Research Article

To simulate AODV, DSR, GRP and OLSR routing protocols of VANET and study the performance indicators using Opnet Modeler 14.5

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Abstract - Wireless technology is developing very fast. VANET is an evolving technology in the field of wireless communication and with the advancement it will contribute more to the smart transportation system in days to come. Quality of service in Vehicular ad-hoc Network (VANET) is primarily dependent on routing protocols. Maximum throughput, minimum packet loss and controlled overhead are the major ultimate objectives of each proposed routing protocol. VANET gives a communication framework that has enhanced the traffic service. Data sharing in this system is time sensitive and require quick and vigorous network connection forming. VANET is serving the said purposes but there are some issues and challenges like efficient handling of fast handovers for audio applications. Therefore, in this paper recently proposed routing protocols along with their pros and cons are discussed. VANET routing protocols are simulated using Opnet simulator and key performance Indicators were assessed. Simulation is performed to check the delays and throughput comparisons between the routing protocols.

Keywords: VANET, Opnet, Simulation, Routing Protocols, ad-hoc network

1. Introduction

VANET is the short form of Vehicular Ad-hoc Network, it is subclass of network of MANET type. The main characteristics of the VANETs are as follows: heterogeneous communication range, mobility of the vehicles, geographically constrained topology, time varying vehicle density, frequently disconnected network, dynamic topology, and the vehicles being the components that build the network. The VANET routing protocols need to be designed considering factors such as the security, mobility and scalability of vehicular communication. The goal of VANET architecture is to allow the connection between vehicles or between vehicles and fixed road side units to have a smooth communication possible.

For routing protocols Key Performance Indicators (KPIs) are essential like (Delay, No. of Hops, Retransmission Attempts, Traffic Received, Throughput); it is not necessary that the network should have the best results in all KPIs, but they must be realistic, and provide acceptable results in all KPIs, and during the decision taking part all the KPIs must be prioritized based on the required solution.

Specific applications like audio and video requires better handoffs and packet transmission across the network. In this paper, a simulation using the Opnet modelar for the most popular VANET routing protocols for a voice enabled service network will be done to obtain the best KPIs from its perspective and choose the best one based on the KPIs.

2. VANET routing protocols

2.1. AODV

AODV (Ad-hoc On-demand Distance Vector) is a loop-free routing protocol for ad-hoc networks. It is designed to be self-starting in an environment of mobile nodes, withstanding a variety of network behaviors such as node mobility, link failures and packet losses. The information is only transmitted between nodes in an on demand mode.

Advantages

- Routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- AODV can be used in large VANET networks.
- Any failure in the VANET links is handled in a prompt way by the AODV.
- The connection setup delay is lower.

- Distance Sequence Number is providing recent route to the destination node.

Disadvantages

- It expends extra bandwidth, because of proactive beaconing high control overhead is occurring when many route reply packets for a single path.
- Compared to other approaches, high processing time is required for the connection initiation and the first attempt to set the path.
- Route inconsistency may occur when old entries are included in intermediate nodes.

2.2. DSR

The DSR protocol utilizes source routing and maintains functional paths. It consists of route detection and route servicing. Route Discovery determines the optimum path for a transmission between a given source and destination. Route Maintenance ensures that the transmission path remains optimum and loop-free as network conditions change, even if this requires changing the route during a transmission.

Advantages

- In DSR protocol no proactive updates are desired.
- Route caching can reduce route discovery.
- The DSR protocol is Beacon less.

Disadvantages

- When the links get down it can't be reformed locally.
- The performance of DSR protocol views declining in highly mobile VANET.
- DSR is not scalable to large networks.
- The connection setup delay is higher

2.3. OLSR

The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad hoc networks, which can also be used on other wireless ad hoc networks. It means optimized link state routing which means a routing protocol using the proactive mode. In this, whenever any change in the topology occur, MPR (multipoint relay) are responsible to generate and forward the topology information to selected nodes. OLSR operation fundamentally consists of servicing and updating information in a set of tables. The tables are managing the route calculation itself as well.

Advantages

- Suitable with data intensive application as it has less average end-to-end delay.
- Doesn't require central administrative system to handle routing process

Disadvantages

- The control message overhead gets increased with increased in mobile hosts.
- In OLSR, large amount of bandwidth and CPU power is required to compute the optimal path.

2.4. GRP

GRP routing is used into two approaches. In greedy forwarding, the data is sent to the closest neighbor of the destination node; the second approach is perimeter routing which implies planner graph traversal concept.

Advantages

- Route discovery and management is not required.
- GRP supports scalability
- Suitable for high node mobility pattern

Disadvantages

- The protocol requires position determining services.
- GPS devices don't work in tunnel

3. Simulation setup and metrics

To monitor different performance matrices related to all four routing protocols in VANET environment, we have simulated some scenarios with the help of OPNET modeler 14.5. This scenario consists of 40 nodes enabled with voice application. The area considered for simulation is 10 km X 10 km. For the application designation we have included the Application config and Profile config to set the applications (voice) used by the nodes. Subsequently, we changed the routing protocol of all the nodes to all the routing protocols i.e. AODV, DRS, OLSR and GRP consecutively. The metrics considered for observation are throughput, media access delay, network load, traffic drop and delay. The seed value considered for simulation is 128.

4. Simulation Results

4.1 Throughput – fig. (1) Depicts the throughput of the network. The simulation runs for the entire duration which generates result in time_average mode, specifies OLSR has maximum throughput, than AODV. GRP protocol gives minimum throughput, whereas DSR remains behind to AODV.

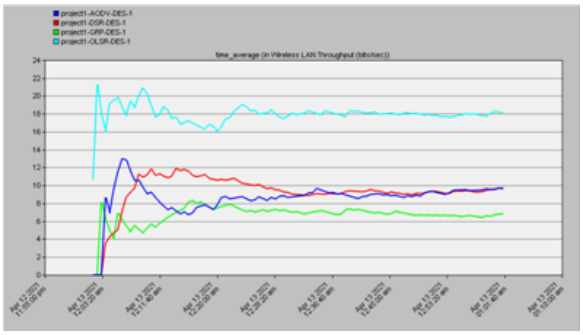

fig. (1) Throughput in the network

4.2 Network Load – as depicted in fig. (2) The network load for AODV and DSR is equal minimum at approx. 10 min. of the experiment. Further the network load increases steadily throughout the execution. At the same time interval, GRP has 1000 bits/sec network load, further remains constant. The OLSR has maximum network load 2200 bits/sec.

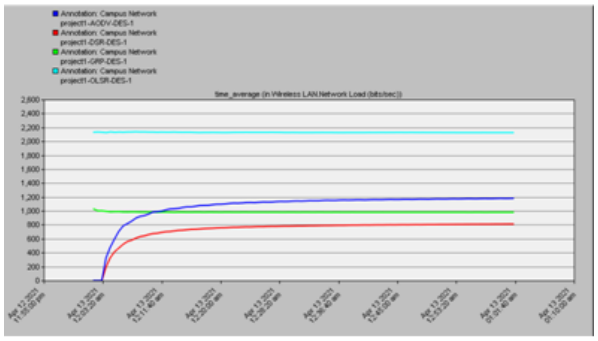

fig. (2) Network Load in the network

4.3 Media Access Delay – GRP protocol has maximum peak of Media Access Delay at around 20% time of the execution; further the delay gets decreasing. OLSR and DSR have gradual increase in their delays. AODV protocol has minimum delay and it remains consistent throughout the experiment, as shown in fig. (3).

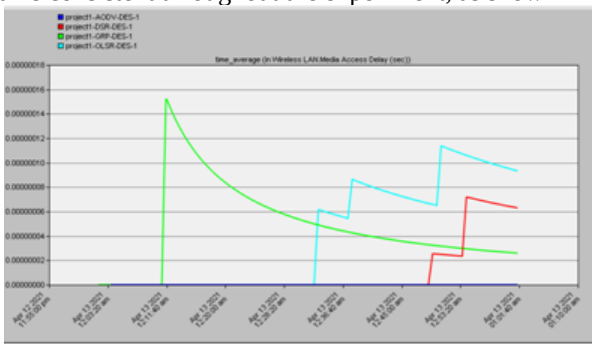

fig. (3) Media Access Delay in the network

4.4 Traffic Dropped – fig. (4) Specifies OSLR protocol has the maximum packets traffic drop. Other protocols AODV, DSR and GRP have minimum packets traffic drop.

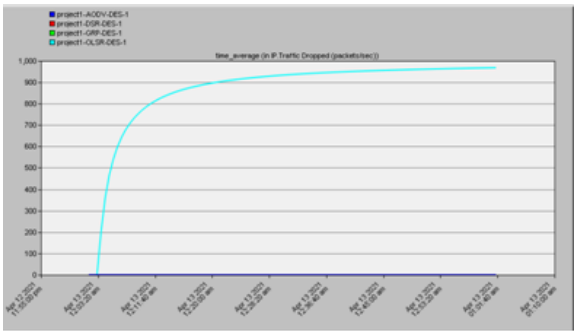

fig. (4) Traffic Dropped in the network

4.5 Delay – All protocols have propagation after 10% of execution time, DSR has minimum delay 0.00024 s, which remains constant further. OLSR and AODV protocols are having slightly higher delay than DSR and it remains constant in execution. The GRP protocol has highest delay peak 0.00030 s, which further gets decreases until reaches to 0.00026 s.

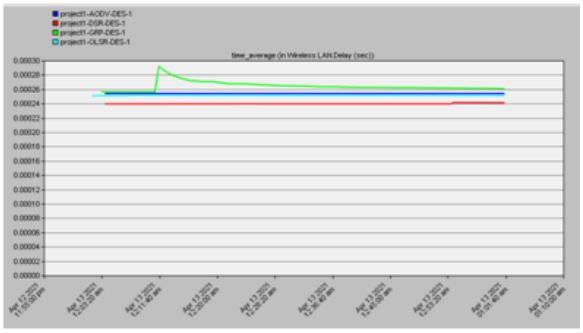

fig. (5) Delay in the network

5. Conclusion

In this work, simulation based analysis has been carried out to analyze the VANET system performance using different routing protocols. In this paper, we have reviewed many studies related to routing protocols. As per the research completed, AODV proved to be the best routing protocol in VANET environment. The proposed simulated results may be serving as guidelines for design of modern traffic control mechanisms which follows safety application, faster data packet dissemination and intermittent connection problem in VANETs.

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