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IMPROVED COMMUNICATION STRATEGY BASED ON INTERNET OF THINGS ASSOCIATION OVER VEHICULAR ADHOC NETWORK ENVIRONMENT

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ABSTRACT:

In this system, a Vehicular Adhoc network model is created with multiple numbers of vehicles, in which it contains Power Supply Unit (PSU), Roadside Unit (RSU), Vehicle Transmitter (VTx) and Vehicle Receiver (VRx). All these nodes are associating together to form a virtual vehicular network sing Network Simulator (NS2) tool. In this scenario, accidents are identified by using detection sensors and inform the respective details to the RSU for intimating that to the emergency unit to take an appropriate action. For establishing a communication between one vehicle to other vehicular nodes, a latest technology based communication medium Internet of Things (IoT) is used. All the vehicles are able to move in all directions such as Left-Right-Front and Back (LRFB) to perform a proper communication model between vehicles on the simulation environment. The proposed scheme is useful to identify the accidents over the traffic scenario and the information are reported to the proper emergency unit without any communication delay by using the advances of IoT and RSU based information transmissions. All these traces are marked into the respective monitoring entity called Information Centric Networking Unit (ICNU) and also it contains Least Recently Used (LRU) eviction policy for the eviction of content from RSU's. The proposed system efficiency is proved in resulting portions in terms of enhanced throughput ratio, reduced communication delay between vehicles, improved network lifetime and reduced communication overhead.

KEYWORDS*:* VANETs, Information centric network, VANET security, IOT

INTRODUCTION:

The two most popular mechanisms for data dissemination used by VANETs are push-based and pull-based schemes. Without making any requests, a push-based method transmits data proactively to other vehicles. This technique is intended to transmit important information to approaching vehicles, such as warnings and messages about traffic safety. The pull-based approach first sends a message requesting the content or data it requires, and the return includes the data packet. This technique is typically employed for infotainment-related services or in situations when the consumer or requester initiates communication. VANET nodes mostly use wireless communications for information transferring.

VANET nodes are highly mobile due to which the connection time for information sharing is very short that leads to the problem of connectivity . Many strategies that use IP-based ad-hoc networking are proposed in the literature for routing and forwarding. Direct V2V communications are not secure with the TCP/IP implementation because of network topology, a large number of nodes/vehicles, and ad-hoc network connectivity. To deal with this problem, researches have been trying for the last decade to embed a newly emerging technology in VANETs, named Information-Centric Networking (ICN) . To support V2V communications, named-data networking (NDN), and Content Centric Networking (CCN) , which are instances of the ICN, best fixit in the future Internet . ICN architectures work well in searching, sharing, and retrieving information in highly mobile nodes of VANETs.

Applications for VANETs fall primarily into three categories: Traffic management [13], Infotainment-related [12], and Road Safety [11].

VEHICULAR AD HOC NETWORK TYPES:

The main elements of the VANET architecture are On Board Units (OBU) and Road Side Unit (RSU) [5]. OBU is a radio device installed in the vehicle, in turn that RSU places along the road and works as a router between vehicles. OBUs are modules integrated into the on-board system, with their own computing resources, an antenna and an information display. In addition to firmware and hardware modules, VANET also includes communication interfaces that allow these modules to communicate. There are different types of interfaces depends on the direction of information transfer between objects:

• *Vehicle-to-Vehicle (V2V)* – In V2V vehicles can communicate with each other directly. It allows to organize the exchange of messages between the participants of the road in order to improve the road safety;

• *Vehicle-to-Infrastructure (V2I)* –It is a communication model that allows vehicles to share information with the infrastructure components such as overhead RFID readers and cameras, traffic lights, lane markers, streetlights, signage and parking meters. It also allows to collect the information in centers and organize a system for controlling and regulation of traffic flows;

• Infrastructure-to-Infrastructure (I2I) –In I2I the communication takes place between the infrastructure components. This type of interface allows to exchange the information from wired/wireless communication channels;

• *Vehicle-to-X (V2X)* - is a universal type of interface that allows to organize interaction like V2V and / or V2I;

• *Vehicle-to-broadband cloud (V2B)* – It allows OBUs to interact with cloud services using broadband data transfer technologies of mobile operators.

RELATED WORK:

Internet of Things (IoT) devices use IP addresses to interact with each other, i.e. the client sends requests toward a specific server and the request is satisfied by the server. We emphasize IoT devices that have limited resources in terms of power and energy [1]. With the progress in the domains of ICT emerging technologies such as wireless sensor networks and fifth generation wireless communication capabilities, it has become more difficult to connect and monitor millions of devices, where the most important feature is the content security [2–5]. An IoT network consists of many such wireless devices that interact with the physical environment for collecting surrounding information and providing several services with the help of Internet [6,7]. The motivation toward IoT is the utilization of smart and intelligent devices for enabling and automating various services [8,9]. By using IoT, smart applications can be built, such as smart homes, smart cities and smart buildings. [10,11].

The LRF mechanism proactively places the requested data at upcoming nodes/RSUs for vehicles. In VANETS, vehicles continuously change their positions while travelling and move with the changing RSUs. The main problem in the existing techniques is at the access points or RSUs when a vehicle moves away from the RSU. Due to frequent changes in the RSUs and movement of the vehicles, connectivity and delivery problems arise. The currently used host-centric network cannot fulfill the requirements of highly mobile VANET nodes.

PROPOSED METHOD:

In this paper, we assume that each vehicle obtains the Geo-location and queue state information of its neighboring vehicles by exchanging packets. Each vehicle maintains an information set about its neighbors and updates the set as a new packet arrives. The frame structure design is shown in table 1. The node Id is used to identify the neighbor vehicle. The node position, node direction, and node speed can be used to predict the position of this neighbor vehicle. The queue length and packet number are used to calculate the queuing delay.

TABLE I: Frame structure of a packet.

Node ID	Node position	Node direction	Node speed	Queue length	Packet nos.
2bytes	4bytes	2bytes	2bytes	1bytes	2bytes

As shown in Figure 1, vehicles initially request contents from their nearest RSUs. If the content is available at the RSU, it sends the content to the vehicle as well as to addresses that are stored in the AT. If the content is not available at the RSU, the LRFB strategy utilizes the NDN architecture. The RSU checks its PIT entries; if the same entry of the content is present in the PIT, it discards the request and makes an entry into the FIB. The entries in the FIB are sent to the base station where the base station responds to the request and provides data to the RSU. The RSU, after receiving the requested data, caches it into the content store and fulfills the request of the vehicle. The RSU also proactively caches this information against the addresses stores in the AT.

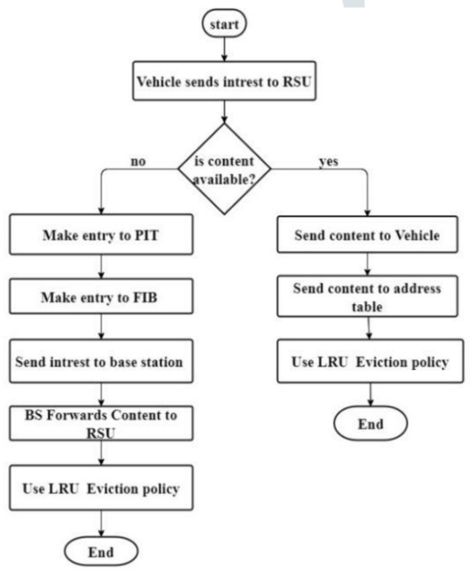


Figure 1: LFRB Working Mechanism

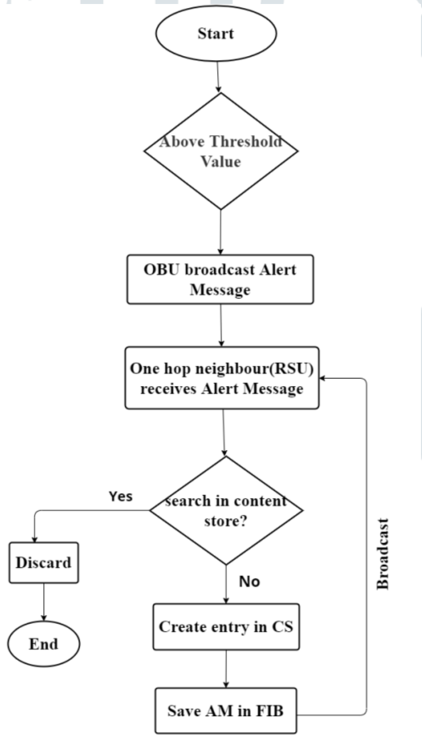


Figure 2: LRFB Working Mechanism for Accidents.

In this way, the requested data is proactively cached at the upcoming left, right, front and back RSUs. The proactively placing of data at all sides of RSUs is due to the fact that vehicles may either move left, right, or go straight on the road. In the LRFB strategy, whether a vehicle moves at one side of the road or changes the route, it receives data/content without any delay. Data from the other two RSUs is discarded with the help of the eviction policy. The eviction policy is used to make space for newly received information from stored data on the device. In other words, when the memory of a device is full, the eviction policy is used to make space by evicting the old content. The LRFB strategy uses Time-Aware Least Recently Used (LRU) eviction policy]for the eviction of content from RSUs. TLRU keeps up contents in the store as per their access time. . The least recently utilized content is deleted to make room for the new stuff . The old content is cleared with the aid of TLRU, freeing up extra space for the latest arriving content. As a result, the network's performance can be improved by using time aware LRU policy.

In the proposed approach due to the rapid mobility of vehicles when they hit each other, a sensor in the OBU responds only if it is greater than the threshold value, which indicates the occurrence of accident on the premises. The OBU broadcasts an alert message (AM) toward one hop neighbor nodes i.e. RSUs.The neighbor nodes receive the AM and match the AM data with the CS entries. If the data already exists in the CS, then this AM is discarded. Likewise, if the data do not exist, then the data stored in the CS and AM are sent to the FIB table to further broadcast it toward neighbor nodes When other vehicles receive accident information, they can choose their route depending on the severity of the accident. The Road Routers will change the direction of the vehicles carry the communication.

To achieve efficient data dissemination, we consider several parameters including vehicle strength, channel quality, data packet length, vehicle strength, transmission speed, power consumption, time duration are listed in table II.

TABLE II: SIMULATION PARAMETERS

Parameter	Value or Protocol
Data packet length	1500
Vehicle strength	150
Transmission speed (bps)	60
Power consumption (units)	60
Time interval (sec)	8
Propagation model	Two Ray Ground
PHY	wireless
Queue/Drop Tail	priority queue
MAC layer	802.11p
Simulation time	150s

RESULTS & DISCUSSIONS:

After performing the simulations, the results of the LRFB is compared with those of the LRF strategy on different metrics, i.e., network delay, energy consumption, queuing delay, back off slots. Each metric is further tested with vehicle or node variations. Because content is actively placed on all future vehicle paths, including the left, right, front and back RSUs, the speed of the vehicles is unimportant In the simulation process, different numbers of tests were performed on each metric to produce results. Then the average of these results was taken and compared with the LRF strategy for each metric.

1.Network Delay:

The network delay can be calculated by averaging the End-to-End (E2E) delay which is the time taken for a packet to be successfully delivered from the source to the destination, including processing, queuing, transmitting and propagation delay. The processing delay is the time for extracting header of packets and executing various algorithms. The queuing delay is the waiting time of a packet in a queue before transmitting. The transmission delay is the required time for transmitting all the messages to channel. The propagation delay is the required time for propagation of the packet.
Thus:

$$Delay = Dproc + Dqueue + Dtrans + Dprop.$$

According to lTV Recommendation [14], to achieve good transmission quality, a network delay of no more than 150 ms is required. If the delay exceeds 300 ms, the quality of the network stream is significantly degraded.

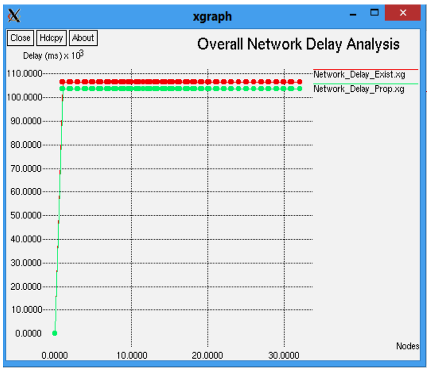


Figure 3.a Overall Network Delay

From fig.3.a we can observe the overall network delay of the system is reduced compared to the previous one.

2.Energy Consumption Analysis:

Each individual node consumes a certain amount of energy for processing the data packets; this is referred to as "energy consumption." The overall cost of energy per packet (E total) when there are r receiver nodes within the sender's communication range is calculated as

$$E\ total = E\ send + \sum_{k=0}^{r} E\ recev.$$

As we know that energy is the product of power and time.Where Esend is the sender's energy and Erecev is the receiver's energy and calculated as below.

$$Esend = Psend \times T\ ime = (Isend \times Vsend) \times \frac{Packetsize}{Bandwdth}$$

$$Erecv = Precv \times T\ ime = (Irecv \times Vrecv) \times \frac{Packetsize}{Bandwdth}$$

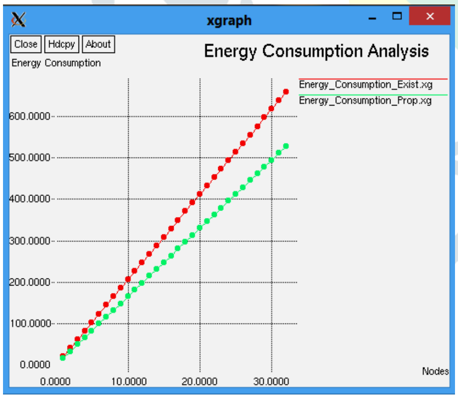


Figure 3.b. Energy consumption analysis

From fig.3.a we can observe the energy consumption of the system is reduced compared to the previous one.

3. Queuing Delay:

The queuing delay is the waiting time of a packet in a queue before transmitting.Providing a low delay data transferring is crucial in VANET. However, it is a challenging task because VANET has those characteristics, such as: high mobility, high rate of topology change, distributed control, high speed of vehicles, and so on. In order to enhance low delay in VANET, we need to improve IEEE 1609.4 multi-channel MAC. This can be observed in the output graph.
the queuing delay is calculated as follows:

$$\text{Dqueue}=\frac{1}{\mu-\lambda}-\frac{1}{\lambda}\times\frac{QL\,\rho^{QL}}{1-\rho^{QL}}$$

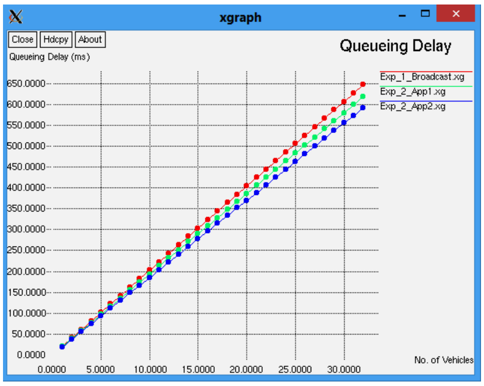
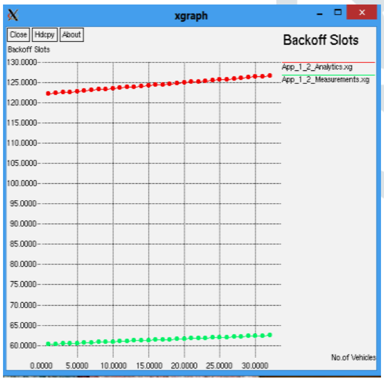


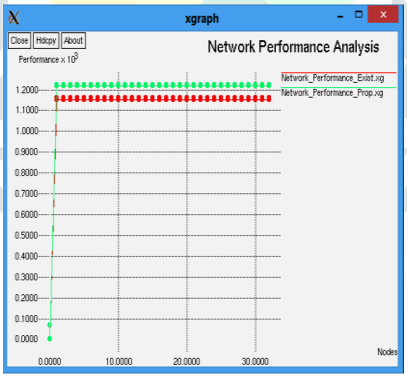
Figure 3.c. Queuing delay.

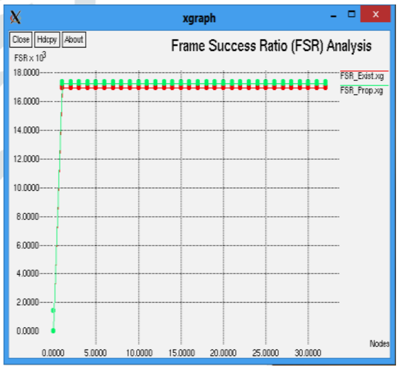
where, ρ is utilization which is equal to μ λ , where λ and μ are packet arrival rate and packet service rate, respectively. QL shows maximum queue length. If reschedule of packets is used on priority basis, Dqueue will be reduced substantially. Since the priority was added on a message, the messages don't queue and immediately will be sent to the head of line. Therefore, it does not take time for queuing to the head of line.From fig.3.c. we can observe the queuing delay of the system is reduced compared to the previous strategy,.here we can observe the queuing delay for two different applications.

4. Backoff Slots:

Back off time is the waiting time that a station waits before attempting transmission of frame.Every time a packet fails during transmission, the backoff stage of the CSMA/CA process adjusts its size according to the standard. The backoff operation relies on a basic deterministic methodology that ignores the state of the medium at the moment of transmission. From fig.3.d we can observe the backoff slots of the system is reduced compared to the previous one.







3..d. Backoff slots 3.e . Network Performance Analysis 3. f. Frame Success Ratio

From the above graphs 3.e and 3.f it is observed that the network performance is improved and also the number of frames successfully transmitted to the receiver is also improved.

TABLE II: COMPARISION OF LRF AND LRFB STRATEGY.

s.no	Parameter	LRF STRATEGY		LRFB STRATEGY	
		Vehicles/Nodes 10	Vehicles/Nodes 20	Vehicles/Nodes 10	Vehicles/Nodes 20
1.	QUEUING DELAY	70 ms	530 ms	250 ms	500 ms
2.	ENERGY CONSUMPTION ANALYSIS	285 J	560J	220J	450J
3.	OVERALL NETWORK DELAY	205 ms	207 ms	195 ms	198 ms
4.	NETWORK PERFORMANCE ANALYSIS	1.23	1.25	1.31	1.34
5.	FRAME SUCCESS RATIO	30	31	32	34
6.	BACKOFF SLOTS	128	63	126	61

From the table II. we can observe that on an average the network delay is reduced by 10ms, energy consumption is reduced by 87.5 units, queuing delay is reduced by 25ms, back off slots(chances of re transmissions) are reduced by 2% compared to the LRF strategy and Network performance is improved and also the number of frames successfully transmitted to the receiver is also improved. We can observe that each metric is further tested with two vehicle or node variations. Because content is actively placed on all future vehicle paths, including the left, right, front and back RSUs, the speed of the vehicles is unimportant.

Conclusion:

In this paper, we first give an outline of VANETs, with a detailed description of their architecture, characteristics, and applications. Following that, we discussed the primary research challenges and unresolved problems that must be taken into account while creating effective and affordable VANET protocols and applications. The LFRB working mechanism even when accidents occur and the eviction policy used in the network are discussed. This paper also discusses the performance metrics like queuing delay, energy consumption, back-off slots, network delay, network performance, and frame success ratio.

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