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A Review of Fog Network implementations in current IoT products

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***Abstract*— More and more "Smart devices" are coming online every year. These Smart Devices have the ability to communicate with other Smart Devices across the web, exchange information and make intelligent decisions. More connected Smart devices mean larger streams of data. This influx of new connections has caused the services that manage those Smart devices to come under heavy load. To combat this, measures have been taken to process the data as close to its origin as possible. Some of those measures involve the addition of certain "supervisor" devices to the network, in turn causing the networks to increase in complexity. This paper is a review of existing IoT products, and the measures taken within them to combat complexity in IoT networks especially of those formed due to Fog Networks.**

Keywords—Fog Networks, Edge Computing, Edge Gateways

I. Introduction

Before the advent of the Technological Revolution, household items simply performed the tasks they were built for. They were known as "dumb" things. Then a concept known as the "Internet of Things" (IoT) came along which made it possible for any end user device to have Internet connectivity. This allowed devices to connect to other as well as online services for extended functionality [1]. Ever since the first internet accessible Smartphones appeared in the mid-90s, connected devices have increased in complexity and grown in intelligence [2]. This in turn has caused the networks they were connected to, to grow in complexity as well.

In traditional IoT architectures, all data generated from connected devices are sent to the Central Server for storage and further analysis. The added complexity from new devices that are connecting to the network has caused additional load to be applied on the central servers orchestrating the communication between those devices. A new concept known as "Edge Computing" aims to combat this. It refers to the computational logic that is done close to or at the source of the generated data [3]. Edge Computing proposes that a certain amount of preprocessing be done at the edge without delegating everything to the Central Server [4]. Fog Computing (via Fog Networks) is one way in which Edge Computing can be implemented.

The aim of Edge Computing (implemented through Fog Networks) is to reduce the load on the Central Server. But on the flip-side as more Fog Networks with different devices get added and network structures get more modularized, the Central Server is left uninformed. Thus, more attention should be given to the *relationship* between the Network Edge and the cloud than each of those components individually.

This paper is a study on how existing IoT products handle that complexity at an architectural level. It would include a mix of both mainstream and obscure/novel implementations to better gauge new and upcoming trends in this field. The study would focus on how those products would handle complex networks on the Central Server end, especially those created due to hierarchical fog networks/device arrangements. These are the networks that are formed when Edge Gateways are nested one under another while other devices are also connected to them. This creates pockets of Fog Networks (also known as Cloudlets) that inevitably increase network complexity [1].

This paper is structured so that section 1 includes the introduction and the background. This will be followed by section 2 of which the first portion would focus on the various terminology and techniques used within this domain, while the latter part will focus on the study of existing products, their reference architectures and features. The paper would conclude with section 3.

II. Literature Review

According to the Eclipse Foundation, a typical IoT network comprises of several tiers [5]. Those tiers are;

1. The Central Server
2. Edge Gateways
3. Edge Devices

All of the above tiers take part in strengthening the relationship between the Cloud and the Edge. In order to better understand what functions each of those tiers perform, it is needed to explore and investigate existing research and look at current implementations that have attempted to combine them together.

A. Edge Computing

The "Edge" in this context refers to the literal geographic location. So, when taken together as "Edge Computing" it translates to computational logic that is done close to or at the source of the generated data [3].

Prior to its' usage in IoT devices, similar concepts have been implemented in the web development space for its' inherent advantages. In the 1990s, the American cloud service provider Akamai; introduced CDNs (Content Delivery Networks) to accelerate web performance [6]. As the consumption of web content increased with higher

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