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Edge Computing:
A Review on Computation Offloading and Light Weight Virtualization for IoT Framework

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ABSTRACT

In this article, the researchers have provided a discussion on computation offloading and the importance of docker-based containers, known as light weight virtualization, to improve the performance of edge computing systems. At the end, they have also proposed techniques and a case study for computation offloading and light weight virtualization.

KEYWORDS

Cloudlet, Computation Offloading, Container, Fog Computing, Mobile Edge Computing, Virtualization

1. INTRODUCTION

In the current trend of technology (Wang & Alexander, 2016), the emergence of IoT is considered for enabling real-world applications and it has been justified by following technologies such as sensors and embedded systems, ultra-low power based processors, Radio Frequency Identification (RFID), mobile services, cloud and fog computing, wireless communication etc. The computation off-loading is performed using cloud and fog technologies for managing large-scale data analysis and managing huge operations.

The questions raised by IoT designer is so challenging and there may be multiple solutions exist: i) trade-off between quality of service and energy consumption, ii) off-load data for computation and storage or consider on-board processing, iii) which communication technology is applied under certain requirements to bring IoT system more adequate for real-world operations? iv) requirement analysis for relevant range of IoT devices for communication, considering data-rate and low-power devices constraints etc. The data generated from IoT devices including audio, video or unstructured data is processed using big-data approach. In Figure 1, the IoT edge computing layers are shown to manage the services from cloud to smart devices.

The different computing mechanism (Premsankar, Di Francesco, & Taleb, 2018) for IoT edge computing is discussed below:

- **Device level:** This mechanism is used mainly for low-power requirements and the major decision is required to perform computation on device itself or to offload it for better computation;
- **Gateway level:** It is also known as smart phone centric approach. It is used for those devices which require more computational power and useful for healthcare and engineering applications.

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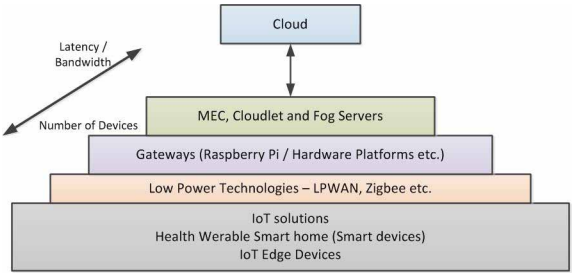
Figure 1. Fundamentals of IoT Edge Computing (Premsankar, Di Francesco, & Taleb, 2018)



It is able to manage the data communication through the wireless communication and the issues concern with latency is required to minimize for better performance;

- **Fog level:** This layer is able to give more computation power compared with device and gateway approaches. It is a micro cloud activity to manage the data closer to the user and it is able to solve data analysis at greater depth;
- **Compare to cloud computing:** It is used to reduce latency and bandwidth issues for different IoT applications;
- **Cloud level:** It is mainly used for server processing at cloud and big data can be processed to provide decision making in different cloud layers.

In Figure 2, three different edge computing platforms (Premsankar, Di Francesco, & Taleb, 2018) are shown and the comparison of edge system to the fog and cloud systems are shown with necessary elements.

2. IOT-ENABLE MIDDLE LAYER TECHNOLOGIES

In this section, three different IoT-enable middle layer technologies are discussed below:

1. Fog Computing

The fog computing (Ai, Peng, & Zhang, 2018; Atlam, Walters, & Wills, 2018; Yi, Li, C., & Li, Q., 2015) is useful for variety of tasks between cloud and edge architectures for end-to-end IoT applications. The fog is used between cloud to things providing different services such as storage, computation and networking. The fog is different than the edge, as it is the concept in which services are provided among networks and between different devices that reside at the edge. The fog is extension to cloud at finer detail for service proving at closer to the user, while edge is known to work without cloud. The IoT data is very huge in amount that is generated by various applications. The fog nodes are considered as key elements for cloud-IoT solution and it is used to perform data analysis and mining of data generated by sensor devices to perform faster execution. The fog architecture is designed to provide decision making of such sensor data to manage IoT devices. The fog computing is useful for face recognition-based security and privacy issues, driver based assistance service, healthcare and emergency based latency services etc.

For example, considering vehicle-to-vehicle application, the processing is to be performed with the support of middle layer platforms, so it is mandatory to offload data at any cost. Using fog computing, fog manager can handle offloading request between fog orchestrator and fog abstraction layers. It can manage certain issues such as quality service, optimal fog node selection, load balancing