FOG COMPUTING FOR MOBILE AD-HOC NETWORKS: PARADIGM, SCENARIO AND ISSUES

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ABSTRACT

MANET is an association of large no. of sensor nodes and having self directed commands using the unprotected wireless connection. The individual needs in the network can accompany and leave the network without any permission. MANET is an infrastructure less network. The network topology is rapidly changed due to nodes mobility, resource constraints and bandwidth limitation of wireless medias. This nature of nodes leads to different type of security threats. Manet suffers from disruption so that nodes are not able to take part in path finding method with a target to spoil full network functioning. In this paper, readers can have a more thorough understanding of fog computing for MANET and the trends in this domain.

Keywords

Manet, Fog Computing, Cloud Computing, comparison, Mobility.

1. INTRODUCTION

It is impressive that automotive industry has a huge development in recent years. With the improvement of software, hardware and communication technology, the design and implementation of several types of networks deployed in different environments are upgrading, especially for mobile ad-hoc network termed as MANET. MANET is a wireless network formed by collection of mobile nodes without the preset infrastructure. When network topology changes nodes in range is still connected. The major shortcoming is their limited bandwidth, memory, processing capabilities and open medium and so these are more prone to malicious attacks [8]. Manet is flexible and maintains the connectivity between devices when a node moves from one location to another.

Manet has a wide usage. That's why there are several open issues about it, such as security threats, its operation cost, mobility, data management, finite bandwidth, malicious broadcasting messages, reliable data delivery, dynamic path establishment and limited hardware.

Cloud Computing is the hottest technology within recent years. With the development of Manet, resources as computing, storage and networking are needed by users much increasing in different scenario, a no. of solution based on cloud computing is emerged. According to the requisite and affordability of users, this platform provides vastly manageable and scalable virtual servers, virtual networks, computing resources, storage

resources. It offer a solution to process distributed contents. But, it cannot meet all the requirements of QoS (Quality of Service) in Manets so that new technology and architectures are needed.[8],[9]

Fog Computing is a paradigm that extends cloud computing and service to the edge of networks. As opposed to the clouds, which I more centralized, fog computing is aimed at services with widely distributed deployment. With one of the attribute localized, low latency communication and more context awareness in fog computing is possible. Fog computing provides all the benefits of cloud computing as well as new resources and benefits for Manet. It also reduces the burden on clouds and analysis real time data stream with clouds etc. Any device with computing, storage and network connectivity can be a fog node.

The goal of this article is to investigate the key features of fog computing and identify its main application for Manet. The structure of rest of the paper is organized as follows: section 2 summarize the related work on fog computing focusing on its concept, features and making comparison to cloud computing. Section 3 presents the application scenario fir MANET. Section 4 represents challenges and issues. And make conclusion in section 5.

2. FOG COMPUTING

Fog computing is closely related with internet of things (IoT)[5]. IoT is generating an unprecedented volume and variety of data. But by the time data makes its way to the cloud for analysis, the opportunity to act on it might be gone. In Cisco's white paper, intended for IT and operational technology professional, explains a new model for analyzing and acting on IoTs data. It is called either edge computing or fog computing.

Analyzes the most time sensitive data at the network edge, close to where it is generated instead of sending vast amount of IoTs data to the clouds.

__Acts on IoTs data in milliseconds, based on policy.

__Sends selected data to the clouds for historical analysis and longer term storage. [6]

Next section, the concept of fog computing will be introduced and characterization will be presented.

2.1 Concept of Fog Computing

Stolfo coined the term FOG computing where technology is used to protect the real sensitive customers from disinformation attacks against malicious insiders[1].Fog computing was first introduced by Bonomi in 2012[2]. Fog computing is defined as "a scenario where a huge no. of heterogeneous (wireless and sometime autonomous) decentralized devices communicate and potentially cooperate among them and with the network to perform storage.

2.2 Characterization of Fog Computing

Fog reduces service latency, and improves QoS, resulting in superior user experience. The majority fog characteristics includes: proximity to customer, geographical distribution, and support for mobility. The different characteristics of it are listed below:

Edge location, location awareness, and low latency: at the edge of network, fog computing supports endpoints with finest services, reducing in data movement across the network significantly.

Geographical distribution: This computing consist of very large no. of distributed nodes, as a consequences of wide geo distribution, as evidence in sensor network general, and the smart grid in particulars. The service and application objective of the fog is widely distributed for example fog will play an important role in delivering high quality streaming of data.

Support for mobility: LISP (Locator/ID Separation Protocol) is a routing and addressing architecture developed by CISCO system. It provide mobility technique, fog applications can communicate directly with mobile devices.

Heterogeneity: fog nodes are highly heterogeneous at different levels of network hierarchy for low latency and scalability requirements.

Interoperability: fog components must be able to interoperate, wide range of service require the cooperation of different providers.

2.3 Comparison to cloud computing

Real time applications with which users directly interact with are badly affected by delay and delay jitters caused by latency in network. In table 1, the difference between fog and cloud computing are summarized. [13]

Table 1 Comparison of fog computing and cloud computing

	FOG COMPUTING	CLOUD COMPUTING
TARGET USER	**Mobile Users**	**General internet users**
CONNECTIVITY	Wireless interface, power in the physical proximity and communicate through	Faraway from users and communicate through IP network
FEATURES OF SERVICES	Low latency for real time application	High latency for real time application
	Support for mobility	Limit to support for mobility
	Less demand for bandwidth	Sensitive for bandwidth

	Single hop wireless connection to server at the edge of local network	Multiple hops with servers internet connection.
	Limited storage and compute power	Ample and scalable storage space and compute power
	Light weight data analytics	Long term data analytics
WORKING ENVIORNMENT	Outdoor or indoors	Warehouse size building with air conditioning system.

3. APPLICATION SCENARIO FOR MANET

Currently, we just list the application scenario based on fog computing in MANET. Due to advantage of edge location, Fog computing has the ability to support application with low latency requirements. For example, gaming, augumented reality, real time video stream processing based on fog server and fog node. Typical applications include:

A. Military battlefield: military equipment now contains some sort of computer equipment. Ad-hoc networking allows them to use of commonplace network technology to maintain the information.

B. Commercial sectors: Ad-hoc networking can be used in rescue operation for disaster relief efforts. Other commercial scenario includes e.g. ship to ship ad-hoc mobile communication, law enforcement.

4. CHALLENGES AND ISSUES

In this section, major challenges and potential issues in the context of fog computing will be identified and discussed. Some of them would be the direction for future work.

(i) **Security and privacy:** To date, there are few works focusing on security and privacy issues in fog computing. Dsouza et al. [3] proposes a policy based resources access control in fog computing, to support secure collaboration and interoperability between heterogeneous resources. Privacy preserving techniques is not mentioned in fog computing. In the fog network, privacy preserving algorithm can be run in between the fog and cloud since computation and storage are sufficient for both sides while those algorithm are usually resource prohibited at the end devices.[4]

(ii) **Data management:** In fog computing**,** all the data should be managed properly. At the time of disaster, earthquake etc where no means of communication left. Then everybody wants to contact with their dear ones. A lot of data is received and transferred. So that time data should be transferred according to their priority bases.

(iii) **Low Operation Cost**: Data transfer cost must be less.

5. CONCLUSIONS

This paper presents fog computing and a frontier concepts for MANETs. The architecture, several interesting application scenario, challenges issues of fog computing in MANET have been identified and discussed. We have outlined the vision and key characteristics of fog computing a platform to deliver a rich portfolio of new services and application at the edge of network. Fog computing supports emerging Internet of Everything(IoE) application that demand real time/ predictable latency. Thanks to its wide geographical area of distribution the Fog paradigm is well positioned for real time big data and real time analytics. Fog supports densely distributed data collection points, hence adding a fourth axis to the often mentioned big data dimensions. Many challenges will be there like its security and privacy issue, its operation cost, its mobility, providing a data management scenario for future work.

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