ISSN: 2366-1313

Secured Trust-based Identity Model for Fog Networks with SDN-based traffic Management and Resource Scheduling

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Abstract

Fog Computing is an extension of the cloud computing model, providing computing resources at the network's edge. It offers similar services to the cloud, including data storage, computation, and application services. Unlike the centralized nature of the cloud, fog computing is decentralized. SDN, with its centralized control and management capabilities, can be a suitable technology to support fog communication. However, it highlights a limitation of the SDN OpenFlow protocol, which is primarily designed for wired networks and lacks support for remote fog networks. Therefore proposed model is described as having a logically centralized network control plane, allowing advanced traffic management and resource management algorithms to be deployed within the SDN framework.A proposed model called "Trust-based Identity model for Internet of Things architecture for handling Fog Networks (TbI-IoT-FN)" to address security concerns in fog networks. This model combines the advantages of software-defined networking and fog computing.model which allows advanced traffic management algorithm to be deployed within the SDN framework.To achieve efficient load balancing in real time applications proper usage of resources are required so,resource scheduling algorithms such as Deep Neural Network (DNN) based Tuna swarm strategy based Bacterial Foraging optimization algorithm (TBFO)is proposed which employs three stages such as monitoring the fog resources, Classification based on deep learning technique and dynamic scheduler that are optimized

Keywords
Fog Computuing, ,SDN TbI-IoT-FN,TBFO,Routing stratergy,fog applications

Introduction

Fog Computing is a distributing computing. Fog computing[1] is a decentralized computing architecture that aims to improve cloud computing performance and reduce data transmission overhead. It involves processing and storing data between the source and a cloud infrastructure. Fog servers play a crucial role in offloading computation at the edge of the network, filtering data, and serving as data collection points for enterprise repositories.

Software-Defined Networking (SDN)[3] is a technology that allows for network programmability and offers more control and flexibility in managing network . In the context of wireless fog networks, the SDN controller is responsible to make fog nodes to communicate with each other and with edge devices by using the OpenFlow and distributed IP protocol[3][4]. The SDN controller consists of a monitoring module to fine-grained control and monitor traffic, and traffic redirection ,but there was a limited focus on secure data transmission and efficient load balancing in wireless fog networks

Proposed Research is focused on developing a fog-based routing protocol for wireless sensor networks with secure data transmissions. Additional security measures are implemented to prevent unauthorized access. The research also aims to reduce transmission costs and minimize the sharing of local information across sensor nodes to conserve energy[2]. Quality of Service (QoS) settings are considered for data routing between cluster heads, fog nodes, and cloud servers. Multiple levels of security are implemented to protect data.

To address the limited resources[6] of sensor nodes, a lightweight, secure, and fog-based power routing protocol is proposed. This protocol aims to reduce network latency , energy consumption and enhancing the safety of data transmission between cluster heads, fog nodes, and cloud servers.

Load balancing is crucial in fog frameworks to evenly distribute the strain on bandwidth and ensure uninterrupted service. Proper allocation of bandwidth during deployment and de-provisioning processes is important. Load balancing involves evenly dividing communication over the network among various assets to improve application efficiency and minimize delays. An innovative approach called TBFO based DNN is proposed to achieve effective load balancing by considering server requirements and computing power,. this approach is derived based on BFO algorithm[7].

Overall, fog computing and SDN offer improved performance and flexibility in managing network traffic and resources. Security, energy efficiency, and load balancing are important considerations in fog

ISSN: 2366-1313

networks to optimize data processing, transmission, and application efficiency.

Literature Survey

[1] Fog computing, an expansion of cloud computing brings cloud services closer, to the edge of networks. Similar to the Cloud Fog provides end users with data, computation, storage and application services. In this article we explore applications of fog computing including its role in software defined networks smart traffic lights in networks and smart grids. We also delve into the advantages and motivations behind fog computing while highlighting the advancements in this field. Additionally we address privacy and security concerns associated with the paradigm of fog computing. To illustrate security vulnerabilities in fog computing we analyze an attack such as a man in the middle attack. Furthermore we investigate the characteristics of this attack by examining its impact, on CPU and memory usage on a Fog device.

[2] In this article we explore the idea of fog computing, as a groundbreaking solution for energy management. The scalability and adaptability of the platform combined with its use of open source software and hardware enable users to implement custom control as services for energy management. This approach not lowers implementation expenses. Also speeds up the time to market, for energy management solutions.

[3] Mendonca and colleagues present a comprehensive review of the progression of programmable networks, covering the early concepts up to the most recent developments. Following that, we provide an introduction to the SDN architecture and delve into the specifics of the Open Flow standard. We then proceed to examine the available choices for implementing and testing SDN-based protocols and services, assess the current and future applications of SDN, and explore potential research directions aligned with the SDN paradigm.

[4] In this study, we introduce Mobile Fog, an advanced programming framework designed for Internet applications that are geographically dispersed, operate on a large scale, and require low latency. By examining scenarios involving camera networks and connected vehicles, we demonstrate the effectiveness of Mobile Fog as a programming model.

[5] The article presents two novel approaches to enhance the energy efficiency. While previous proposals have primarily focused on managing topology information and network scalability, little attention has been given to energy consumption in proactive protocols like OLSR. The suggested abatement in the MPR choosing mechanism of the OLSR protocol, utilizing the concept

ISSN: 2366-1313

of Willingness, aims to extend the network's lifespan without compromising its performance. Additionally, excluding energy consumption caused by overhearing can further prolong the nodes' lifespan without impacting the functionality of OLSR. A comparison between an Energy-Efficient OLSR (EE-OLSR) and the traditional OLSR protocol is conducted, with EE-OLSR demonstrating superior performance. The MDR metric is identified as the most effective in conserving battery energy in a densely populated mobile network with high traffic loads.

[6] The primary objective of this study is to examine the significance of Fog computing in various applications that heavily depend on remote processing or storage. Traditionally, these tasks are carried out in a centralized manner through data centers located in a single location. However, with the emergence of Fog computing, execution and storage can now be distributed across multiple locations, considering factors such as distributed capacity, diverse user applications, and the mobility of smart devices. This analysis specifically delves into the scheduling problem within Fog computing and investigates how user mobility can impact the performance of applications. To optimize execution based on application characteristics, three scheduling policies - concurrent, FCFS, and delay-priority - are thoroughly examined..

[7] The Bacterial Foraging Optimization algorithm is an innovative method of swarming intelligence that demonstrates excellent performance in addressing continuous optimization problems. Nevertheless, it is not commonly utilized for feature selection problems. In this paper, two novel BFO algorithms are proposed: the Adaptive Chemotaxis Bacterial Foraging Optimization algorithm (ACBFO) and the Improved Swarming and Elimination-Dispersal Bacterial Foraging Optimization algorithm .ACBFO introduces two enhancements: the redefinition of the data structure of each bacterium to establish a mapping relationship between the bacterium and the feature subset, and the design of an adaptive method for evaluating the importance of features.

The overall conclusion is that Fog computing is an extension of Cloud computing that brings services closer to the edge of the network, offering data, compute, storage, and application services to end-users. It explores the motivation and benefits of Fog computing, its applications in various scenarios, and addresses security and privacy concerns. Additionally, the survey depicts that the introduction of fog computing as a novel platform for energy management, the evolution and applications of programmable

ISSN: 2366-1313

networks, a high-level programming model for future Internet applications, and proposes modifications to improve the energy performance of the OLSR routing protocol. Finally, it introduces two novel Bacterial Foraging Optimization algorithms for feature selection problems. Which is base concept for by research work.

Research Methodology

SDN is a Contemporary network architecture that uses centralized control intelligence. It can apply its control plane to various networks, such as fog-to-Iota. This is a potential solution for handling large real-time data. In the proposed work concentrates on the SDN-enabled Wireless Fog Network and its various modules which include the development of an optimal routing strategy for packets across fog routers, where as the existing system concentrated on the monitoring and statistics collection capabilities of the software, the minimum ability to offload fog devices during traffic congestion, and the traffic redirection based on limited efficient routing paths, the Partitioning Module for slicing the control plane logic. The proposed work use a centralized SDN controller with a need for improved security measures in fog platforms. Load balancing is predominant task when there is restricted resources available and especially in the Fog computing.

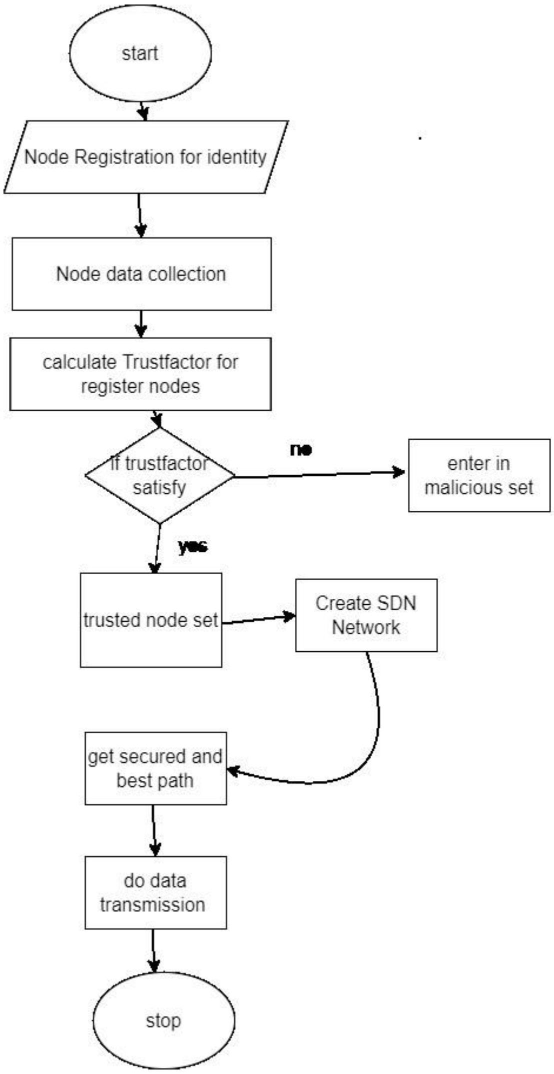

Fig: 1 Flow diagram which depicts the process of finding best secured path to transfer data in fog network

The proposed load balancing employs three stages and are: (I) Monitoring Fog resources, (ii) classification based on DNN and (iii) Dynamic scheduler

Monitoring Fog resources :

In this stage we monitor server and their resources whether they can handle tasks or check the sufficient availability of RAM size, CPU time, processing time etc. These measures can be done based on some measures such as mean storage ,mean computing estimation and mean ram size estimation ,these measures may vary from task to task

Classification based on DNN

After resource monitoring based on the features of server they are classified .In this stage we detect the features of fog server and design a classifier and classify the server whether suitable or not for scheduling

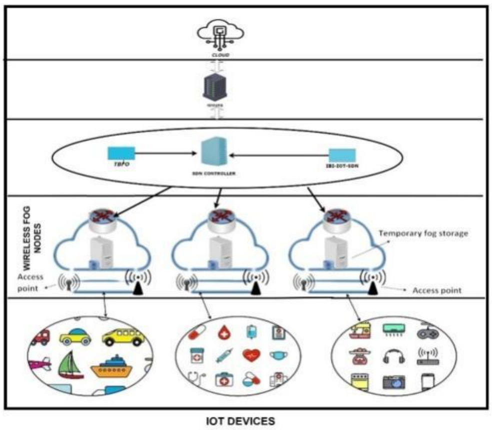

Fig:2 Modified SDN controller to control wireless fog networks

Dynamic scheduler

In this stage we try to schedule the given task to fog servers based on the classification .Here we are introducing TUNA swarm bacterial foraging optimization (BFO) algorithm which has been derived from BFO with. Various kinds of operations which includes the E.coliforaging behavior which was adopted and in this research the bacteria is considered as equal to a task or application which are need to migrate from one server to another fog server, if that fog server is over loaded and labeled as not suitable

Conclusion

The suggested solution demonstrates effectiveness in enhancing communication with lower inactivity, implementing adaptable load balancing, and reducing network overhead. The current security state of fog networks fails to meet the requirements of advanced security. The literature briefly discusses solutions for various security concerns such as data integrity, insider threats, resource access strategy, user authentication, and encryption. To alleviate the computational burden, a SDN controller can be utilized to provide centralized control for a detection technique. By combining IoT sensors and WSNs, high-speed routing can be achieved for network users. A fog-based routing protocol, incorporating dynamic threshold and multi-facet QoS criteria, can optimize network longevity and enhance data security for constraint sensors. The management of wireless fog networks and offloading the network can be efficiently handled by combining different protocols and utilizing an SDN-enabled approach. Future work involves the integration of SDN radio resource management and network resource management to enhance spectrum usage and channel interactions.

The proposed model offers intelligent data

ISSN: 2366-1313

management through machine learning techniques for real-time applications. When determining future security levels, distributed attacks must be taken into consideration.

An innovative deep neural network (DNN) approach is proposed for the allocation of load balancing with available resources. The proposed work involves monitoring server resources, classifying suitable servers, and selecting the appropriate server. Optimization and performance evaluation were conducted using a dynamic scheduling algorithm and the NS2 simulator.

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