the IIoT scenario require a timely response, unwanted delays can result in severe catastrophic failures.

Bonomi et al. proposed the Fog Computing (FC) model as a way of expanding cloudbased technologies to the network edge, sharing processing, storage, and networking resources and services along the CloudtoThings continuum, closer to IoT devices' topological proximity.So, the placement of a special node called fog node as an intermediate node to perform tasks efficiently and effectively is a crucial need in IIoT. Due to its placement and ability to do tasks fog is an intermediary node to perform specific