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Efficient Wireless Fog Networks Management by Software Defined Networking

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Abstract:

Today's Recent emerging technology is Fog computing or fog networking, which brings the cloud computing services such as communication, computation, network control and storage, closer to the network edge wireless devices. In order to improve network reliability and latency and to overcome the issues caused by geographically distributed locations in cloud-computing, fog has been introduced, Since the one-hop communication in the network edge is predominantly wireless.

Wireless mesh networks are being considered to build wireless fog networks. Fog networks consist of fog nodes. Each node may be routers , embedded servers , switches , video surveillance cameras, fog nodes works according to the type of data they receive and IOT application should be installed to each fog nodes . The wireless fog devices are increasingly used locally , such as for intra vehicle communication and intra sensor communication etc. Where data generated and consumed locally. To make such and future solutions fog computing architecture should enable real time data sharing across the range of platforms such as embedded sensors , mobile servers wirelessly. Each fog node is imagined as wireless router to its neighbour to provide resilient network with high capacity data transfer fault tolerance as well as higher availability. To manage this isolated fog computing infrastructure we use a centralised SDN control plane. Software Defined Networking is a network architecture approach that enables the network to be intelligently and centrally control and manage entire networks .

Apart from this we need to provide a routing protocol which selects the best path to forward the packet. But some distributed routing protocol take their routing decision based on local knowledge of each router's neighbour , thus this neighbourhood reflects only a partial visibility of the network, which limits the ability to perform global network management and monitoring the fog networks. so we require a SDN-enabled wireless fog architecture that combines both open flow and distributed wireless protocol ,which provides a flexible deployment and management of fog infrastructure and a hybrid routing protocol that performs data forwarding and global and optimal path selection as well as monitoring the entire network

Introduction

Fog Computing [1] is an emerging technique to bring cloud computing services, such as communication, computation, network control and storage, to the network edge. Fog services can be hosted at users' edge wireless devices to increase network stability and latency, and solve the challenges originating from geographically spread sites in cloud computing. Additionally, fog computing requires on discoverable, generic, forward-deployed servers positioned in singlehop proximity of mobile devices [2]. These servers should be utilized to offload expensive computing at the network edge, execute data filtering to remove extraneous material from streams intended for dismounted users, and serve as collection points for data heading towards business archives. Obviously, the number of users in the fog network is often bounded as we can anticipate in advance what the size of the network is, how big a group of wireless users, similar to regular wireless access points in public environment such as airports, cyber-coffee, etc.

Fog-detector-based wireless fog devices are also increasingly being used locally, such as for intra-vehicle communications, intra-sensor communication, and smart energy management in intra-buildings, in which data are generated and consumed locally. Fog computing architectures are needed to enable wireless real-time data sharing across a variety of platforms, such as mobile servers and embedded sensors, in order to create such solutions and future ones. Since each fog node is a wireless router, the system can provide fault tolerance and higher availability for its nearby neighbours while also acting as a resilient network. A new approach to testing new protocols has been proposed in the form of Software Defined Network (SDN) [6]. The refactoring of wireless protocols into processing and decision planes in SDN enables the creation of modular and declarative programming interfaces across the wireless stack. On the other hand, an external SDN controller is used to centralise the network's management and control. In contrast, software pipelines holding abstracted flow tables replace the hardware pipelines of traditional routers. There are a number of flow tables that can be customised and fine-tuned by the controller.

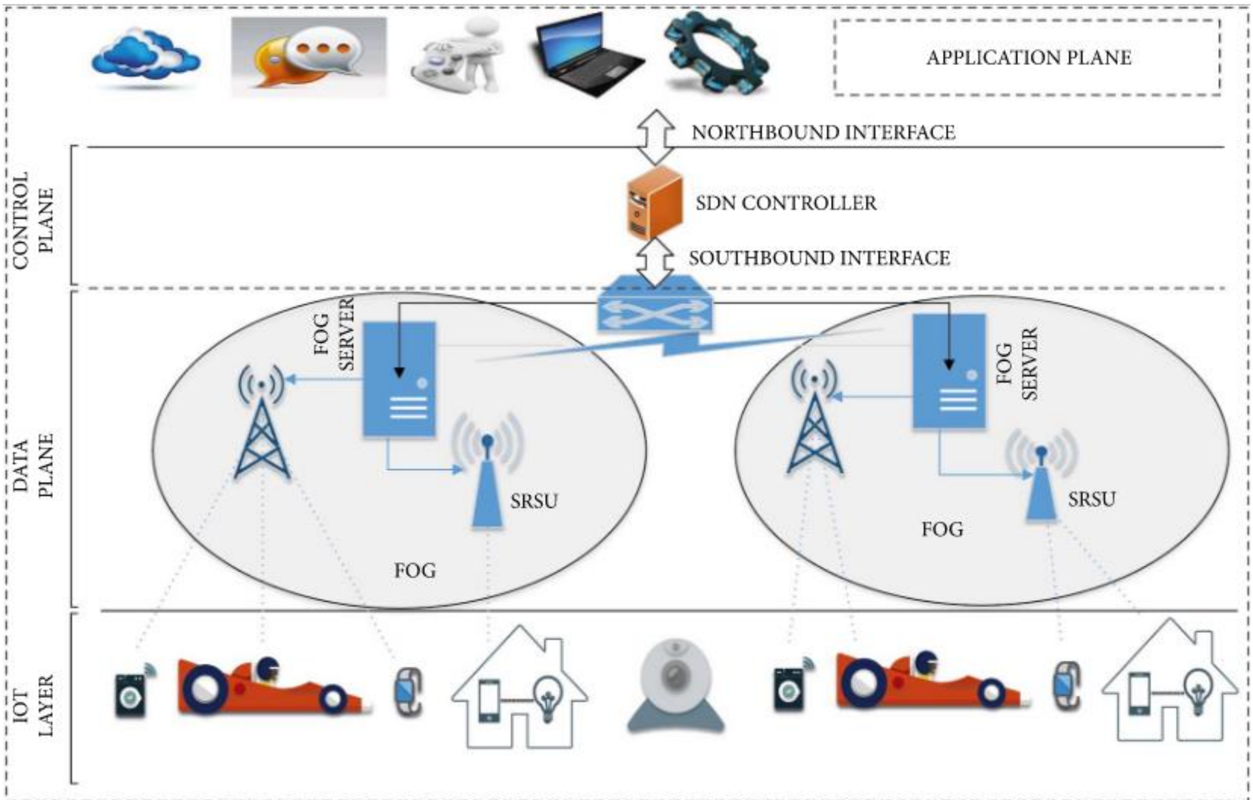

Figure 1 Architecture of SDN fog-to-IoT communication.

As a result of the wide distribution of its services, fog computing provides end-users with better administration services. Fog computing also has the unique feature of supporting heterogeneous devices. An LSTM network designed by Diro and Chilamkurti [7] can detect cyber-attacks with a high degree of accuracy in the open stack environment, especially when large and confidential data is being transported. As a result, a detection framework is required for the majority of Internet of Things (IoT) devices. It is critical for a company to have an Intrusion Detection System (IDS) to prevent cyberattacks. IDS-based deep learning was proposed by Chockwanich and Visoottiviseth [8]. An RNN and a CNN were used to identify different types of attacks by analysing their outputs. Fog-to-IoT computing is a rapidly growing topic, yet it faces a significant security risk. New and growing cyber-attacks can be detected early and efficiently utilising DL algorithms in fog-to-IoT communication using an SDN-based DL architecture (Figure 1). The CIDDS-01 dataset is used for both performance and evaluation.

Literature Survey

[1] This article considers an opportunity of Fog implementation for Alert Services on top of Wireless Sensor Network (WSN) technology. In particular, we focus on targeted WSN-alert delivery based on spontaneous interaction between a WSN and hand-held devices of its users. For the alert delivery, we propose a Gravity Routing concept that prioritizes the areas of high user presence within the network. Based on the concept, we develop a routing protocol, namely the Gradient Gravity Routing (GGR) that combines targeted delivery and resilience to potential sensor-load heterogeneity within the network. The protocol has been compared against a set of state-of-the-art solutions via a series of simulations. The evaluation has shown the ability of GGR to

match the performance of the compared solutions in terms of alert delivery ratio, while minimizing the overall energy consumption of the network.

[2] This paper surveys the state-of-the-art in programmable networks with an emphasis on SDN. We provide a historic perspective of programmable networks from early ideas to recent developments. Then we present the SDN architecture and the Open Flow standard in particular, discuss current alternatives for implementation and testing of SDN-based protocols and services, examine current and future SDN applications, and explore promising research directions based on the SDN paradigm.

[3] This paper presents the current state of the research and future perspectives of fog computing in VANETs. Moreover, we discuss the characteristics of fog computing and services based on fog computing platform provided for VANETs. In this paper, some opportunities for challenges and issues are mentioned, related techniques that need to be considered have been discussed in the context of fog computing in VANETs. Finally, we discuss about research directions of potential future work for fog computing in VANETs. Within this article, readers can have a more thorough understanding of fog computing for VANETs and the trends in this domain.

[4] In this article, we elaborate the motivation and advantages of Fog computing, and analyse its applications in a series of real scenarios, such as Smart Grid, smart traffic lights in vehicular networks and software defined networks. We discuss the state-of-the-art of Fog computing and similar work under the same umbrella. Security and privacy issues are further disclosed according to current Fog computing paradigm. As an example, we study a typical attack, man-in-the-middle attack, for the discussion of security in Fog computing. We investigate the stealthy features of this attack by examining its CPU and memory consumption on Fog device

[5]. This survey discusses the definition of fog computing and similar concepts, introduces representative application scenarios, and identifies various aspects of issues we may encounter when designing and implementing fog computing systems. It also highlights some opportunities and challenges, as direction of potential future work, in related techniques that need to be considered in the context of fog computing.

[6]. In this paper, the authors discuss Fog Computing and the way in which it complements Cloud Computing. They also elaborate on the benefits of utilizing Cloud and Fog Computing in concert.

[7]. The proper functioning of mobile ad-hoc networks depends on the hypothesis that each individual node is ready to forward packets for others. This common assumption, however, might be undermined by the existence of selfish users who are reluctant to act as packet relays in order to save their own resources. Such non-cooperative behavior would cause the sharp degradation of network throughput. To address this problem, we propose a credit-based Secure Incentive Protocol (SIP) to stimulate cooperation among mobile nodes with individual interests. SIP can be implemented in a fully distributed way and does not require any pre-deployed

infrastructure. In addition, SIP is immune to a wide range of attacks and is of low communication overhead by using a Bloom filter. Detailed simulation studies have confirmed the efficacy and efficiency of SIP.

[8]. Vehicular Ad-hoc Networks (VANETs) have been attracted a lot of research recent years. Although VANETs are deployed in reality offering several services, the current architecture has been facing many difficulties in deployment and management because of poor connectivity, less scalability, less flexibility and less intelligence. We propose a new VANET architecture called FSDN which combines two emergent computing and network paradigm Software Defined Networking (SDN) and Fog Computing as a prospective solution. SDN-based architecture provides flexibility, scalability, programmability and global knowledge while Fog Computing offers delay-sensitive and location-awareness services which could be satisfy the demands of future VANETs scenarios. We figure out all the SDN-based VANET components as well as their functionality in the system. We also consider the system basic operations in which Fog Computing are leveraged to support surveillance services by taking into account resource manager and Fog orchestration models. The proposed architecture could resolve the main challenges in VANETs by augmenting Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), Vehicle-to-Base Station communications and SDN centralized control while optimizing resources utility and reducing latency by integrating Fog Computing. Two use-cases for non-safety service (data streaming) and safety service (Lane-change assistance) are also presented to illustrate the benefits of our proposed architecture.

[9]. In this paper we study the benefits of applying Software Defined Networking (SDN) to control forwarding in a network of constrained wireless edge devices. The proposed architecture is applicable to dense Small Cell deployments featuring wireless back-hauling and edge computing capabilities, or to wirelessly connected sensor nodes following the fog computing paradigm. The paper introduces a novel path forwarding policy based on SDN, and presents an experimental evaluation demonstrating the benefits of the proposed policy to mitigate external interference, achieve flow balancing, and cope with CPU constrained devices

[10]. Fog computing is considered as a trend for future wireless sensor networks (WSNs) due to low latency and energysaving. However, because different fog services have different quality of service (QoS) requirements and related data are forwarded by content-aware traffic control, it is a must for fog computing advanced WSNs to deploy QoS policy dynamically. Software-Defined Networking (SDN) is a future network technique that makes the underlying networks programmable dynamically. In this paper, we propose a software-defined QoS provisioning mechanism for fog computing advanced WSNs. To our best knowledge, this paper is the first to realize software defined QoS provisioning for WSNs.

[11]. We Present Ad-hoc On Demand Distance Vector Routing (AODV), a novel algorithm for the operation of such ad-hoc networks. Each Mobile Host operates as a specialized router, and routes are obtained as needed (i.e., on-demand) with little or no reliance on periodic advertisements. Our new routing algorithm is quite suitable for a dynamic self starting network, as required by users wishing to utilize ad-hoc networks. AODV

provides loop-free routes even while repairing broken links. Because the protocol does not require global periodic routing advertisements, the demand on the overall bandwidth available to the mobile nodes is substantially less than in those protocols that do necessitate such advertisements. Nevertheless we can still maintain most of the advantages of basic distance-vector routing mechanisms. We show that our algorithm scales to large populations of mobile nodes wishing to form ad-hoc networks. We also include an evaluation methodology and simulation results to verify the operation of our algorithm.

[12]. This document describes the Optimized Link State Routing (OLSR) protocol for mobile ad hoc networks. The protocol is an optimization of the classical link state algorithm tailored to the requirements of a mobile wireless LAN. The key concept used in the protocol is that of multipoint relays (MPRs). MPRs are selected nodes which forward broadcast messages during the flooding process. This technique substantially reduces the message overhead as compared to a classical flooding mechanism, where every node re-transmits each message when it receives the first copy of the message. In OLSR, link state information is generated only by nodes elected as MPRs. Thus, a second optimization is achieved by minimizing the number of control messages flooded in the network. As a third optimization, an MPR node may chose to report only links between itself and its MPR selectors. Hence, as contrary to the classic link state algorithm, partial link state information is distributed in the network. This information is then used for route calculation. OLSR provides optimal routes (in terms of number of hops). The protocol is particularly suitable for large and dense networks as the technique of MPRs works well in this context.

Conclusion

We referred 13 papers which are related to our topic, from this survey we took some topics that are very useful to our research such as fog wireless architecture and its functionality, software Defined Networking structure and its working principle over wireless fog network, knowing the working principle of some protocols such as OLSR,AODV,SIP and open flow standards which are used to find the network structure for easy monitoring and routing the packets efficiently.

After detailed study I have roughly come to a conclusion that ,In existing sytem a SDN-enabled wireless fog architecture that combines both Open Flow and distributed wireless protocols are designed to handle intra vehicle and Intra sensor communication applications. and also provides lower latency and efficient load balancing to offload the network load by enabling programmable fog routers.

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