# CHAPTER #7

# PERFORMANCE EVALUATION OF VIDEO STREAMING IN VEHICULAR ADHOC NETWORK

vehicles moving in same and opposite direction. We measure the PSNR, sending rate, receiving rate, end to end delay in ideal and real scenarios.

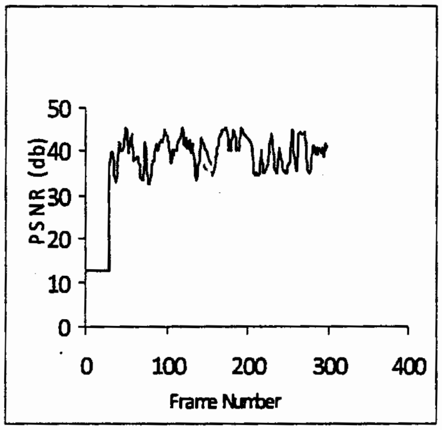


Figure 7.1: PSNR (SD in ideal scenario)

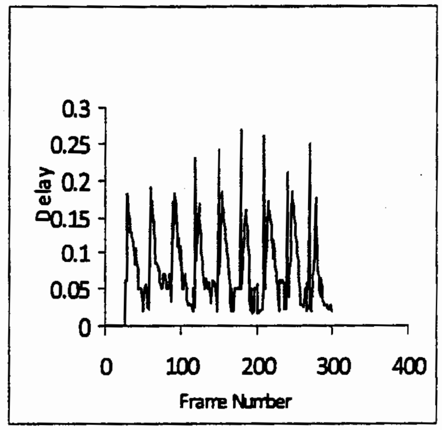


Figure 7.2: Delay (SD in ideal scenario)

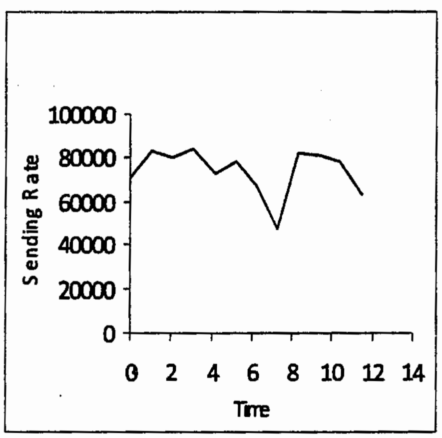


Figure 7.3: SR (SD in ideal scenario)

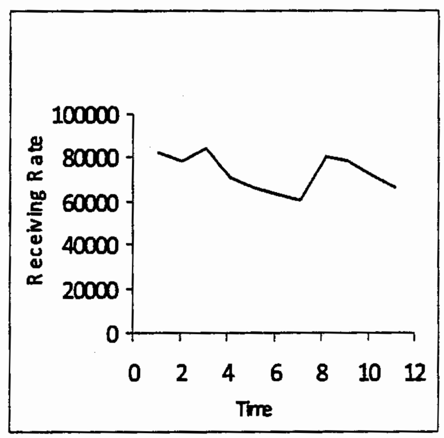


Figure 7.4: RR (SD in ideal scenario)

### 7.2.1 Same direction in ideal scenario

In this study we have two vehicles moving at speed of 100km/hr in same direction. We also consider that no malicious node will affect the performance of network and both the vehicles are also fair nodes. Vehicles A sends video file to vehicle B at 25 frames per second and simulation runs for 100 seconds. We measure the PSNR, sending rate, receiving rate, end to end delay. Figure 7.1 shows the PSNR value and figure 7.2 shows the delay that packet faced during ideal simulation. Figure 7.3 and figure 7.4 shows the sending rate and the receiving rate that vehicles faces.

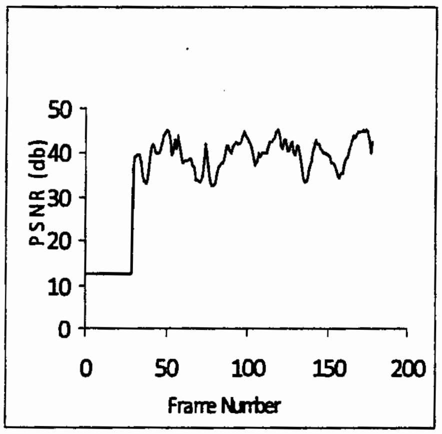


Figure 7.5: PSNR (OD in ideal scenario)

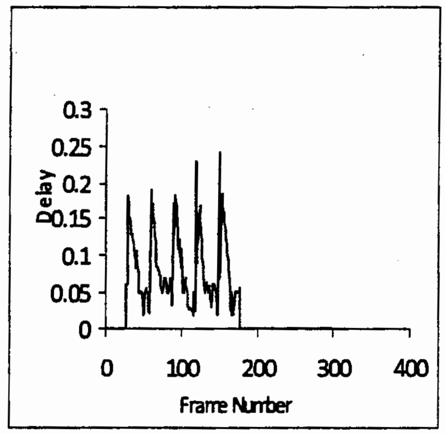


Figure 7.6: Delay (OD in ideal scenario)

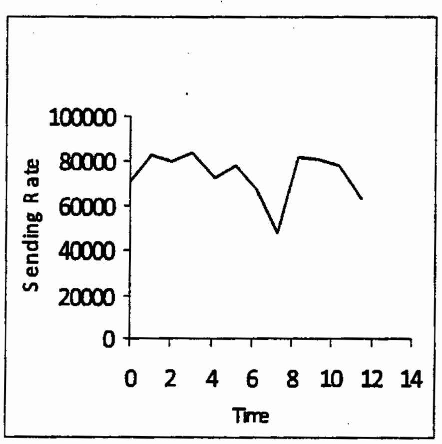


Figure 7.7: SR (OD in ideal scenario)

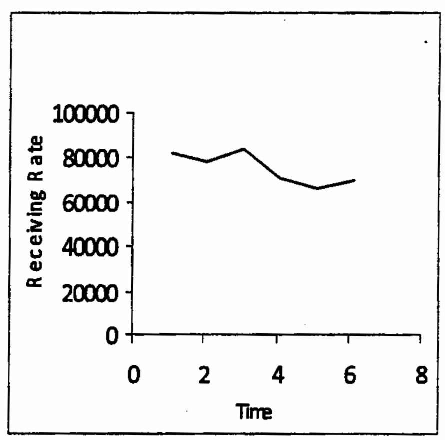


Figure 7.8: RR (OD in ideal scenario)

### 7.2.2 Opposite direction in ideal scenario

In this study we have same scenario as above that two vehicles moving at speed of 100km/hr but in opposite direction and no selfish node will affect the network. Vehicles

A sends video file to vehicle B at 25 frames per second and simulation runs for 100 seconds. As the vehicles are moving at high speed and in opposite direction so that can't share all the information they have in their in buffer. We measure the PSNR, sending rate, receiving rate, end to end delay. Figure 7.5 shows the PSNR value and Figure 7.6 shows the delay. Figure 7.7 and Figure 7.8 shows the sending and receiving rate. Vehicle B can't receive all the packets because after 7 second it is no more over in range.

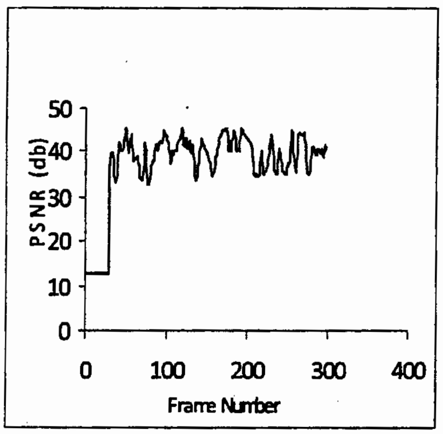


Figure 7.9: PSNR (SD in real scenario)

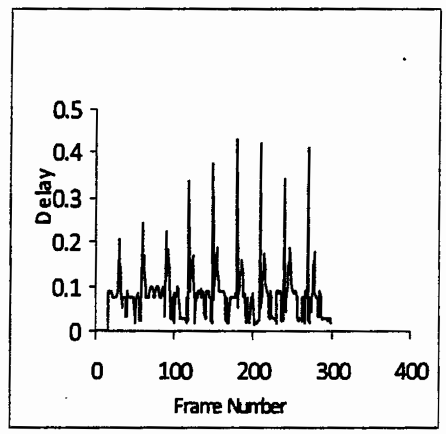


Figure 7.10: Delay (SD in real scenario)

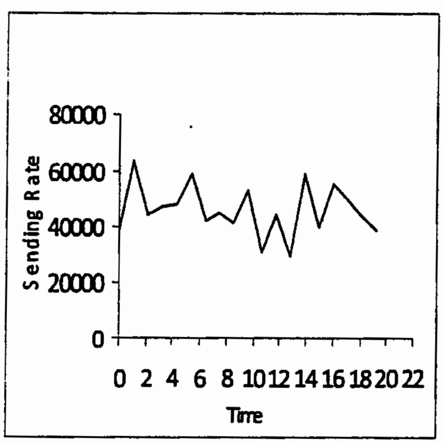


Figure 7.11: SR (SD in real scenario)

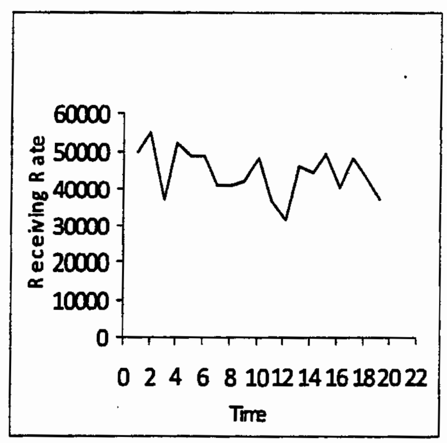


Figure 7.12: RR (SD in real scenario)

#### 7.2.4 Opposite direction in real scenario

In this study we consider the impact of malicious node in opposite where vehicles are moving at high speed. Scenario is same as above. Vehicle A modifies its behavior and sent 15 frames per second to vehicle B. Figure 7.13 shows the PSNR value and Fig 7.14 shows the delay. Figure 7.15 and Figure 7.16 shows the sending and receiving rate.

Due to opposite direction and malicious node, the performance of network degrades more than the opposite direction in ideal scenario.

## 7.3 Secure Multimedia Broadcast Framework for VANETs

Secure multimedia communication enhances the safety of passenger by providing visual picture of accidents and danger situations. We proposed a framework for secure multimedia communication in VANETs. Our proposed frame work is mainly divided into four components (redundant information, priority assignment, malicious data verification and malicious node verification).With help of Network Simulator NS-2 and Evalvid tool we validate our proposed scheme

## 7.4 Proposed Frame Work

Our proposed SMBF framework is composed of four modules (Redundant Information, Message Benefit, Malicious Node Verification (MNV) and Malicious Data Verification (MDV)) as in figure 7.17. SMBF is consist of following steps which are given below.

Step 1) Vehicle A want to share a safety message with Vehicle B.

Step 2) SMBF sends message to redundant information for verification.

Step 3) On the basis of reply, SMBF decides to forward or discard the message.

Step 4) Redundant Messages are discarded.

Step 5) New Information is sent for Message Benefit.

Step 6) Relevance value is sent to SMBF.

Step 7) Request to MNV for malicious node verification.

Step 8) Receives Reply from MNV and on basis on reply SMBF decides to forward or discard the message.

Step 9) If the node is malicious, data is discarded.

Step 10) Request is sent to MDV to verify the malicious data.

Step 11) Receives Reply from MDV and on basis on reply SMBF decides to forward or discard the message.

Step 12) If the data is malicious, it is discarded.

Step 13) If the node and data are not malicious then it is forwarded to Vehicles B.

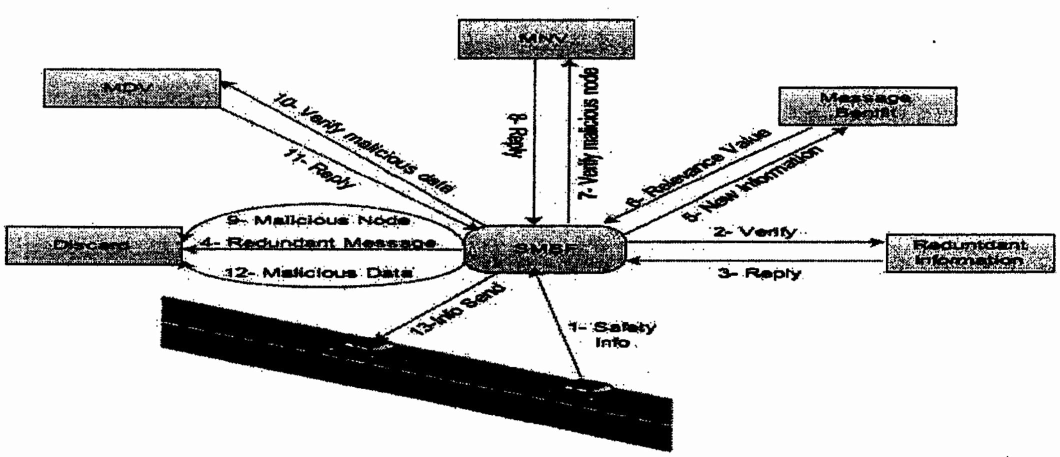


Figure 7.17: Secure Multimedia Broadcast Framework (SMBF)

**Redundant Information:** Every node maintains a table of Message ID of currently received messages. We assume that the Message ID is unique and on basis of it we detect the redundant messages.

**Message Benefit:** We calculate the priority of each message. Safety Message gets higher priority than any other messages.

**Malicious Node Verification:** We detect the malicious node on basis of signal strength.

**Malicious Data Verification:** We detect the malicious data on basis of existing messages from neighbor and also on the basis of position of node.

## 7.5 Implementation and Results

In this study we evaluate the performance of multimedia streaming in VANETs scenario. The mobility model we use is Manhattan Mobility Model and EvalVid generates the multimedia traffic. We perform the simulation with help of NS-2 on Cygwin and parameter used in simulation is mentioned in the table 7.1.

| **Parameters** | **Values** |
|---|---|
| Channel | Wireless |
| Vehicles | 3 |
| MAC protocol | 802.11 |
| Radio Propagation Model | Two-Ray Ground |
| Time | 50 s |
| Data type | multimedia |

Table 7.1: Simulation Settings

### 7.5.1 Study I

We simulate the multimedia traffic in two different scenarios. First we measure the delay, PSNR and throughput in scenario where there is no mechanism, which exists for detection of malicious data and malicious node as shown in figures [7.18] [7.19] [7.20].

In this study we have three Vehicles (V1, V2 and V3) are moving at very high speed.V2 and V3 want to share a multimedia traffic with V1 and V2 is a malicious node that sends malicious data to V1 and affects the performance of network.V1 has no frame work to determine the validity of data and it considers both V2 and V3 are fair nodes. The delay in this case is higher and throughput is lowered because of the effect of malicious data.

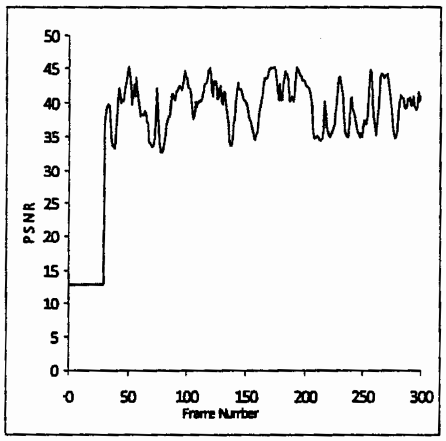


Figure 7.18: PSNR

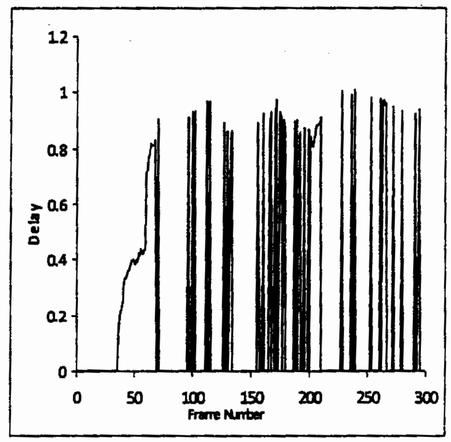


Figure 7.19: Delay

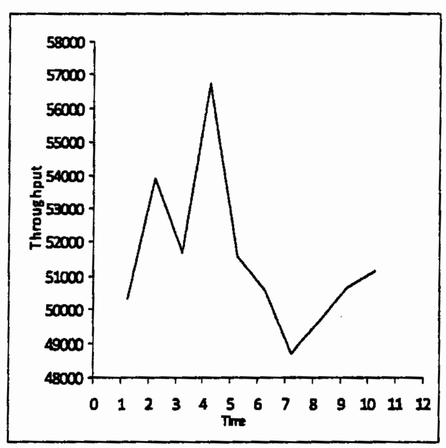


Figure 7.20: Throughput

### 7.5.2 Study II

Now we consider the same scenario as the above one. But in this case V1 has the SMBF to determine the redundant messages, malicious node and malicious data. We measure the delay, PSNR and throughput by applying the SMBF as shown in figures [7.21] [7.22] [7.23]. Performance of the network is not affected in this case because MDV detects the malicious data on basis of existing messages from neighbor and also on the basis of position of node. So in this case delay is lower and throughput is higher because the malicious data does not affect the network.

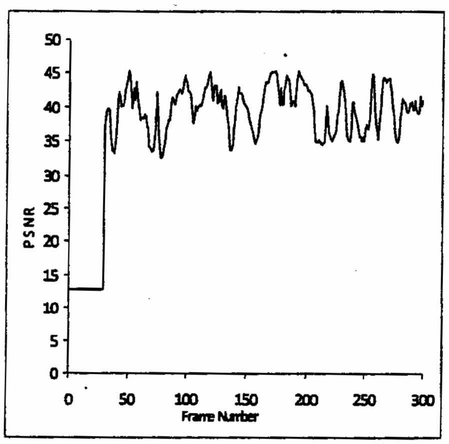


Figure 7.21: PSNR of SMBF

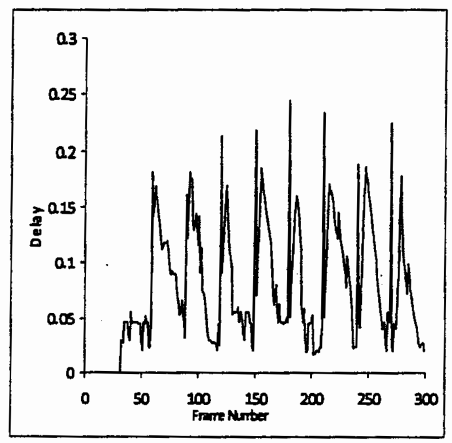


Figure 7.22: SMBF Delay

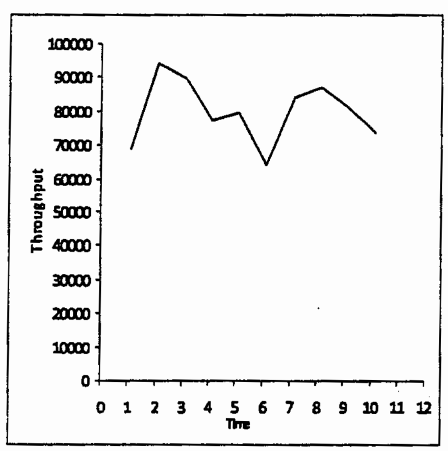


Figure 7.23: SMBF Throughput

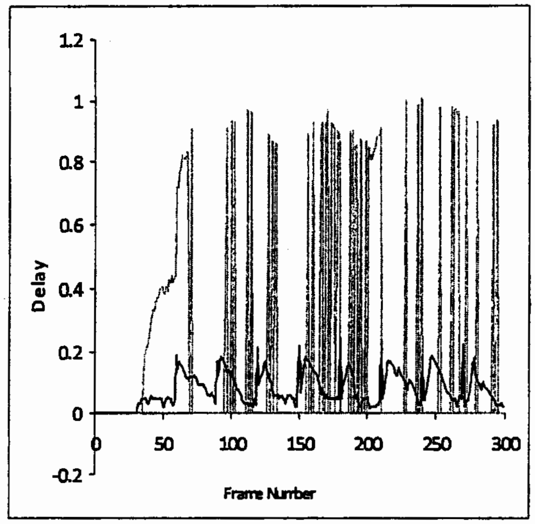


Figure 7.24: Delay Comparison

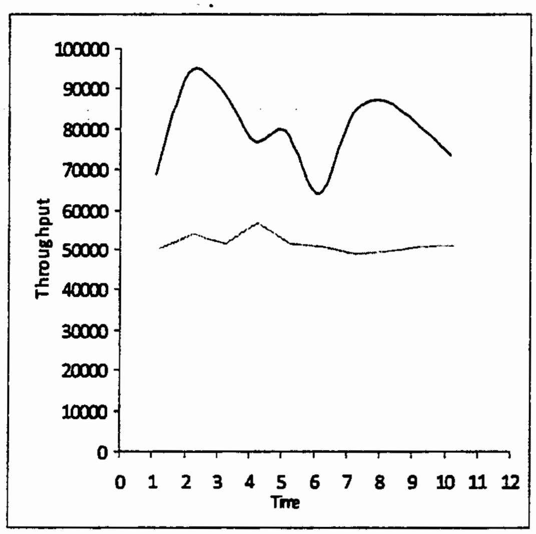


Figure 7.25: Throughput Comparison

## 7.6 Comparisons

At last we measure the comparison of study I and study II to determine how much delay increases and throughput decreases, when there is no framework for the detection of malicious data and malicious node. Figure 7.24 and figure 7.25 shows that delay is much lower when SMBF is applied and throughputs also increase much more by using SMBF. Results show that the throughput of multimedia traffic improved 20% to 40% while using SMBF

## 7.7 Conclusion

In this section we evaluate the performance of multimedia data in ideal and real scenario. Simulation shows performance of multimedia traffic in VANETs scenario. We also analyze the impact of malicious vehicle on multimedia data in same and opposite direction. Results show that the Performance of network is affected by mobility, direction and malicious node.

We also proposed a framework SMBF for secure multimedia communication in VANETs. We evaluate the performance of multimedia data in ideal and real scenario. Simulation shows performance of multimedia traffic in VANETs scenario. We analyze the effect of malicious node and malicious data with and without SMBF. Results show that the Performance of multimedia traffic improved while using SMBF.

# CHAPTER #8

# VALIDATION OF SECURE BROADCAST FRAMEWORK USING VANETS

## 8.1 Introduction

We proposed a framework for secure broadcast communication in VANETs and measure its performance with of NS2 and real testbed scenario.

## 8.2. Proposed Study

Our proposed SBF framework is composed of four modules (Redundant Information, Message Benefit, Malicious Node Verification (MNV) and Malicious Data Verification (MDV)) as in figure 8.1. SBF is consist of following steps which are given below.

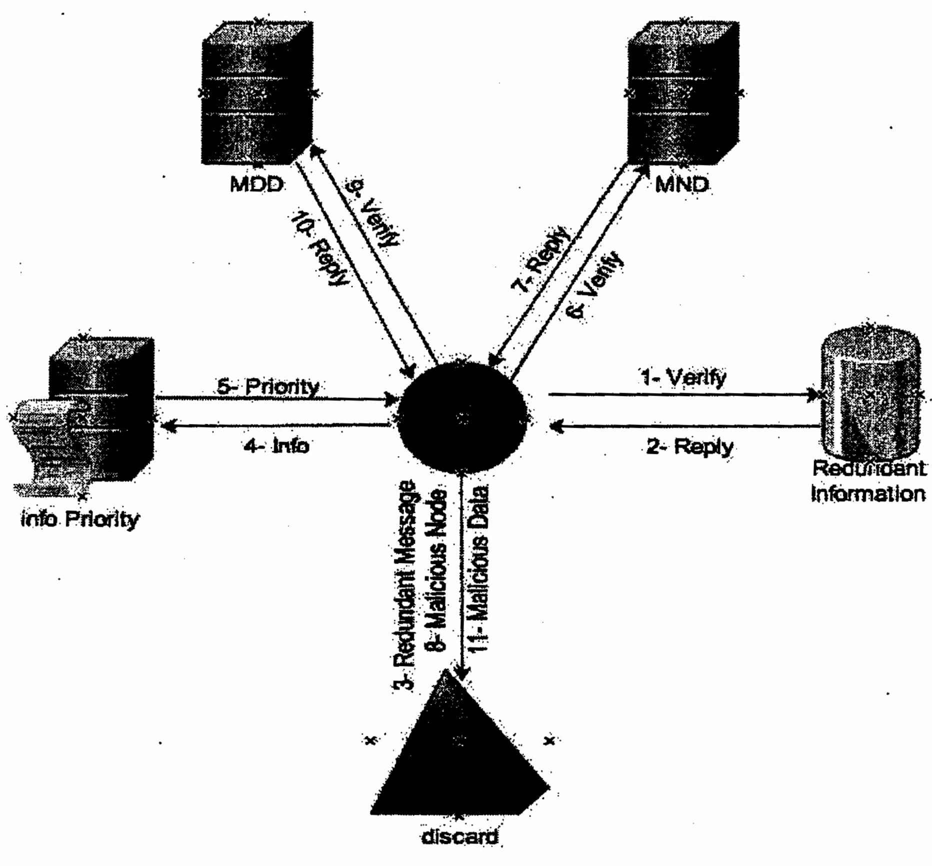


Figure 8.1: Secure Broadcast Framework

## 8.3 Testbed Implementation and Results

In this study we validate the SBF in VANETs scenario using testbed. We measure the global benefit of SBF in three different scenarios and compare its performance with normal broadcast mechanism. Using java socket we make two servers that share information and measure the global benefit.

## 8.4 Study I

In this study we consider two vehicles that are stationary in the parking of King Saud University. Vehicles are sharing messages using normal broadcast mechanism (NB) and secure broadcast framework. As shown in figure 8.2, global benefit of SBF is more than NB. Redundant and malicious data reduce the global benefit of NB where as in SBF, it is detected and is not broadcasted as in the case of NB.

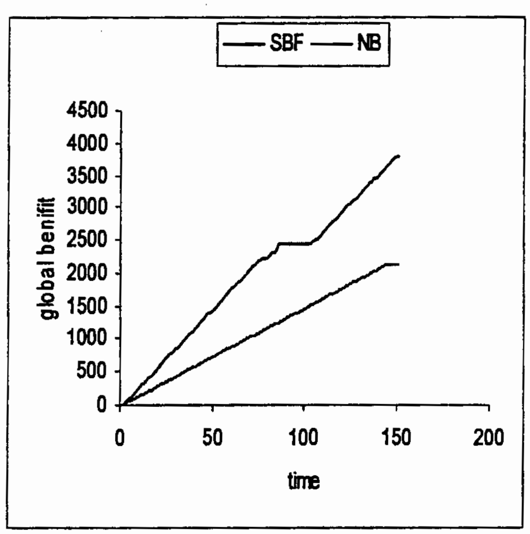


Figure 8.2: Global Benefit of SBF and NB

## 8.5 Study II

In this study we consider two vehicles in the parking of King Saud University. Vehicle A is stationary and vehicle B is moving towards the stationary vehicle. Vehicles are sharing messages using NB mechanism and SBF. But in this case vehicles have limited time to share messages as vehicle B is in the range of vehicle A for 27 seconds. Global Benefit of SBF is slightly more than NB because there is no redundant and malicious data, that is forwarded in case of SBF as shown in figure 8.3.

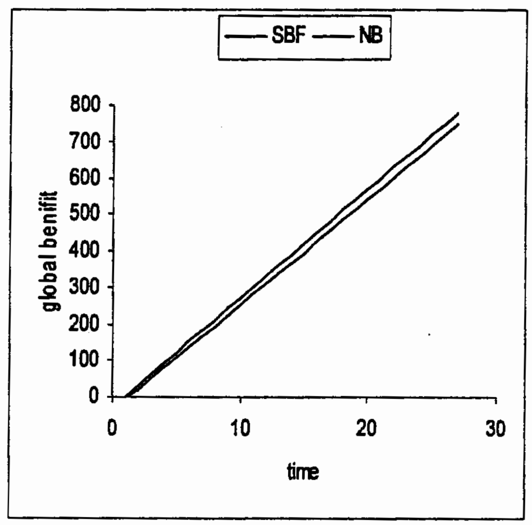


Figure 8.3: Global Benefit of SBF and NB

## 8.6 Study III

In this study we consider two vehicles that are moving in the parking of King Saud University and sharing data using NB mechanism and SBF. Due to mobility, global benefit of SBF and NB is less than the global benefit of study I and study II. Global benefit of NB is less than SBF because it forwards the redundant and malicious data that is discarded in case of SBF as in figure 8.4.

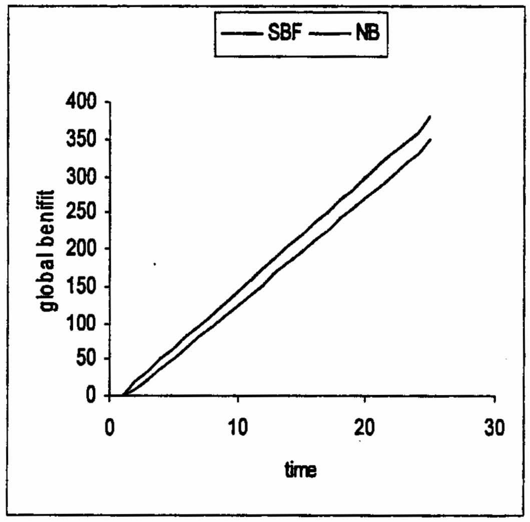


Figure 8.4 Global Benefit of SBF and NB

## 8.7 Study IV

In this study we just see the comparison of SMBF using NS2 simulator and Testbed. Testbed scenario is same as the above one and simulation results show that in theoretical global benefit is high as shown in figure 8.5 but in practical its performance is somehow low than actual one.

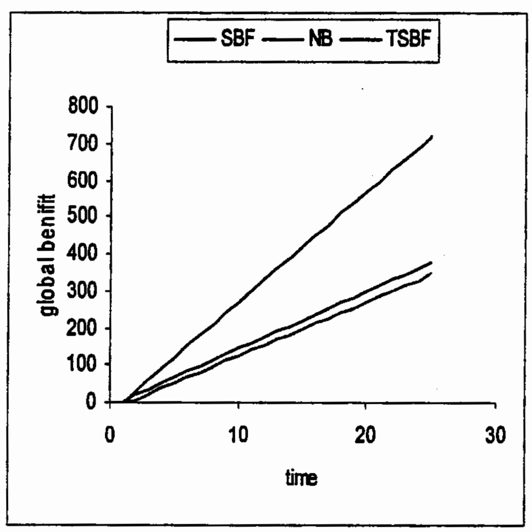


Figure 8.5: Global Benefit of SBF, NB and TSBF

# CHAPTER #9

# CONCLUSION AND FUTURE WORK

# 9. Conclusion and Future Work

In this work we have analyzed the existing broadcast techniques their pros and cons in sparse and dense network. After that we measure the performance of broadcast schemes with help of NS-2 simulator in VANETs scenario. Simulation shows that simple flooding produces a lot of redundant messages which increases gradually with time. It produces 10 to 15 times more surplus information as compared to relevant information. It works fine in sparse network but in dense network its performance is not fair and it also has no priority mechanism. Relevance approach has less redundant message and it gives priority to safety messages than other messages. But it still has some drawbacks. Like it does not consider network control and proposes for ideal scenario where no malicious node exists. Relevance approach is enhanced to consider the network control and simulates it in real scenario by considering the impact of malicious node.

OLSR is a table driven proactive protocol that exchanges hello packet to get information of network at each vehicle. By modifying the OLSR protocol and inserting a preference list in hello packet so that the number of surplus and redundant messages can be reduced. With the help of preference list 80% of surplus information is removed.

Relevance based approach is proposed for VANETs to give the safety and high priority traffic more bandwidth. But the network parameter is missing in existing message benefit formula. So the proposed approach enhances the global benefit by adding the network parameter in relevance based approach for network control traffic and simulation shows that global benefit is improved by using enhanced relevance based approach as higher priority traffic gets more medium than lower bandwidth traffic.

Relevance based approach relys on intermediate node for communication so it considers there no selfish node exist in network. However it is not possible in real scenario. We in this thesis simulated the relevance based approach using 802.11e, virtual queue with 802.11e and enhance message benefit in real and ideal scenario. Simulations results show that global benefit is improved by using virtual queue with enhance mathematical model and double than the existing relevance approach.

We also evaluate the performance of multimedia data in ideal and real scenario. Simulation shows performance of multimedia traffic in VANETs scenario. We also analyze the impact of malicious vehicle on multimedia data in same and opposite direction. Results show that the Performance of network is affected by 10% to 20% by malicious node.

We also proposed a framework SMBF for secure multimedia communication in VANETs. We evaluate the performance of multimedia data in ideal and real scenario. Simulation shows performance of multimedia traffic in VANETs scenario. We analyze the effect of malicious node and malicious data with and without SMBF. Results show that the throughput of multimedia traffic improved 20% to 40% while using SMBF.

At the end SBF is validated by using testbed in King Saud University. Simulation shows performance of multimedia traffic in VANETs scenario. We analyze the affect of malicious node and malicious data with and without SMBF in testbed scenario. Results show that the Performance of multimedia traffic improved while using SMBF.

In future we will validate the proposed solution with VANETs Testbed by considering large number of vehicles. We will use OLSR Prefence_List with Enhance Mathematical model and also do the comparison with existing approaches.

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3. Aneel Rahim, Zeeshan Shafi Khan, Imran Ahmad, Muhammad Sher," Efficient Mechanism to Exchange Required and Relevant Information in VANETS", accepted in Journal of the Chinese Institute of Engineers [Impact Factor 0.219]
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# APPENDIX—JOURNAL PUBLICATIONS

## Appendix J1 -- Sensor based Framework for Secure Multimedia Communication in VANETs

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# Sensor Based Framework for Secure Multimedia Communication in VANET

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**Abstract:** Secure multimedia communication enhances the safety of passengers by providing visual pictures of accidents and danger situations. In this paper we proposed a framework for secure multimedia communication in Vehicular Ad-Hoc Networks (VANETs). Our proposed framework is mainly divided into four components: redundant information, priority assignment, malicious data verification and malicious node verification. The proposed scheme jhas been validated with the help of the NS-2 network simulator and the Evalvid tool.

**Keywords:** multimedia; malicious data; security; VANETs; malicious node

# Appendix J2 – Information Sharing In Vehicular Adhoc Network

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International Conference on Computers, Communications & Control
ICCCC 2010, Romania, Oradea, Baile Felix, May 12-16, 2010 

# Information Sharing in Vehicular AdHoc Network

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**Abstract**

Relevance Technique broadcast the useful information and removes the redundant data. 802.11e protocol implementation has certain flaws and is not suitable for VANETs scenarios. Main issue in 802.11e protocol is internal sorting of packets, no priority mechanism within the queues and often lower priority traffic get more medium than high priority traffic. In this paper, the mathematical model of relevance scheme is enhanced so that it can consider the network control in real scenario by considering the impact of malicious node in network. Problems of 802.11e protocol can be resolved by making virtual queue at application level. We analyze the comparison of simple virtual queue with the over all impact of virtual queue and mathematical model. Similarly we compare the mathematical model with over all impact of virtual queue and modified mathematical model using NS-2 simulator.

**Keywords:** VANETs, Broadcast, 802.11e, Malicious

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# Appendix J3 – Validation of Secure Broadcast framework using VANETs

" Information International Journal, Vol.14, No.1, January, 2011, ISSN 1343-4500 [Impact Factor 0.09]"

# Validation of Secure Broadcast framework using VANETs

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**Abstract**

Secure Multimedia communication enhances the safety of passenger by providing visual picture of accidents and danger situations. In this paper we proposed a framework for secure multimedia communication in VANETs. Our proposed frame work is mainly divided into four components (redundant information, priority assignment, malicious data verification and malicious node verification).With help of Network Simulator NS-2 and Evalvid tool we validate our proposed scheme

**Key Words:**

## 1. Introduction

Vehicular Ad-Hoc Networks (VANETs) are a subclass of Mobile ad Hoc Networks (MANETs), in which moving vehicles (equipped with wireless device) form a network. [1]. VANETs like MANETs are distributed; self-organizing communication networks, that do not need any infrastructure. [2] In VANETs vehicles communicate with each other from time to time and require no base station, no router for their communication. They can share information either directly or through intermediate nodes.

VANETs have some distinctive properties that discriminate it from MANETS and some other types of adhoc networks [3].It includes very high speed of vehicles ,no battery constraints, reliability and security problems, and movement of vehicles is limited.

Mostly in VANETs, vehicles are interested in the same kind of information for example information about any accident, road block and weather situation of particular route.

Broadcast is frequently used in adhoc network for information sharing. [4]. It is mechanism through which a vehicle in VANETS send message to all its neighbors vehicles in the same VANETs. Sharing emergency, traffic, weather, and road data among vehicles, and delivering advertisements and announcements are through on broadcast. Broadcasting in VANETs is used by different unicast and multicast protocols to establish and maintain their route. Dynamic Source Routing (DSR) [5], Ad Hoc On Demand Distance Vector (AODV)[6], Zone Routing Protocol (ZRP) [7], and Location Aided Routing (LAR) [8] are the example of unicast routing protocols.

This paper is organized as follows: In section 2, we discuss how to assign a priority to

# Appendix J4 – Efficient Mechanism to Exchange Required and Relevant Information in VANETS

"Submitted in Journal of the Chinese Institute of Engineers, ISSN 0253-3839 [Impact Factor 0.219]"

# Efficient Mechanism to Exchange Relevant Messages in VANETS

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**Abstract:**
*Vehicular adhoc networks are subclass of mobile adhoc network. Broadcast is a commonly used technique for communication. OLSR is a table driven proactive protocol that exchange hello packet to get information of network at each vehicle. We modify the hello packet and add a new parameter called preference list, which contains interest of the vehicle and data which current vehicle have. In this way network load is reduced and due to mobility we have very short time to exchange date. So we only forward data according to neighbor preference.*

**Keywords:** Inter-Vehicle Communication (IVC), Vehicular Ad hoc NETworks (VANETs), Broadcast, DSDV (Destination-Sequenced Distance Vector).

## 1. Introduction:

In Vehicular Ad-Hoc Networks, vehicles communicate with each other from time to time and require no base station, no router for their communication. They can share information either directly or through intermediate nodes. Vehicular Ad-Hoc Networks (VANETs) are a special case of Mobile ad Hoc Networks (MANETs) [1]. VANETs like MANETs[2][3] are distributed; self-organizing communication networks, that do not need any infrastructure. [4] VANETs have some distinctive properties that discriminate it from MANETS and some other types of adhoc networks [5].It includes very high speed of vehicles, no battery restriction reliability and security problems, and movement of vehicles is limited.
Mostly in VANETs, vehicles are interested in the same kind of information for example information about any accident, road block and weather situation of particular route.Broadcast is frequently used in vehicular adhoc network for information sharing. [6]. It is mechanism through which a vehicle in VANETS send message to all its neighbor vehicles in the same VANETs. Sharing safety, weather, and road information, advertisements and announcements are through on broadcast. [7] Broadcast in VANETs is used by different multicast and unicast protocols to establish and maintain their route. Dynamic Source Routing (DSR) [8], Ad Hoc On Demand Distance Vector (AODV) [9], Zone Routing Protocol (ZRP) [10], and Location Aided Routing (LAR) [11] are the example of unicast routing protocols.

## 2. Related Work:

In related work we discuss the existing proactive, reactive protocols and we also describe the AODV and OLSR protocols in detail.

### 2.1 Reactive Protocols

Reactive protocols are on-demand protocols, which find a path only on request. Ad hoc On Demand Distance Vector (AODV) protocol and Dynamic Source Routing (DSR) protocol are the example of reactive protocol. These protocols used simple flooding to establish a route. Because route information may not be available at the time a route request is received, the delay to determine a route can be quite significant [12]

### Ad hoc On Demand Distance Vector protocol

AODV is a reactive routing protocol that minimizes the number of broadcasts by creating routes on demand [13]. The Ad hoc On-Demand Distance Vector (AODV) routing protocol is intended for use by mobile nodes in an ad hoc network. It offers quick adaptation to dynamic link conditions, low processing

# Appendix J5 – Enhanced Relevance Based Approach for Network Control

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# Enhanced Relevance-Based Approach for Network Control

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**Keywords:** vehicular ad hoc networks, broadcast, 802.11e

**Received:** March 9, 2009

*Simple flooding, probabilistic approach, area-based scheme, knowledge-based approach and Multi hop Vehicular broadcast is not suitable for VANETs scenario because of its dynamic nature. Relevance scheme is proposed to disseminate the relevant message for sharing in VANETs and discards the redundant massages from the network and improves the over all performance of network. The relevance-based approach does not provide network control and it only broadcast user traffic. This paper presents an improvement in mathematical model to consider the network control. Simulations using NS-2 show that proposed mathematical model consider the network control and improve the global benefit.*

*Povzetek: Predstavljen je matematičen model izboljšanega nadzora in upravljanja z mrežo.*

## 1 Introduction

Broadcast is the main building block of mobile applications and routing protocols in mobile adhoc networks [1]. Adhoc network is infrastructure less temporarily network, which is mainly used for disaster area and battle field. [2] Vehicular Ad-Hoc Networks is some how different from it in term of battery and mobility.

VANET is the collection of vehicles that communicate with each other from time to time and require no base station, no router for their communication. They can share information either directly or through intermediate nodes [3].

Mostly in VANETs, vehicles are interested in the same kind of information for example information about any accident, road block and weather situation of particular route [4]. So broadcast is the only best option for communication in VANETs.

In Mobile adhoc network a lot of work has been done for broadcast schemes but these existing techniques doses not perform well in VANETs. Simple flooding, probabilistic approach, area-based scheme, knowledge-based approach and Multi hop Vehicular broadcast are not suitable for VANETs scenario. As Collision, Contention and redundant messages [7] are the shortcoming of simple flooding. Probabilistic approach try to solve the redundant message and works fine in dense network but it performance degrades in sparse network. Area-based and knowledge-based approaches also not perform very well because of the dynamic nature of VANETs. Multi hop Vehicular broadcast [6] have Scalability problem. These schemes also ignore the relevance of information and inject the surplus information in network. Relevance approach is proposed to differentiate between high and low priority traffic and improve the performance of network by discarding the redundant messages from the network. The relevance-based approach also has one problem that it does not provide network control and it broadcast only user traffic.

This paper presents an enhancement in mathematical model of relevance-based approach to overcome this problem and global benefit of the network is enhance by adding the network control.

This paper is organized as follows: In section 2, previous work is described. In section 3, enhanced mathematical model is proposed. In section 4, simulation study and results are shown. Lastly in section 5 conclusions is given.

## 2 Related work

In this section, we will discuss the basic techniques for broadcast i.e. simple flooding, probabilistic approach, area-based scheme and knowledge-based approach. But these techniques can't work fine in VANETS because of dynamic nature of the network. After that we discuss the relevance-based approach that is designed specially for VANETs. We describe its properties, methodology and implementation.

# Appendix J6 – Performance evaluation of broadcast techniques in VANETs

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Indian Journal of Science and Technology Vol.2 No. 10 (Oct 2009) ISSN: 0974- 6846

# Performance evaluation of broadcast techniques in VANETs

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**Abstract**: Broadcast is mainly used in VANETs for communication intended to reduce collision, contention, redundant messages and hidden node problem. It also improves the message reliability. But there is no comprehensive analysis and performance evaluation of broadcast exists. In this paper we briefly discuss the existing broadcast techniques their pros and cons in sparse and dense network. Thereafter we also measure the performance of broadcast schemes with help of NS-2 simulator in VANETs scenario.

*Keywords*: VANETs, flooding, AODV, MDDV DSR, UMB, network congestion.

**Introduction**

Vehicular ad-hoc networks (VANETs) is the most popular application of wireless communication technologies (Choi & Jung, 2009). Vehicle to vehicle (Yang *et al.*, 2004) and vehicle to roadside (Jhang & Liao, 2009) enable the passengers to share safety and comfort information (Shirani & Hendessi, 2008). Traffic management, collision avoidance, safety warnings are the safety applications (Saleh *et al.*, 2007). The comfort application (Guette *et al.*, 2008) gives facility to passenger by sharing information like parking or hotel information and petrol or gas station information etc. Security is also an essential requirement in VANETs. VANETS are prone to security attack due to lack of infrastructure, high mobility (Inhyeok *et al.*, 2008) and dynamic network topology as compare to any other network (Nguyen & Nguyen, 2006; Mao *et al.*, 2003).

Jayachandran *et al.* (2007) explains communication and its techniques of broadcast is mainly used in VANETs. A variety of broadcast schemes has been proposed for MANETs and VANETs. But none has done performance evaluation in VANETs scenario. This paper presents a comparative study of broadcast techniques in VANETs. In addition, with help of NS-2, we evaluate the broadcast scheme and measure their performance in terms of throughput and redundant messages

This paper is organized as follows: In section 2, different broadcast approaches are described. In section 3, comparison of broadcast approaches is performed. In section 4, we evaluate the performance of broadcast schemes and in section 5, conclusion and future work is given.

**Related work**

With help of broadcast, unicast and multicast protocols establish and maintain route in VANETs (Al-Shurman *et al.*, 2005). Dynamic Source Routing (DSR) (David *et al.*, 2003), Ad Hoc On Demand Distance Vector (AODV) (Charles *et al.*, 2003), Zone Routing Protocol (ZRP) (Zygmunt, 1997) and Location Aided Routing (ZAR) (Young-Bae & Nitin, 1998) are example that use broadcasting for their route establishment and maintenance in VANETs (Zhang & Jiang, 2004). A variety of broadcasting schemes exist such as simple flooding, probability based approaches, area based approaches etc. In this section we will briefly discuss all the broadcast schemes and their pros and cons.

Flooding is a simple broadcast technique (Zhang & Jiang, 2006) for communication. Vehicles send information to other vehicle and this process continues until all vehicles get same information. It works fine in sparse network but in dense network it produces collision, contention and redundant messages.

Probabilistic scheme (Ryu *et al.*, 2004) reduces the collision, contention and redundant messages in dense network as it broadcast the messages with some fixed probability. But in sparse network, all the vehicles can't receive the same packets with small probability. If the probability is increased it works much like flooding (Brad & Tracy, 2002). Hence, its performance becomes greater in dense network as compare to sparse network.

Counter based technique is used to analyze the redundant messages. We use counter to record the redundant message. Whenever the redundant message is received, we increment the counter by one. We compare the counter with certain threshold value if it is less than it we forward the packet otherwise the packet is discarded (Zhang & Jiang, 2004).

Distance based scheme first calculates the distance between itself and its neighbor vehicles. Then it compares the distance with threshold. If the distance is greater than threshold it forward the packet otherwise it ignore the message (Brad & Tracy, 2002).

Location based scheme first calculates the coverage area with help of sender location. The vehicle will ignore the packet if area is smaller than a threshold value, otherwise the packet will be broadcast (Brad *et al.*, 2004).

Neighbor knowledge methods (Joon *et al.*, 2003) maintain a table that contains the information of its neighbor node. A vehicle decision depends upon this information to forward message or not. All vehicles share hello packets with their neighbors to get current information. They store this information in their table for future use. Neighbor knowledge methods totally rely on the exchange of hello packet. Contention and collision can be happen if the interval is short and large interval degrades the performance of network due to mobility.

Broadcast can also be done by using trees. But it is not fit for ad hoc networks, due to the dynamic nature. An efficient and reliable tree based broadcasting technique was proposed which is stable in dynamic network (Korkmaz *et al.*, 2006). It first maintains a spanning tree in

# Appendix J7 – A Comparative Study of Mobile & Vehicular Adoc Networks

"International Journal of Recent Trends in Engineering, ISSN: 1797-9617, Vol 2, No. 4, November 2009"

REVIEW PAPER
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# A COMPARATIVE STUDY OF MOBILE AND VEHICULAR ADOC NETWORKS

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*Abstract*—*Mobile Ad Hoc Network and Vehicular Ad-Hoc Networks are emerging area for research and development. VANETs are subclass of MANETs. But unlike MANETs it does not have battery constraints and have high mobility. Unicast and Multicast protocols in MANETs and VANETs use broadcasting to provide important control and route establishment. Possible applications of VANETs relying on broadcast for sharing safety, weather, and road information among vehicles. This paper presents a comparative study of Mobile and Vehicular adhoc network.*

*Index Terms*— *Mobile Ad hoc NETworks, Inter-Vehicle Communication, Vehicular Ad hoc NETworks, Broadcast, Urban MultiHop Broadcast, Multi-Hop Vehicular Broadcast*

## INTRODUCTION:

Mobile nodes temporary form a network for information sharing and require no need of routers and base stations is called Mobile Ad Hoc Network (MANET). They communicate with each other over multihop wireless links. [1]. RFC 2501 [2] shows that MANETs have different features like dynamic topologies, limited security, bandwidth and energy constrains.

Vehicular Ad-Hoc Networks (VANETs) are special case of MANETs [3]. Self Organized and distributed network, where fast moving vehicles have fixed movement along some path. [4]

VANETs have salient features (high speed, no battery constraints, limited movement, reliability and security problems) that discriminate it from other adhoc network. [5]. In wireless network, broadcasting is frequently used operation as compared to wired network. They are a lot issues and problems in wireless adhoc network because of node mobility and scattered resources. [6] VANETs are promising network for intelligent systems having short communication range between the vehicles [7].

Mostly in Vehicular adhoc network (VANETs), vehicles are interested in the same kind of information for example information about any accident, road block, parking, and fuel station or weather situation of particular route. So the broadcast is frequently used in vehicular adhoc network for information sharing. In this paper: section 2 and 3, characteristics and uses of MANETs are discussed. In section 4 and 5 broadcast approaches and security issues of MANETs are given. In section 6 and 7, characteristics and uses of VANETs are described. In section 8 and 9 broadcast approaches and security issues of VANETs are given. Lastly in section 10 conclusions is given.

## CHARACTERISTICS OF MOBILE ADHOC NETWORKS

RFC 2501[2] shows that MANETs have several salient characteristics:

Dynamic topologies: Nodes communicate with each other directly and also with intermediate nodes. As the network is dynamic, the nodes enter and leaving frequently.

Bandwidth constrains; wireless links have variable and lower capacity than wired links. Fading, noise, and interference conditions effect the throughput of wireless communication.

Energy constrains: Majority of nodes in MANETs dependent on batteries for their energy. So the most important parameter for optimization is energy conservation.

Limited physical security: Security is more complicated and difficult to achieve in Mobile wireless networks as compare to wired network. Different attacks like denial of service attack, man in the middle attack eavesdropping and spoofing should be considered. As they is no central server and base station so failure of single point can't produce more harm as compare to wired network.

# APPENDIX— CONFERENCE PUBLICATIONS

# Appendix C1 – Performance Evaluation of TCP in VANETS Using 802.11e

"16th IEEE International Conference on Networks (ICON 2008) New Delhi, India Dec.12th to 14th, 2008"

# Performance Analysis of TCP in VANETs by Using 802.11e

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*Abstract*-Communication in VANETS needs consideration of high mobility, congestion, collision and reliability factors. The successful delivery of important messages needs high reliability in case of TCP traffic during high congestion. Reliability and performance of priority based traffic is better than for same priority traffic and produces different results. In this paper we have analyzed the performance of TCP traffic in VANETs by using 802.11e and compared it with 802.11. Using NS2 we show that remarkable increase in the performance of TCP traffic is observed in case of 802.11e.
*Keywords*:- TCP, UDP, 802.11, 802.11e

## 1. INTRODUCTION

Vehicular Ad-Hoc Networks (VANETs) is a subclass of Mobile ad Hoc Networks (MANETs) where fast moving vehicles form a temporary network for communication [1]. Vehicle to Vehicle direct communication make it feasible to share information even there is no base station or router as it is necessary in Intelligent Transportation Systems (ITS) [2,3]. It is distributed and self-organizing network in which speed of node is high and node movement is fixed along some patterns [4].

VANETs have some distinctive properties that discriminate it from MANETs and some other types of adhoc network [5]. It includes very high speed of vehicles, no battery constraints, reliability and security problems, and movement of vehicles is limited.

IEEE 802.11 standard provides wireless connectivity to automatic machinery and equipment, which may be mounted on vehicles within a local area [6].

One of the major shortcomings of the IEEE 802.11 MAC is that it does not provide QoS support for real-time applications and for service differentiation [7]. So in order to provide QoS to important messages we must have to consider some other alternatives.

The 802.11e is the extension of IEEE 802.11 MAC in order to provide QoS support [8]. 802.11e provides prioritization among nodes or flows. So by using it we can increase the performance of important and emergency messages.

In this paper we analyze the behavior of TCP and UDP traffic with 802.11 and 802.11e.This paper is organized as follows. In section 2, the weakness of 802.11 and benefits of 802.11e are discussed. Section 3, demonstrates the simulation scenario and experimental results, and finally a conclusion is given in section 4.

## 2. RELATED WORK

In this section we will briefly explain the Distributed Coordination Function (DCF) and Point Coordination Function (PCF) of 802.11, Hybrid Coordination Function (HCF) of 802.11e, their weakness and benefits.

### *2.1 802.11 Medium Access Control*

The 802.11 Medium Access Control (MAC) layer supports two access mechanisms [9] (DCF and PCF). DCF is a medium access protocol that use carrier sense multiple access protocol with collision avoidance (CSMA/CA) for medium sharing mechanism [3].

The DCF is designed to provide best effort data transmission and all flows have equal priority. So it does not provide service differentiation. The major function of DCF is to reduce the collision among the flows that are competing for access to the Wireless Medium (WM) [10].

To support multimedia transmissions, PCF was introduced. PCF is optional MAC function [11] and polling-based contention-free access scheme [12]. It is optional because hardware implementation of PCF is very complicated. [13]

### *2.2 Weakness in 802.11*

The 802.11 is primarily designed to support multimedia delivery in WLAN but it has a limited QoS. As mentioned in [10] the 802.11 has the following shortcoming.

- Random beacon delays and unknown transmission in PCF mode.

# Appendix C2 – A Need of Secure Data Dissemination Scheme for VANETS

"Doctoral Symposium on Research in Computer Science", IEEE, Lahore, 9-10 Aug 2008" .

# A Need of Secure Data Dissemination Scheme for VANETS

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## Abstract

*Broadcasting in VANETs provides important control and route establishment functionality for a number of unicast and multicast protocols. Existing Techniques like simple flooding have shortcoming such as redundant rebroadcasts, collision, contention, Multi hop Vehicular broadcast have Scalability problem. Existing Approaches does not differentiate between safety and route messages and give them same importance. Relevance based approach is the only scheme that forward relevant message for sharing and discard the surplus messages. But it also has some drawbacks. The relevance based approach using 802.11e does not provide internal resorting of the packets in a packet queue and does not consider the network control, it only consider the user traffic. The author considers the ideal situation where all nodes are doing their work fair but it is not possible in practical. The problem is to enhance the mathematical model of relevance based approach or to design a new data dissemination scheme that is secure and it consider considers not only the user traffic but also the network control.*

## 1. Introduction

Mobile Ad Hoc Network (MANET) is a type of wireless network in which mobile nodes collectively form a temporary network without any routers and base stations, and communicate with each other over multihop wireless links. [1]. RFC 2501[2] shows that MANETs have several salient characteristics like Dynamic topologies Bandwidth-constrained, Energy-constrained operation and Limited physical security.

Vehicular Ad-Hoc Networks (VANETs) are special case of MANETs [3]. It is distributed and self-organizing network in which speed of node is high and node movement is fixed along some patterns. [4]
VANETs have some distinctive properties that discriminate it from MANETs and some other types of adhoc network. [5]
It includes very high speed of vehicles, no battery constraints, reliability and security problems, and movement of vehicles is limited.

## 2. Related Work

Different unicast and multicast protocols like Dynamic Source Routing, Ad Hoc On Demand Distance Vector, Zone Routing Protocol and Location Aided Routing use broadcasting to establish and maintain the route in VANETs.
A considerable number of broadcasting schemes have been proposed such as simple flooding, probability based approaches, area based approaches etc.

### 2.1 Simple flooding:

A simple approach to perform broadcast is by flooding. In this method, a vehicle sends a message to all of its neighbors and its neighbors in return send message to its neighbors. This process continues until all the vehicles get the same message.

### 2.2 Probabilistic scheme:

In this scheme the message is broadcast with some fixed probability. In dense network, due to share coverage only few nodes can do rebroadcast to save network resources. [6]

### 2.3 Area Based Scheme

In Area Based Scheme a node calculate the additional coverage area on bases of received redundant messages. If a node achieve sufficient additional coverage area with broadcast then it will rebroadcast else not. [6]

### 2.4 Neighbor Knowledge Methods

In Neighbor Knowledge methods every node maintains neighbor node information. With help of this information a node decide to

# Appendix C3 – Impact of Malicious Node on Broadcast Schemes

"Published in SecTech 2009, CCIS 58, pp. 86–92, 2009."

# Impact of Malicious Node on Broadcast Schemes

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**Abstract.** Broadcast is frequently used operation in vehicular adhoc network (VANETs) for sharing traffic, weather, and safety information among vehicles. Relevance based approach forward high priority traffic for information sharing and removes the redundant and surplus messages. The relevance based approach depends upon the intermediate nodes and consider ideal scenario where there is no selfish and malicious node but it is not possible in real life scenario. We in this paper simulate the relevance based approach using NS-2 in a real scenario and consider the impact of malicious node and determine how much throughput of network is affected by malicious node.

## 1 Introduction

A large number of Broadcast Techniques have been proposed for information sharing but they are not appropriate for VANETs as they have certain drawbacks like simple flooding [1] have shortcoming such as redundant rebroadcasts, collision and contention. Probabilistic scheme [2] is proposed to overcome the simple flooding problems but its performance is poor in sparse network as the nodes can't get all messages until the probability is high and it works similar with simple flooding when its probability is high. Neighbor Knowledge method exchange hello packet to get neighbor information and hello packets degrades the network performance. If the interval of hello packet is short it will cause contention and collision and large interval influence the network performance due to mobility [3]. Multi hop Vehicular broadcast [4] have Scalability problem. All existing techniques also do not consider the importance of message except the relevance based approach.

The relevance based approach depends upon the intermediate nodes for communication. All nodes in VANETs are considered as fair nodes [5] (forward the information to increase the global benefit regardless of their own benefit) but it is not possible in real life scenario.

We in this paper simulate the relevance based approach in real scenario and consider the impact of malicious node on relevance based approach and determine how much throughput of network is affected by malicious node. This paper is organized as follows: In section 2, we discuss relevance based approach, its characteristics and its implementation using cross layer, 802.11e and 802.11e with virtual queue. In section 3, proposed study and results are presented using NS-2. Lastly in section 4 conclusions is given.

D. Ślęzak et al. (Eds.): SecTech 2009, CCIS 58, pp. 86–92, 2009.

# Appendix C4 – A SURVEY ON BROADCAST APPROACHES IN VANETS

"Mosharaka International conference on communication and network, Jordan 2008"

# A SURVEY ON BROADCAST APPROACHES IN VANETS

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## Abstract

*Inter-Vehicle Communication (IVC) Systems has captured the interest of industry and research community. In VANETs, broadcast is a most commonly used technique. Sharing safety, weather, and road information among vehicles depends on broadcast. Broadcast plays important role in VANETS, as it is used to establish and maintain the route for unicast and multicast protocols. Despite a considerable number of proposed broadcasting schemes, no comprehensive comparative analysis has been previously done. This paper presents a comparative study of different broadcast approaches in VANETs.*

**Keywords:** Inter-Vehicle Communication (IVC), Vehicular Ad hoc NETworks (VANETs), Broadcast, Urban MultiHop Broadcast (UMB), Multi-Hop Vehicular Broadcast (MHVB).

## 1. Introduction

Vehicular Ad-Hoc Networks (VANETs) are a subclass of Mobile ad Hoc Networks (MANETs), where wireless-equipped vehicles form a temporary network. VANETSs do not need any infrastructure and vehicle to vehicle communication does not need any infrastructure as it is necessary in Intelligent Transportation Systems [1]. VANETs are self organized and distributed network with high mobility and specified movement patterns [2].

VANETs have some distinctive properties that discriminate it from MANETs and some other types of adhoc network. [11]. It includes very high speed of vehicles, no battery constraints, reliability and security problems, and movement of vehicles is limited.

In VANETs, broadcast is a mostly used technique. Sharing safety, weather, traffic and road information among the vehicles depends on broadcast [22]. Different broadcasting schemes have been proposed, but no comprehensive comparative analysis has been previously done. This paper presents a comparative study of different broadcast approaches in VANETs.

This paper is organized as follows: In section 2, different broadcast approaches are described. In section 3, comparison of broadcast approaches is performed. In section 4, conclusion and future work is given.

## 2. Broadcast Approaches

Different unicast and multicast protocols like Dynamic Source Routing (DSR) [18], Ad Hoc On Demand Distance Vector (AODV) [19], Zone Routing Protocol (ZRP) [20] and Location Aided Routing (ZAR) [21] use broadcasting to establish and maintain the route in VANETs. A considerable number of broadcasting schemes have been proposed such as simple flooding, probability based approaches, area based approaches etc.

### 2.1 Simple Flooding

A simple approach to perform broadcast is by flooding. In this method, a vehicle sends a message to all of its neighbors and its neighbors in return send message to its neighbors. This process continues until all the nodes get the same message. There are following drawbacks in simple flooding [4].

- Redundant and unneeded rebroadcasts. When a vehicle decides to rebroadcast a broadcast message to its neighbors, all its neighbors already may have the message.

- Contention for medium. After a vehicle broadcasts a message, if its neighbors also decide to rebroadcast the message, these transmissions,

# Appendix C5 – PBBS: Priority Based Broadcast Scheme for VANETs

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# PBBS: Priority Based Broadcast Scheme for VANETs

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## Abstract:

*Broadcast is frequently used method for communication in Vehicular Ad hoc Networks (VANETs.). Possible applications relying on broadcast include sharing emergency, traffic, weather, and road data among vehicles, and delivering advertisements and announcements. Simple flooding broadcast technique cannot distinguish the messages of different applications. So safety and emergency messages cannot get preference and experience delay which can lead to unfavorable results. This paper presents a novel scheme for broadcasting which can recognize messages of different applications. Safety and emergency messages get priority to provide better road safety. Simulations using NS-2 show that proposed scheme is more effective and achieve the afore-mentioned objectives.*

**Keywords:** Vehicular Ad hoc NETworks (VANETs), Broadcast, 802.11e

## 1. Introduction:

Vehicular Ad-Hoc Networks (VANETs) are special case of MANETs [1]. It is distributed and self-organizing network in which speed of node is high and node movement is fixed along some patterns. [2]

VANETs have some distinctive properties that discriminate it from MANETs. [3] It includes very high speed of vehicles, no battery constraints, reliability and security problems, and movement of vehicles is limited.

Different Unicast protocols use Broadcasting, in order to provide important control and route establishment. For example, unicast routing protocols such as Dynamic Source Routing (DSR) [4], Ad hoc On-demand Distance Vector (AODV) [5], Zone Routing Protocol (ZRP) [6] and Location Aided Routing (LAR) [7] use broadcasting to establish routes. Some multicast protocols and geocast protocols often use broadcast for different purposes. [8] Simple flooding does not recognize the messages of different application type and can't give any priority to emergency and safety messages. Low priority message types like route messages, weather messages and common messages get the medium more than the highly priority messages like safety messages.

This paper presents a priority based broadcast scheme for VANETs, in which messages are recognized into four types and then forwarded according to their assigned a priority.

This paper is organized as follows: In section 2, previous broadcast approaches are described. In section 3, proposed broadcast scheme is given. In section 4, simulation study and results are given. In section 5 conclusions are given.

## 2. Related Work

A considerable number of broadcasting schemes have been proposed such as simple flooding, probability based approaches, area based approaches etc.

### 2.1 Simple flooding:

A simple approach to perform broadcast is by flooding. In this method, a vehicle sends a message to all of its neighbors and its neighbors in return send message to its neighbors. This process continues until all the vehicles get the same message. [9]

### 2.2 Probabilistic scheme:

In this scheme the message is broadcast with some fixed probability. In dense network, due to share coverage only few nodes can do rebroadcast to save network resources. [10]

### 2.3 Area Based Scheme

In Area Based Scheme a node calculate the additional coverage area on bases of received redundant messages. If a node achieve sufficient additional coverage area with broadcast then it will rebroadcast else not. [10]

# Appendix C6 – Relevance Based Approach with Virtual Queue Using 802.11e protocol for Vehicular Adhoc Networks

"Published in IEEE, PNEC, Karachi, Pakistan 2009"

# Relevance Based Approach with Virtual Queue for Vehicular Adhoc Networks

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**Abstract:**
*Vehicular adhoc networks are subclass of mobile adhoc network. Broadcast is a commonly used technique for communication. Different techniques are proposed for broadcast but they can't consider the importance of message except relevance based approach. Relevance based approach is the only scheme that forward relevant message for sharing and discard the surplus messages. The relevance based approach using 802.11e does not provide internal resorting of the packets in a packet queue. This paper presents an idea of virtual queue at application level to overcome this problem.*

**Keywords:** Vehicular Ad hoc Networks (VANETs), Broadcast, Urban MultiHop Broadcast (UMB), Mobility-Centric Data Dissemination Algorithm for Vehicular Networks (MDDV).

## 1. Introduction:

Mostly in Vehicular adhoc network (VANETs), vehicles are interested in the same kind of information for example information about any accident, road block, parking, and fuel station or weather situation of particular route. So the broadcast is frequently used in vehicular adhoc network for information sharing.

In wireless network, broadcasting is frequently used operation as compared to wired network. They are a lot issues and problems in wireless adhoc network because of node mobility and scattered resources. [1] VANETs are promising network design for intelligent transportation systems and based on short communication range between the vehicles [2].

In VANETs, vehicles communicate with each other from time to time and require no base station, no router for their communication. They can share information either directly or through intermediate nodes. [3]

Fast moving Vehicles with WiFi (Wireless network interfaces) form VANETs anywhere without the need of fixed infrastructure [4].

VANETs have some distinctive properties that discriminate it from MANETS and some other types of adhoc networks [5].It includes very high speed of vehicles, no battery restriction reliability and security problems, and movement of vehicles is limited.

Two type of application exist in VANETs (Safety and non Safety applications). Safety application includes accident, fuel station, traffic and road data etc. and non safety application includes the entertainment and tolling information [14].

Broadcast Techniques like simple flooding[6] have shortcoming such as redundant rebroadcasts, collision, contention, Multi hop Vehicular broadcast [7] have Scalability problem. All existing techniques do not consider the importance of message except the relevance based approach.

The relevance based approach using 802.11e also have one problem that it does not provide internal resorting of the packets in a packet queue.[8] This paper presents an idea of virtual queue with relevance based approach using 802.11e to overcome this problem. This paper is organized as follows: In section 2, related work and relevance based approach using 802.11e is described. In section 3, enhanced due to virtual queue is given. In section 4, simulation study and results are shown. Lastly in section 5 conclusions is given.

# Appendix C7 – Performance Evaluation of Video Streaming in Vehicular Adhoc Network

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# Performance Evaluation of Video Streaming in Vehicular Adhoc Network

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**Abstract.** In Vehicular Ad-Hoc Networks (VANETs) wireless-equipped vehicles form a temporary network for sharing information among vehicles. Secure Multimedia communication enhances the safety of passenger by providing visual picture of accidents and danger situations. In this paper we will evaluate the performance of multimedia data in VANETS scenario and consider the impact of malicious node using NS-2 and Evalvid video evaluation tool.

**Keywords:** Evalvid, multimedia, malicious.

## 1 Introduction

Multimedia communication has gained the attraction of research community [1]. Multimedia Information includes the several applications like television, Chatting, gaming, internet, Video/Audio-on-Demand, video conferencing [2]. Due to rapid growth of multimedia application, Security is an important concern [3].

Authentication, Confidentiality, Integrity and non repudiation are the essential security requirement of multimedia communication in VANETs. [4] Security attacks (Denial of service, malicious node attack, Impersonation) and vulnerabilities (Forgery, violation of copywrite and privacy) exist in multimedia application due to mobility and dynamic nature of VANETs [5].

Video transmission in VANETs faces a lot of challenges due to limited bandwidth and transmission errors [6]. Security, Interference, channel fading, dynamic topology changes and infrastructure less are some other factors that degrade the performance of video streaming in VANETs [7].

We in this paper analyze the performance of multimedia traffic in VANETs with and without the interference of malicious node. We measure performance in terms of PNSR, delay, sending rate, receiving rate of vehicles.

This paper is organized as follows: In section 2, we discuss the feasibility of multimedia application in VANETs scenario and different existing frameworks for media streaming in VANETs In section 3, proposed study and results are presented using NS-2 and Evalvid. Lastly in section 4 conclusions is given.

## 2 Related Work

Moez et al. (2007) experimentally proof the feasibility of multimedia application in VANETs scenario by using IEEE 802.11 [8].

S.K. Bandyopadhyay et al. (Eds.): ISA 2010, CCIS 76, pp. 220–224, 2010.