VISVESVARAYA TECHONOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi – 590018

A PROJECT SYNOPSIS ON

"Dynamic Urban Evaluation Routing Protocol For Enhanced Vehicle ad hoc Networks"

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Submitted by

SONIKA K (4CA22CS101)

T R MYTHRI (4CA22CS107)

VISMAYA H D (4CA22CS121)

VARSHITHA K S (4CA23CS412)

Under the Guidance of

Prof.Chandana M G

Assistant Professor

Department of Computer Science and Engineering

CAUVERY INSTITUTE OF TECHONOLOGY

Siddaiahna Koppalu Gate,Sundahalli

Mandya – 571402

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ABSTRACT

Recently, a crucial need has grown for improving data communication for the application of roads and ad hoc networks. That is, to provide reliable and operational efficiency in data delivery and throughput. Due to the fast fragmentation and dynamic network behavior, there is an increasing demand to reach reliability in data transmission. Furthermore, the various features and the manifold of dynamic topologies in the vehicular ad hoc network raise the need to redesign the routing strategy. Thus, ensuring efficient and reliable data delivery. This paper aims to introduce a Software architecture for Road Network. The architecture is based on fog computing and aims to improve the overall performance in vehicular networks. The proposed architecture is a new routing design for the urban system to accomplish low energy consumption and operational efficiency in data delivery. The integration between the software defined networks and fog computing platform in the proposed architecture aids to address the high rate of data transmission. Historically, this high rate negatively affected network capacity and power consumption. To prove the effectiveness of the proposed architecture, it is compared with five state-of-art algorithms published in high impact journals. The proposed architecture performance is tested based on four metrics namely packet delivery ratio, network throughput, power consumption, and routing overhead. The experimental results indicate that a 50–60% improvement in both power consumption and packet delivery ratio, while a 60–65% enhancement in network throughput and routing overhead, respectively.

Keywords Fog computing platform · Intelligent transportation systems · Geographic routing protocol · Software-defined-network · Vehicular ad hoc network · Internet of things.

INTRODUCTION

Cities are becoming overcrowded with more people using the roads. This con tributed to increasing traffic congestion, dangerous circumstances, and road accidents. Accordingly, governments' road improvement programs are vigorously pursuing to enhance inland transport system using cutting-edge technologies. Thus, improving roadway safety and reducing traffic congestion. Intelligent Transportation Systems (ITS) combine avant-garde information and leading-edge communication technologies employed in traffic management systems to enhance safety, operational efficiency, sustainability of transportation networks, improve traffic flow and increase drivers' experiences. Vehicular Ad Hoc Networks (VANETs) are considered the heart of the ITS. VANET provides a wide range of advanced automotive solutions to meet the needs of road passengers without compromising the Quality of Service (QoS) requirements. The overall QoS objective is to allow the system to introduce high-quality transport services at an acceptable cost. However, VANET suffers from the lack of data transmission reliability which has a negative impact on the overall network performance due to the quick changes in network design and frequent fragmentation.

Geographical routing protocol is used to address the reliability of data delivery, especially with the networks that are characterized by frequent changes in their topology where there is no need to maintain a static route. The vehicles in geographical routing communicate with each other based on their location. Therefore, each vehicle is keen to share information about its location periodically for keeping the transport system up-to-date. Several challenges appear due to continuous data interchange making the network more susceptible to communication overhead and congestion that affect network bandwidth and power consumption. Otherwise, based on, data transmission among vehicles consume 90% of the entire energy of sensor batteries. Thus, resulting in a short network lifetime and high packet loss rate. Moreover, VANET environment faces inherent wireless network issues such as unpredictable wireless signal, limited bandwidth and unacceptable power consumption in the data transmission process due to its specific characteristics. Locally data storing and processing help the system to create a local overview of the network. Thus, accelerating the geographical routing performance decision making. Fog computing is a decentralized computing model where the location is nearer to the end-user and where data is analyzed and stored without being transferred to a cloud server. Therefore, it provides a proper computing environment in real time with low time latency and without high bandwidth usage. Therefore, fog computing is used to maintain all information about the VANET and rearrange the nodes based on their location.

Thus, informing the proposed routing protocol about the node status. To improve geographic routing and reduce the huge amount of data trans mission across VANET, a geographical architecture based on the integration of Software-Defined Network (SDN) and Fog platform is proposed. This integration offers better-informed solution to support local computing and processing as close as possible to vehicular units. As a result, the consumption of bandwidth and power is reduced by alleviating unnecessary traffic for cloud computing.

LITERATURE SURVEY

Numerous studies have proposed various strategies to enhance routing in Vehicular Ad Hoc Networks (VANETs), particularly focusing on geographic and traffic-aware routing methods.

1. **Greedy Perimeter Stateless Routing (GPSR)**:

- Combines greedy forwarding with perimeter forwarding to solve the local maximum problem.
- Though scalable, it may underperform in throughput compared to protocols like AODV.

2. **Street-Centric and Traffic-Aware Protocols**:

- **Street Centric Routing** adapts geographic routing to transmission rates in urban scenarios.
- Other improvements include perimeter coordination, connectivity awareness, and partial backward routing based on road junctions and traffic patterns.

3. **End-To-End Oriented Management Architecture (EEOMA)** [Ali et al.]:

- Reduces overhead and improves scalability using two data management techniques within a fog-computing framework.

4. **Fog Computing-Based Architectures**:

- **Pereira et al.** designed VANET architecture with fog-enabled RSUs and OBUs, reducing latency and enabling edge analytics.
- **Chen et al.** and others introduced globally distributed fog frameworks to control data upload and save bandwidth.

5. **Clustering and Scheduling Approaches**:

- **Darabkh et al.** introduced clustering to avoid local maxima and minimize bandwidth usage via control overhead reduction.
- **Kadhim** proposed multicast routing with SDN and fog to meet QoS under time/bandwidth constraints.

6. **Advanced Routing with Path Stability Estimation**:

- Combines SDN and fog computing to choose the most stable path when the VANET infrastructure is unreliable.

7. **Service-Oriented Fog-SDN Architectures**:

- Integrate data scheduling algorithms and reduce network delay.
- **Khoury** explored how fog-SDN improves propagation rate and overall performance.

EXISTING SYSTEM

1. **Greedy Perimeter Stateless Routing (GPSR):**

- Uses greedy and perimeter forwarding.
- Faces issues like the *local maximum problem*, which leads to loss of connectivity.

2. **Street-Centric Routing Protocols:**

- Select forwarding nodes based on traffic density, road direction, and distance.
- Helps improve routing in urban environments with grid-like road structures.

3. **Traffic-Aware Geographic Routing Protocols:**

- Includes **perimeter coordinator**, **connectivity-aware**, and **partial backward protocols**.
- Focuses on selecting junction-based nodes to make forwarding decisions.

4. **EEOMA (End-to-End Oriented Management Architecture):**

- Manages VANET data through:
    - Simplified data traffic handling.
    - Interference control at the MAC layer.
- Incorporates fog computing to reduce latency and improve stability.

5. **Fog Computing Architectures:**

- Replaces traditional cloud-only models.
- Offers localized computing via RSUs and OBUs acting as fog nodes.
- Reduces latency and enhances real-time decision-making (e.g., **Pereira et al.**, **Chen et al.**).

6. **Cluster-Based Routing Protocols (e.g., ICDRP-F-SDVN):**

- Utilize clustering to avoid local maximum issues.
- Reduce control overhead and increase delivery rate.

7. **SDN-Fog Integration Models:**

- Combine Software Defined Networking (SDN) and fog computing.
- Enable flexible routing, optimized bandwidth usage, and dynamic service provisioning.
- Examples include **SUAS-HIS**, **EMHR with BwEst**, and **Geo-CAP**.

PROPOSED SYSTEM

The proposed system introduces a novel routing protocol called **Dynamic Urban Evaluation Routing (DUEvR)**, designed to enhance communication efficiency in Vehicular Ad Hoc Networks (VANETs). It integrates a **Software-Defined Network (SDN)** and **Fog Computing** framework, referred to as **SDN-FoG**, to overcome existing issues such as high energy consumption, network congestion, and unreliable data delivery. The SDN-FoG architecture is structured into three layers: the vehicle sensor network layer (including smart vehicles and roadside units), the fog computing layer (which processes and filters data locally), and the cloud layer (responsible for long-term storage and complex computations). The DUEvR protocol improves geographic routing by dynamically selecting optimal forwarding nodes based on real-time vehicle location, energy levels, and connectivity status. It divides the urban VANET environment into variable-sized cells and strategically elects **Fog Head Nodes (FHN)** to coordinate routing decisions within each sector. Additionally, it employs optimization models to maximize fog node coverage using circular packing techniques, and an energy model to extend network lifetime by preventing early depletion of node resources. The proposed protocol significantly reduces routing overhead and enhances overall network performance. Experimental results demonstrate that DUEvR achieves **50–60% improvements in packet delivery and energy efficiency**, and **60–65% gains in throughput and reduced overhead** compared to existing methods such as Geo-CAP, EEOMA, and EMHR.

METHODOLOGY

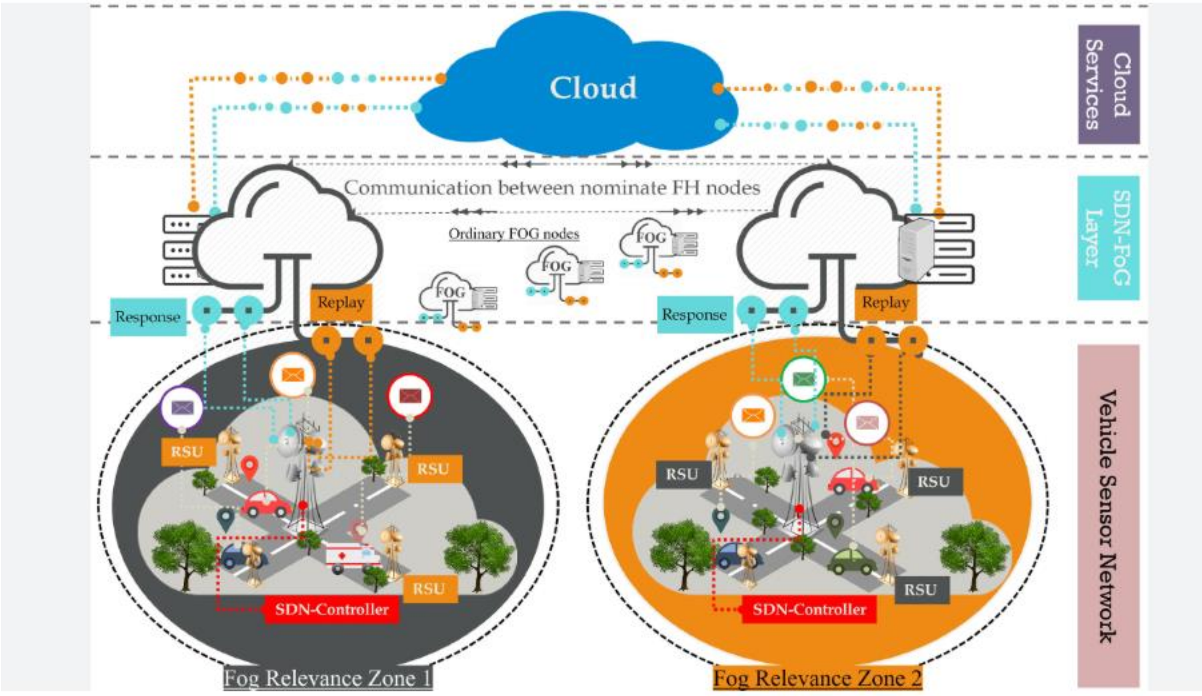

Fig.1:The proposed SDN-FoG conceptual design architecture

The proposed methodology introduces the Dynamic Urban Evaluation Routing (DUEvR) protocol within a three-layered architecture that integrates Software-Defined Networking (SDN) and Fog Computing to optimize routing in urban vehicular ad hoc networks (VANETs). The first layer consists of smart vehicles equipped with onboard units (OBUs), GPS, and Roadside Units (RSUs) that gather and transmit real-time data. The second layer, known as the SDN-FoG layer, deploys fog nodes (FNs) near the edge of the network to locally manage routing and reduce the dependency on cloud communication. The third layer, the cloud layer, stores historical data and performs large-scale data analysis.

The network is geographically divided into circular sectors called "cells" using optimization algorithms to ensure complete area coverage with minimal overlap. Within each cell, a Fog Head Node (FHN) is dynamically selected based on factors such as energy level and proximity to the base station. Vehicles and FNs periodically exchange HELLO messages containing information like position, velocity, and node ID to maintain up-to-date neighbor tables and support routing decisions.

An energy-aware transmission model is employed, considering both free-space and multipath signal propagation. This helps in evaluating energy consumption per packet transmission and prevents energy holes by balancing load among nodes. The DUEvR protocol dynamically selects the next-hop node by evaluating the shortest geographic distance, highest energy availability, and best connectivity. The protocol utilizes flow tables and routing tables maintained in fog nodes to support intelligent and low-latency routing decisions.

Finally, the proposed methodology is implemented and evaluated using NS2.35 simulator with IEEE 802.11p standard for vehicular communication. Performance metrics such as packet delivery ratio, throughput, energy consumption, and routing overhead are analyzed and compared with several state-of-the-art protocols, confirming the efficiency and superiority of the DUEvR approach.

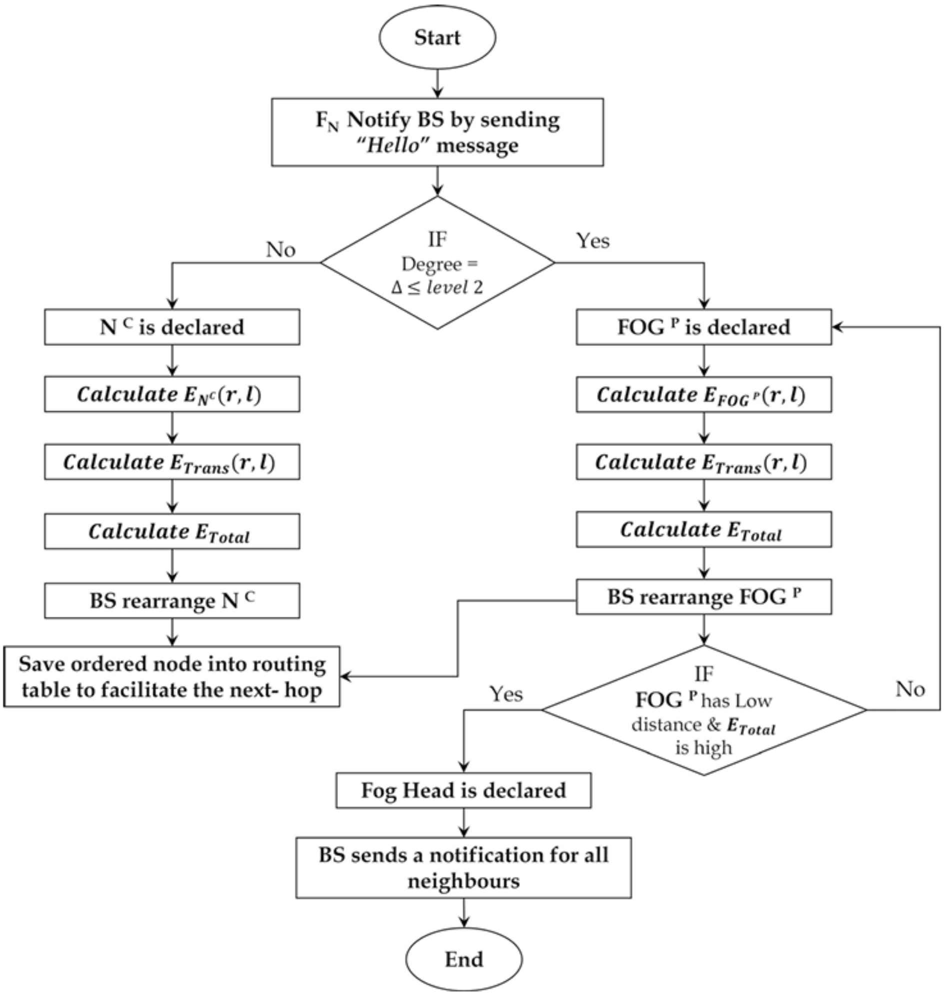

Fig.2:Flowchart

The main steps to select FoG head. All steps of the proposed algorithm are described in Fig.2.

SOFTWARE AND HARDWARE REQUIREMENTS

- **Software Requirements**

Component	**Description**
Operating System	Ubuntu Linux (64-bit, preferably version 16.04 or later)
Network Simulator	NS2.35 (Network Simulator 2, version 2.35)
Simulation Environment	Trace-based simulation with SUMO (optional, for vehicle mobility modeling)
Programming Language	C++ and OTcl (for NS2 module development)
Visualization Tools	Xgraph / NAM (Network Animator)
Protocols Implemented	IEEE 802.11p / WAVE, AOMDV, DUEvR (custom)
Supporting Tools	AWK (for data processing), Gnuplot (for graph plotting)

- **Hardware Requirements**

Component	**Minimum Specification**
Processor (CPU)	Intel Core i5 or higher (Dual/Quad-Core)
RAM	8 GB minimum (12 GB or more recommended)
Hard Disk	250 GB HDD or SSD with at least 10 GB free
Graphics	Integrated graphics (e.g., Intel HD 520 or higher)
Network Interface	Wireless LAN Adapter (for real-world testing)
Power Supply	UPS (Uninterruptible Power Supply) recommended for long simulations

This setup ensures that the simulation of the DUEvR protocol, along with comparison to other protocols and evaluation of metrics like throughput, energy consumption, and routing overhead, can be carried out effectively.

CONCLUSION

This paper introduced a Software-Defined Road Network architecture based on FOG computing for enhancing overall performance in VANET. This architecture proposed a new routing design for the urban system to accomplish low energy consumption and operational efficiency in data delivery. In this work, the proposed integration methodology ensured high control of the volume of data transmission across the network. Therefore, the network bandwidth and power transmission usage are reduced. The effectiveness of the proposed routing protocol DUEvR was proved by comparing its performance against the state-of-art algorithms, including Geo-CAP, EEOMA, EMHR with BwEst, ASP-UAVN, and SUAS-HIS. The performance of DUEvR was tested based on four QoS metrics. Those are packet delivery ratio, network throughput, power consumption, and routing overhead. The experimental results indicated that there is a 50–60% improvement in both power consumption and packet delivery ratio, while a 60–65% enhancement in network throughput and routing overhead.

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