Abstract No: SC-10 **Smart Computing**

A self-configuring communication protocol stack for fog-based mobile ad-hoc networks

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Abstract

This paper introduces a self-configuring communication protocol stack for fog-based mobile ad-hoc networks. The rapid development of Internet of Things (IoT) technologies have made mobile ad-hoc networks (MANETs) to become pervasive in our everyday lives. In MANETs, the nodes dynamically get connected and disconnected with other nodes of the network while maintaining the quality of service (QoS). However, when the devices have to contact frequently to cloud-based servers for various services and, as well as when the number of devices connected increases, the QoS could drop drastically due to high bandwidth consumption and the consequent latency. Fog computing (as well as edge computing) aims at shifting data processing and other services offered by cloud-based servers in a computer network towards the edge of the network to minimize the issues raised due to latency. Given these circumstances, combining 'fog computing' with MANETs seems a promising solution that enhances the QoS. However, the definition of fog computing is still debatable and, as well as the technologies are still being developed. Even though a reasonable foundation has been laid by the various concepts, there is a necessity for further research on different algorithms to meet the harsh requirements of node discovery, connectivity, communication and latency when combining fog computing with MANETs. The protocol stack presented in this paper addresses the issue of node discovery and peer-to-peer communication in MANETs in a fog network. The methodology involves a build and test approach in which the conceptual protocol stack has been implemented for messaging between mobile peers in a Wi-Fi network without connecting to the Internet.

Keywords: Fog computing, Internet of Things, MANETs, Node discovery

Introduction

The rapid development of Internet of Things (IoT) technologies have made mobile ad-hoc networks (MANETs) to become pervasive in our everyday lives. Even though the military tactical communication could be considered as the fundamental or primary application of MANETs (Giordano, 2002), there is a growing range of commercial and other applications such as vehicular ad-hoc networks (VANETs) (Kai et al., 2016), sensor networks, rescue missions in natural disasters, low enforcement operations, etc. (Giordano, 2002). There will be 50 billion connected mobile devices by 2020 according to Cisco and these impressive numbers will soon be overpassed by the myriad of sensing/acting devices placed virtually everywhere (Vaquero and Rodero-Merino, 2014). According to (Das, 2013), MANETs have the key characteristics of dynamic topology, shared medium, absence of infrastructure, multi-hop scenario and resource constraints. Thus, maintaining the quality of service (QoS) in MANETs is always challenging.

When the number of nodes connecting with a MANET grows, for example in IoT environments like VANETs, there would be a huge demand for resources such as