# The Impacts of E-Commerce as a Service upon Fog Computing

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***Abstract*—Fog Computing is a technology that extends cloud computing and services to the edge of the network. It provides data, compute, storage and application services to the users like cloud. From kitchen equipment to aeroplane, started getting an IP address which has also been a part of internet. In the past few years, the great transmission of theoretical concept of different industries such as E-commerce into real application has been used by cloud computing. Based on adopted fog features and characteristics those are encouraging small companies that providing their E-commerce products to adopt their development into fog computing. In order to assist the E-commerce small companies with the right way to start with the basic requirements and upgrading their computing resources as their fog user base grows with time, herewith the impacts of E-commerce as the services upon fog computing is proposed.**

***Index Terms*—Fog Computing, Cloud Computing, Cisco, Internet of Things, E-Commerce and E-Commerce as a Service.**

## I. INTRODUCTION

We are embracing the prevalence of ubiquitously connected smart devices, which are now becoming the main factor of computing. Along with the development of wearable computing, smart metering, smart home/city, connected vehicles and large scale wireless sensor network, the Internet of Things (IoT) has received attentions for years and is considered as the future of Internet. IDC (International Data Corporation) has predicted that in the year of 2015, "The IoT will continue to rapidly expand the traditional IT industry" up 14% from 2014" [1]. However, due to the limited computation/storage on smart devices, cloud computing is considered as a promising computing paradigm, which can provide elastic resources to applications on those devices. In spite of attempts of augmenting IoT applications with the power of cloud, there are still problems unsolved in that IoT applications usually require mobility support, geo-distribution, location-awareness and low latency.

Fog computing is proposed to enable computing directly at the edge of the network, which can deliver new applications and services especially for the future of Internet [2]. For example, commercial edge routers are advertising processor speed, number of cores and built-in network storage.

The main goals of this paper are (1) to formulate fog computing based E-commerce as a service model to examine the advantages and disadvantages of fog computing upon E-commerce. (2) To enhance the E-commerce based on fog features and characteristics, and (3) to analyzes the impacts of fog computing on E-commerce enterprises in detail.

In this paper, in section 2 we present an overview of fog computing. Section 3 describes the key characteristics of fog computing. E-commerce and E-commerce as a service have been described in detail at section 4. Impacts of fog computing upon E-commerce are presented in section 5. In, section 6 presents some concluding remarks.

## II. FOG COMPUTING: OVERVIEW

Fog computing is an emerging technology that is basically used for IoTs .Fog computing fetches data and services from network centre to the network edge. Similar to Cloud, data, compute, storage, application services are given to the end-users by the fog. Fog computing is a distributed computing model that fetches centralized located data storage, processing and application and given to the network edge device(set top box, access point). Fog computing is a technique that is locally hosted where the user uses the service. To be simplified fog computing is a model that provides IoT data processing, storage instead of sending to cloud it is locally processed in smart devices. Both Cloud and fog structure are for compute, storage and networking resources [3]. The IoT architecture and fog computing illustrated in Fig. 1.

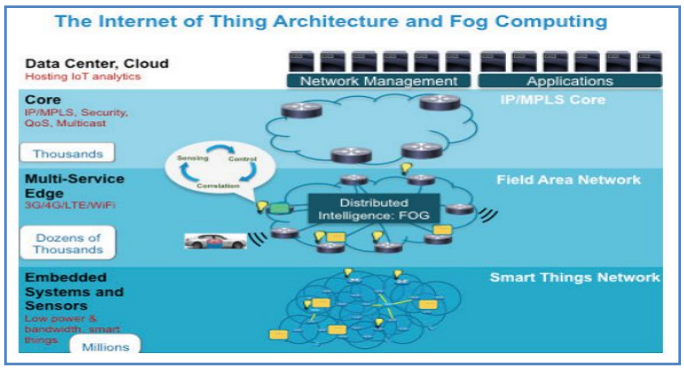



Fig. 1: The IoT Architecture and Fog Computing

In fog computing data collected by sensors are not sent to cloud server instead it is sent to devices like network edge or

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set top box, routers, access point for processing thus by reducing the traffic due to low bandwidth. Fog computing improves the Quality of service and also reduces latency.

Small computing works are locally processed and responses are sent back to the end users without the use of cloud.

So, fog computing is emerging as a better option than cloud computing for smaller computing works. Fog computing plays an important role by reducing the traffic of data to the cloud. Since fog system is placed near to the data sources computation and communication are not delayed.

CISCO gives us the example of jet engine. Whenever the jet engine is connected to the internet, half an hour running time of the jet engine creates 10 TB of data. This huge data itself will create a big traffic in the bandwidth which cannot be neglected. So comes the importance of fog computing. Fog computing is complementary to cloud. Certain features of fog computing differentiate it from cloud, Fog Computing is used for real time interactions but cannot totally replace cloud computing as it is preferred for high end batch processing. As the name suggests cloud system is placed at a distant where as the fog system is placed locally near to the end user.

The idea behind transmitting data to network edge is the concept of fog computing and this has been made possible by CISCO iox platform. Open source software Linux and CISCO ios network operating system are combined to form the architecture of iox. There will be two Operating System for communication and computation in Cisco routers. The Communication and computing requirement for Internet of Things has been provided by a single platform called iox. Linux transforms routers to mini-computer by which we can run third party application.

The Cisco iox allows users to host their OS and application in its open and extensible environment. Thus we can develop our own smart application to capitalize on the power of fog computing. The Iox platform provides an SDK and middleware services by which we can host our application, interface and analyze data locally in real time. It has the capability to support and deploy users business logic in the network device nearby to the one next data for immediate action. It consumes lesser time by connecting your application with any protocol, device or interface. Iox platform analyze data in real time [3]. An architecture of fog computing is shown in fig. 2.

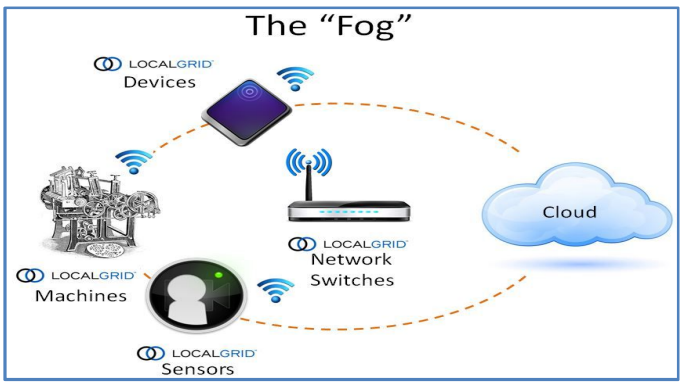



Fig. 2. Fog Computing Architecture [4]

## III. KEY CHARACTERISTICS OF FOG COMPUTING

- *Heterogeneity:* Fog Computing is a highly virtualized platform that provides compute, storage, and networking services between end devices and traditional Cloud Computing Data Centers, typically, but not exclusively located at the edge of network. Compute, storage, and networking resources are the building blocks of both the Cloud and the Fog [4].
- *Edge Location, Location Awareness, And Low Latency:* The origins of the Fog can be traced to early proposals to support endpoints with rich services at the edge of the network, including applications with low latency requirements (e.g. gaming, video streaming, augmented reality) [5].
- *Geographical Distribution:* In sharp contrast to the more centralized Cloud, the services and applications targeted by the Fog demand widely distributed deployments. The Fog, for instance, will play an active role in delivering high quality streaming to moving vehicles, through proxies and access points positioned along highways and tracks [5].
- *Large-Scale Sensor Networks to Monitor the Environment:* the Smart Grid are other examples of inherently distributed systems, requiring distributed computing and storage resources [5].
- *Very Large Number of Nodes:* as a consequence of the wide geo-distribution, as evidenced in sensor networks in general and the Smart Grid in particular.
- *Support for Mobility:* It is essential for many Fog applications to communicate directly with mobile devices, and therefore support mobility techniques, such as the LISP protocol, that decouple host identity from location identity, and require a distributed directory system.
- *Real-Time Interactions:* Important Fog applications involve real-time interactions rather than batch processing.
- *Interoperability and Federation:* Seamless support of certain services (streaming is a good example) requires the cooperation of different providers. Hence, Fog components must be able to interoperate, and services must be federated across domains [5].

## IV. E-COMMERCE AND E-COMMERCE AS A SERVICE

We are in the midst of an E-commerce-driven revolution in retail. Prior to the mid-1990s, E-commerce didn't exist. Today, business-to-consumer (B2C) E-commerce is a $1 trillion per year business worldwide [6]. In addition to becoming increasingly important to business, E-commerce is a fairly unique use case within Information Technology (IT). It's perhaps the most visible platform a retailer has, either influencing or directly contributing around half of revenue.

Failures lead to front-page news, disclosures in earnings calls, reduction in stock price, and firings. Most applications are just not that important if payroll is processed five hours late, nobody cares. All customer touch-points are increasingly

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likely to be facilitated by E-commerce, as point-of-sale systems are being replaced with tablets that connect to a single E-commerce platform. An outage now is the equivalent of barring customers from entering all physical stores. Because of increasing competition and the maturity of offerings, customers are increasingly fickle about performance. They expect response times to be instant [7].

E-commerce is a type of industry where buying and selling of product or service is conducted over electronic system such as the Internet and other computer networks. E-commerce draws on technologies such as mobile commerce, electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management system, and automated data collection system. Modern E-commerce typically uses the World Wide Web at least at one point in the transaction's life cycle, although it may encompass a wider range of technologies such as e-mail, mobile devices social media, and telephone as well. E-commerce is generally considered to be the sales aspect of e-business. It also consists of the exchange of data to facilitate the financing and payment aspects of business transactions. This is an effective and efficient way of communicating within an organization and one of the most effective and useful ways of conducting business.

Currently there are five types of cloud-based E-commerce as: Consumer to business E-commerce (C2B E-commerce), Business to business E-commerce (B2B E-commerce), Business to consumer E-commerce (B2C E-commerce), Consumer to consumer E-commerce (C2C E-commerce) and Intra organizational E-commerce (IO E-commerce).

## V. E-COMMERCE AS A SERVICE UPON FOG COMPUTING: IMPACTS

The impacts for E-commerce as a service for fog computing that could be concluded as:

- Fog computing offers safe and reliable service of data storage and calculation, as thus modify client's demands for terminal equipments greatly, make it easy to share data and distribute resources reasonably for all fog users, and simultaneously offers almost infinite space and service in time whenever clients need.
- Fog-based E-commerce as a service help fog provider to have customers all around the globe and not be limited to a specific region.
- Huge distributed fog system improves information processing capacity and calculation efficiency greatly while on-demand service and provided by fog computing and brand-new mobile terminal brought out by 3G make fog users no longer worry about the security of service nor the problems of information processing and data transmission.
- Fog-based E-commerce as a service helps increase profits in fog computing; it can increase sales and decrease costs.
- Fog-based E-commerce as a service provide personalized product and fog user customization.
- Fog-based E-commerce as a service supports rapid responses to market opportunities and challenges, compared with licensed or internally developed on-premises applications.
- Fog-based E-commerce as a service' lower costs and faster deployments enable IT and business leaders to evaluate new opportunities without large upfront investments.
- The wide range of fog-based E-commerce as a service and integration platforms offers IT leaders great flexibility when choosing deployment models and suppliers.
- Fog computing can provide economics dependable E-commerce system, SaaS is a kind of software which generally provides the service.
- The variety of fog-based E-commerce as a service offerings means IT leaders must understand the pros and cons of each option to select the best infrastructure approach for their needs.
- Fog-based E-commerce as a service increases flexibility and ease of shopping for the fog user.
- By virtue of the fog computing platform an E-commerce enterprise can choose and rent IT products and services based on its demand so as to establish the technical architecture.
- E-commerce companies can start with the basic requirements and upgrade their computing resources as their customer base grows with time.
- Fog-based E-commerce applications as a service enable businesses to rapidly respond to market changes. However, IT leaders need to understand the potential trade-offs involved with using fog E-commerce applications, including higher long-term costs and potential reduced control over the customer experience.
- Fog-based E-commerce as a service helps organizations bring higher return on advertisements, if managed properly.
- Fog computing enables E-commerce enterprises to rent rather than purchase hardware and software, which helps them to decrease the cost of system building.
- To realize the fog marketing. Based on a powerful background data, intelligent analysis and optimal proposal of marketing should be offered to realize the fog marketing. To minimize the operation cost, enterprises only need to focus on the core sector.
- Fog computing solved the problem of resources utilization efficiency. For an E-commerce company, it is necessary to invest on the software and hardware to maintain the operation. With the company’s growth, the investment will be increased. However, the utilization efficiency of the invested infrastructure is low due to the sales season and the change consumers’ behavior.

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- Fog-based E-commerce as a service helps organizations identify new suppliers, partners and customers.
- Through fog platform, enterprises use E-commerce software system as required at any time and pay in accordance with service time and the scale of resource occupation, all of which save expenses. The software used are the latest version and no personnel is needed to maintain them.
- Fog computing can provide good economic efficiency for the application of business enterprise E-commerce.
- Operation and management based on fog computing. E-commerce business can process data flexibly during its operation and management. So long as the demand of calculation and storage is knowable, fog computing can be applied to realize the automation of the solutions in application, without considering the position of equipment resources.

## VI. CONCLUSION

The term fog computing in no longer a buzz word, but indicates how corporate information and E-commerce applications are stored online, can be accessed and shared. Fog computing offers many benefits to the E-commerce. The speed of building E-commerce websites, the cost savings of infrastructure and the reliability of a stable platform are just a few examples of the benefits of a fog service. Through the conducting of this research we believe that, we can create an E-commerce as a service in order to assist the E-commerce small companies with the right way to start with the basic requirements and upgrading their computing resources as their fog user base grows with time, based on fog computing on fog features and characteristics. Thus, this creation will open up a new space for the smooth development of E-commerce.

However, these E-commerce models are still in the early stages of exploration and applications. The external services as internet service provider, IT service provider, software developer, fog users, system integration provider and hardware suppliers. Some problems issues faces E-commerce fog computing such as fog security issues, challenges, the standard that fog computing services provide, internet connectivity, regulatory issues of fog services, technical issues and lack of relevant laws and regulations in the fog are not well resolved yet in practice, pending further research and exploration. Either way, E-commerce application model based on fog computing will not stop its pace to proceed. As the fog computing technologies become more sophisticated and the applications of fog computing become increasingly widespread, E-commerce will certainly usher in a new era of fog computing. The E-commerce as a service model will enhance the productivity in the E-commerce applications, it reduces the investment costs and it also improves the computational power of E-commerce applications.

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