Journal of Engineering and Applied Sciences 12 (Special Issue 11): 9266-9277, 2017
ISSN: 1816-949X

Issues and Challenges of Video Dissemination in VANET and Routing Protocol: Review

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Abstract: New technology called Vehicular Ad-hoc Networks (VANETs), this topology quick changing and frequent disconnection has taken huge attention within last years and makes it complex to design an active routing protocol to routing data among vehicles, Vehicle to Vehicle (V2V) communication and Vehicle to roadside Infrastructure (V2I). Routing protocols which existing for VANETs don't efficient upon meet all traffic scenarios. Hence, the study of an efficient routing protocol has received significant recognition. Therefore, it is really essential to distinguish the pros and cons of routing protocols that can be done for additional growth or development of any new routing protocol. This study present different aspects of VANET technologies that form a real life vehicular network. More detail for the potential applications and current initiatives for the vehicle networks are covered. In addition, brief discussion of existing related work on video streaming in VANETs which are focused on different protocol stack layers. Finally, provides a comprehensive background on vehicular communication networks. Also, the surveys different routing techniques that have improved video broadcasting functionality to achieve acceptable QoS over VANETs.

Key words: VANET, routing protocol, video dissemination, QoS, communication, recognition

INTRODUCTION

VANET is a special type form MANET that is a Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication network. It is self-organizing and autonomous wireless communication network, when nodes in VANET involve themselves as servers or/and clients for swapping and sharing data. The architecture network of VANET can do divided toward three categories: WLAN/cellular, pure ad hoc and hybrid, (Sharef *et al*., 2014). It has taken huge attention from industry, government and academy due to new technology.

There are various research around the world that are compared with VANET (Tarique *et al*., 2009). Topology-based protocols like Ad-Hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR) (Johnson *et al*., 2001) are usually used in an ad-hoc network and they forward packets based on link information that stored in the routing table. To reduce the overhead, they usually do not store the route unless needed. Bachir and Benslimane (2003) have proposed a geocast protocol called Inter-Vehicle Geocast (IVG). The alarm messages are sent to vehicles in the risk areas. IVG determines such areas according to the driving directions, speeds and the positions of vehicles. Durresi *et al*. (2005) designed a broadcast protocol called BROADCOMM for handling the emergency on high-way environment. They divided the highway into several virtual cells and separated vehicles into two levels.

MATERIALS AND METHODS

Vehicular network model: VANET is a type of ad hoc network with some unique characteristics and requirements. In the following, discuss unique features of VANETs. Some of these main qualities are (Gerla *et al*., 2006):

Computing power and battery life: Vehicles have much higher reserve power and computing capability than a typical cell-phone or a mobile computer.

Node size and weight: Vehicles have significantly larger size and weight and hence can support complex sensor applications with significant computing component.

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Vehicle speeds: Vehicles travel at speeds up to 100 m/h which results in the lack of continuous coherent communication links and could have frequently changing topology.

Vehicle grid: Vehicles in the grid are few hops away from a Road Side Unit (RSU) or the infrastructure. As mentioned earlier, vehicles are equipped with both sensors and communication devices. After sensor nodes sense data, it is expected to communicate this data to other vehicles and the surrounding infrastructure. In other instances, vehicles are required to retrieve data from other vehicles from the infrastructure or from the internet. Vehicles themselves are considered as nodes in a large network. Due to the nature of the vehicular network, these nodes are highly mobile. When vehicles travel on the highway or in the city, they come in close proximity (within the communication connectivity range) with other vehicles or with road side units (infrastructure). Hence, it can assume that the communication infrastructure of vehicular networks is one of three main models: vehicle-to-vehicle, vehicle-to-infrastructure and hybrid models.

Figure 1a shows Vehicle-to-Vehicle (V2V) model, vehicles communicate with each other in an ad hoc fashion. Vehicles that are in close proximity with each other, communicate directly. This model also overcomes conventional centralized approach and avoids any fixed network size or end-to-end delay. End-to-end delay depends mainly on availability of intermediate vehicles that can be used as hops to communicate or propagate the data. Figure 1b, Vehicle-to-Infrastructure (V2I) model

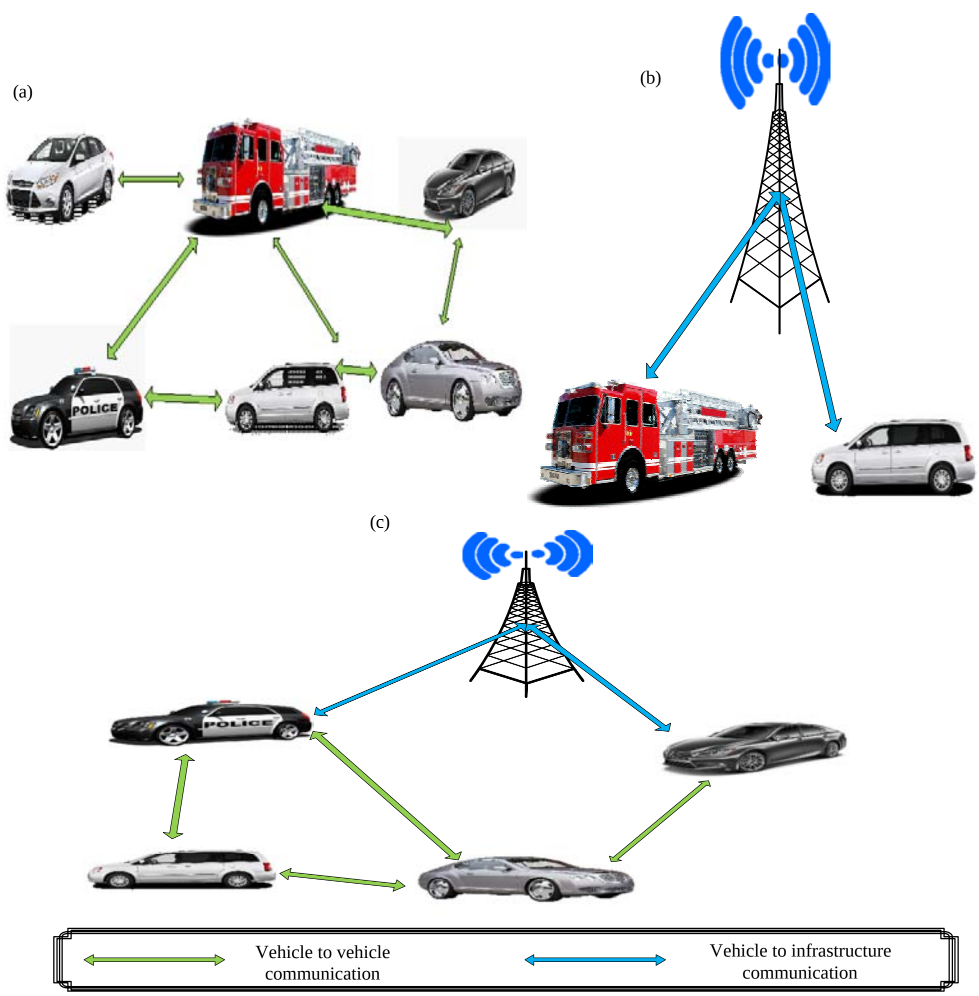

Fig. 1: a) Vehicle-to-Vehicle (V2V) communication; b) Vehicle-to-Infrastructure (V2I) communication and c) Hybrid Model (V2X) communication

is when vehicles connect with an infrastructure-based communication system, as show. An infrastructure-based system is also referred to as Road Side Unit (RSU) (Hsu *et al*., 2011). They can be cellular, WiMax or 802.11 networks. The advantage of these networks is that they are centralized and enable a vehicle access to the internet. One of the main disadvantages of this model is that the communication infrastructure network could be easily overloaded while the cost of using the network could be substantially high. Figure 1c, the hybrid model combines the advantages of both the vehicle-to-vehicle model and the vehicle-to-infrastructure model. In this hybrid model, vehicles communicate by using either of the two models depending on a specific criteria and availability. If other vehicles are absent in the vicinity, vehicles can communicate through the infrastructure.

VANET routing protocols: As well as to provide effcient and reliable routing in VANET has been studied and many protocols have been proposed as shown in Table 1.

Broadcast communication: Broadcast is widely used in VANET for disseminating basic vehicle status informationand event-driven messages through both single-hop and multi-hop. The simplest method to implement broadcast is flooding that every vehicle just rebroadcasts the received messages to all its neighbors except the one who sent it the messages. The performance of such scheme will significantly degrade and a large number of packet collisions will happen when the vehicle density becomes high. Therefore, some protocols have been proposed for achieving effcient broadcast with fewer collisions and lower network overhead. More detail of different broadcasting protocol as shown in Table 2.

Table 1: A summary of the routing protocols

Researcher's	Strategy	Metric	Proposed protocol	Statement of the problem	Positional (neighbour knowledge)	Addressed intermittent connectivity?	Acknowledgment in beacon?
Sanguesa *et al*. (2015)	Epidemic routing	Overhead and delay	RTA-D	Criticality time geocasting	Required	✓	✓
Zeng *et al*. (2017)	High scheduling efficiency verified	Overhead and delay	RLS	Criticality time geocasting	Required	✓	✓
Liu *et al*. (2013)	Receiver consensus	Delivery ratio and delay	ReC	Criticality time geocasting	Required	✓	✓
Oh *et al*. (2012)	Slot reservation and circle of trust	Delivery ratio and delay	ZCO-R	Criticality time geocasting	Required	×	✓
Ros *et al*. (2012)	Acknowledgment+ CDS	Delivery ratio, overhead and delay	Ack-BSM	Reliability geocasting	Required	✓	✓
Ma *et al*. (2012)	Repetition	Delivery ratio and delay	MHE-B	Reliability geocasting	Required	×	✓
Jeong *et al*. (2011)	Trajectory knowledge	Delivery ratio and delay	LD-CROP	Scale: large routing	Required	✓	✓
Naumov and Gross (2007)	Connectivity awareness	Delivery ratio, overhead and delay	CAR	Scale: large routing	Required	✓	✓
Huang *et al*. (2007)	Epidemic routing	Delivery ratio and delay	DAER	Scale: large routing	Required	×	✓
Lee *et al*. (2010)	Receiver oriented	Delay	TO-GO	Scale: small routing	Required	✓	✓
Sahoo *et al*. (2011)	Receiver oriented	Delay	BPAB	Scale: small routing	Not required	✓	Acknowledgment passive
Tseng *et al*. (2010)	Receiver oriented	Overhead and delay	VDEB	Scale: small routing	Required	×	✓

Table 2: Routing protocols in VANET

Researcher's	Proposed technique	Routing protocols	Communication techniques	Remarks
Xiang *et al*. (2013)	Restricted forwarding algorithm and optimal forwarding path algorithm	Geographic stateless VANET routing protocol	Unicast	Sparse connectivity is eliminated by the vehicle density
Tarik	ROMSGP algorithm	Receive on most stable group-path	Broadcast	Routing strategy in terms of increasing the end-to-end throughput andincreasing link duration
Xie *et al*. (2007)	AODV-VANET	AODV	Broadcast	Introduction of the total weight of the Route and expiration time estimation
Chang and Sang-woo	Employing approaches to multi-hop broadcast scheme for reliable packet dissemination	Improved distance-based VANET routing protocol in urban traffic environments	Multicast	proposed protocol improves the performance as compared with AODV, GSR
Celimuge and Wu	Apply a fuzzy constraint Q-learning algorithm	Portable VANET routing protocol PFQ-AODV	Multicast	Provide multihop reliability and efficiency

Table 2: Continue

Researcher's	Proposed technique	Routing protocols	Communication techniques	Remarks
Xin *et al.*	MicroTopology (MT)	Street-centric Routing Protocol based on MT (SRPMT)	Broadcast	With the help of MT, packets can be relayed through the street effectively
Jamal and Toutouh	Coupling optimization algorithms (PSO, DE, GA and SA)	optimized link state routing (OLSR)	Unicast	OLSR configurations result in better Quality of Service (QoS) than the standard Request For Comments (RFC)
Shen *et al.* (2017)	Dynamic Organized Topology (D-OT)	Organized Topology Based Routing (OTBR)	Multicast	Static organized topology based routing using Anti-Pheromone (APS-OTBR) is presented on the basis of the characteristic of S-OT
Husain and Sharma (2015)	Distance-Effect Routing Algorithmfor Mobility (DREAM)	Location-based protocols (LAR)	Multicast	Metrics for analysis of performance like PDR, routing overhead, delay, throughput and lost packet ratio
Zhang *et al.* (2017)	A Micro Artificial Bee Colony (MABC) algorithm	Multicast routing i	Multicast	MABC could be reduced by inventing more powerfulvariation formula or by identifying search patterns in solutions

RESULTS AND DISCUSSION

VANET applications: In this study, survey the potential VANET applications and classify them as safety or non-safety which include convenience and commercial applications. The discussion provides network designers to better understand the communication requirements. For a comprehensive list of VANET applications, refer to the study by Bai *et al.*

Safety applications: Vehicular safety remains the major driver for automotive telematics. With and over 600 million vehicles in service worldwide and 50 million new vehicles produced per year, a potential hazard or flaw in vehicle design can quickly result in a surge of public safety concerns and vehicle recalls costing hundreds of millions of dollars for automakers. Here, survey broadcast scenarios in VANETs and classify the applications based on safety criteria and communication parameters. Safety applications can occur in VANET with means such as single-hop and multi-hop as well as pure Vehicle-to-Vehicle (V2V) or a combination of Infrastructure-to-Vehicle communication (I2V) or Vehicle-to-Infrastructure (V2I). These different VANET safety scenarios are illustrated in Fig. 2-d with communication area covered by the blue region.

According to the CAMP vehicle safety communications consortium consisting of BMW, Daimler Chrysler, Ford, General Motors, Nissan, Toyota and Volkswagen, a comprehensive list of more than 75 application scenarios for intelligent vehicle safety applications enabled by DSRC have been identified (Yao *et al.*, 2017). Table 3 provides a detailed list of important safety applications and the type of communication and traffic information that are involved in different VANET safety scenarios as derived in one of the previous studies (Chen *et al.*, 2010). A comprehensive summary of the current state-of-the-art vehicular communication network projects (academia and industry) on emergency services and road safety is discussed by (Martinez *et al.*, 2010). In Table 3, the latency for safety requirements are approximate values proposed previously by several sources that include previous research papers, automotive practitioner recommendations and consortium reports.

Non-safety applications: Non-safety applications in vehicular networks include convenience and commercial applications and provide tertiary benefits for vehicles such as travel time savings and in car entertainment. Convenience applications enhance traffic flow and increase the driving experience by sharing traffic information between vehicles and the central traffic control system. It provides drivers with ways to make more informed route choice decisions. Commercial applications provide drivers and their passengers with infotainment content delivery, web access and audio and video streaming. Table 4 provides a detailed list of non-safety applications and the type of communication and traffic information attributed to convenience and commercial applications.

Video streaming techniques: Several protocols (Guo *et al.*, 2005; Seferoglu and Markopoulou, 2007; Xie *et al.*, 2007) have been proposed for video dissemination over VANETs. These research works have applied di?erent network adaptive techniques to support media streaming and improve video quality in unreliable and dynamic vehicular network environments. To support video streaming, large amounts of data should be exchanged between vehicles which may cause more overhead and bandwidth consumption in the network

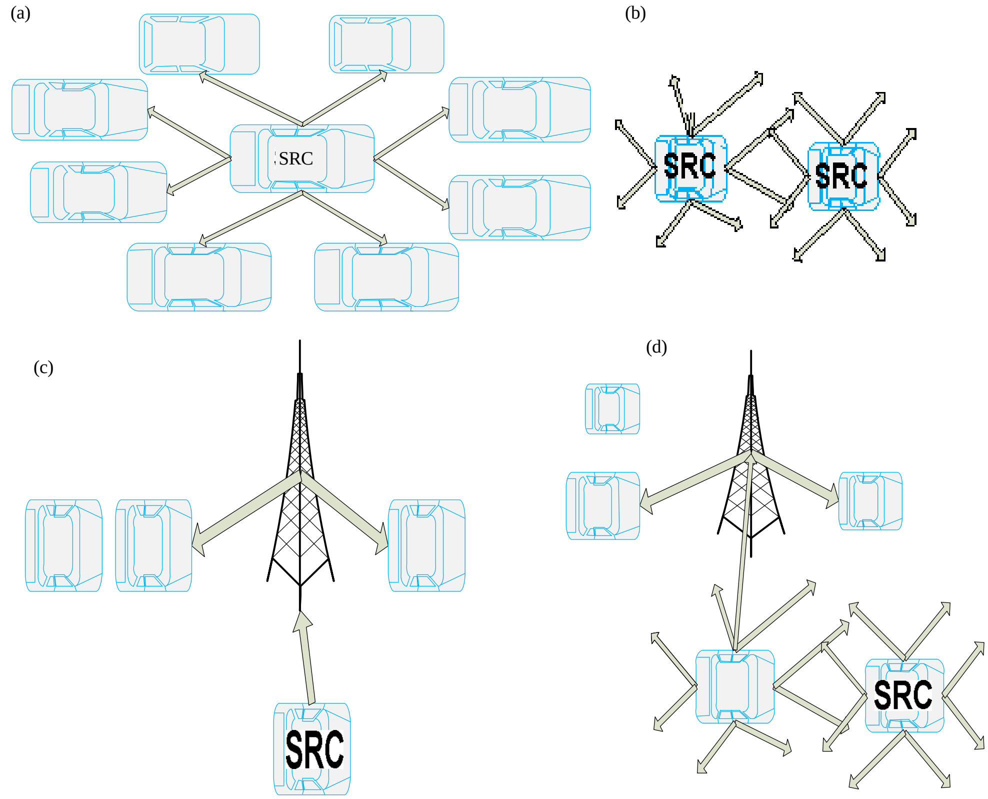

Fig. 2: a) Single-hop V2V; b) Multi-hop V2V; c) Single-hop I2V and d) Multi-hop V2V followed by V2I

Table 3: Safety applications of vehicular

Safety application	Communication type	Traffic information	Transmit mode	Latency (msec)	Comm range (m)
Intersection collision avoidance					
Traffic signal violation warning	Infrastructure-to-vehicle	Traffic signalstatus/timing Pedestrian crossing	Periodic	~100	≤250
Left turn assistant	Vehicle-to-infrastructure infrastructure-to-vehicle	Traffic signal status/timing vehicle position, speed, heading intersection road shape	Periodic	~100	≤300
Stop sign movement assistance	Vehicle-to-infrastructure infrastructure-to-vehicle	Vehicle position, heading, speed	Periodic	~100	≤300
Intersection collision warning	Vehicle-to-vehicle	Vehicle position, heading, speed turn signal status	Event driven	~100	≤300
Blind merge warning	Infrastructure-to-vehicle	Vehicle position, speed, heading	Periodic	~100	≤200
Pedestrian cross information at designated intersections	Infrastructure-tovehicle	Pedestrian detection and crossing	Periodic	~100	≤200
Information from other vehicles					
Cooperative collision warning	Vehicle-to-vehicle	Vehicle position, speed, heading acceleration	Periodic	~100	≤150
Emergency electronic brake lights	Vehicle-to-vehicle	Vehicle position, heading, speed deceleration	Event driven	~100	≤300
Highway merge assistant	Vehicle-to-vehicle	Vehicle position, heading, speed vehicles in merge path	Periodic	~100	≤250
Blind spot warning	Vehicle-to-vehicle	Vehicle position, heading, speed	Periodic	~100	≤150
Pre-crash sensing	Vehicle-to-vehicle	Safety sensor coordination on seatbelts, airbags, prearming	Event driven	~20	≤50
Transit vehicle signal priority	Vehicle-to-vehicle	Vehicle position, heading, speed	Event driven	~1000	≤1000
Cooperative vehicle-highway automation systems (platoon)	Vehicle-to-vehicle vehicle-to-infrastructure	Vehicle headway distance, vehicle cut-in	Periodic	~20	≤100
Cooperative adaptive cruise control	Vehicle-to-vehicle	Emergency vehicle right of way yield	Periodic	~100	≤150

Table 3: Continue

Safety application	Communication types	Traffic information	Transmit mode	Latency (msec)	Comm range (m)
Public safety					
Approaching emergency vehicle warning	Vehicle-to-vehicle	Emergency vehicle right of way yield	Event driven	~1000	≤1000
Post-crash warning	Vehicle-to-infrastructure vehicle-to-vehicle	Disabled vehicle due to crash or mechanical breakdown	Event driven	~500	≤300
Sign extension					
In-vehicle signage	Infrastructure-to-vehicle	Signage typically conveyed by trafficsigns (e.g., school zone, speed limit)	Periodic	~1000	≤200
Curve speed warning	Infrastructure-to-vehicle	Curve location, curvespeed limits, curvature, road surface condition	Periodic	~1000	≤200
Work zone warning	Infrastructure-to-vehicle	Distance to work zone, road closure, reduced speed limit	Periodic	~1000	≤300

Table 4: Non-safety applications vehicular

Non-safety application	Communication type	Traffic information	Transmit mode
Convenience			
Parking spot locator	Vehicle-to-vehicle	Information on open parking spots upon entering a parking lot	Event-driven
Parking availability notification	Vehicle-to-infrastructure	Information on available parkinglots in a geographic region	Event-driven
Free flow tolling	Vehicle-to-infrastructure	Vehicle toll collection at highwaytoll booths	Event-driven
Traffic probe	Vehicle-to-infrastructure	Aggregate traffic probeinformation for the road-side units	User-driven
Congestion road notification	Vehicle-to-infrastructure	Report on road congestion for purposes of route planning	User-driven
Commercial			
Real-time video relay	Vehicle-to-infrastructure	Transmission of multimediacontent from vehicles	User-driven
Content, map or database download	Vehicle-to-infrastructure	Download of digital map content,tourist or landmark information	User-driven
Service announcements	Vehicle-to-infrastructure	Road-side businessesannouncement and advertisement of passing by vehicles	User-driven
Remote vehicle personalization/diagnostics	Vehicle-to-infrastructure	Download of personalized vehicle settings or upload of vehicle diagnostics	User-driven

Table 5: IEEE 1609.X family

Standard	Function	Years	Description
IEEE 1609.1	Resource management	2006	Facilitate communication between remote applications and vehicles
IEEE 1609.2	Security services	2006	Provide security services for applications and management messages
IEEE 1609.3	Networking services	2007	Addresses network layer issues
IEEE 1609.4	Multi-channel operation	2006	4Deals with communications through multiple channels

(Ghafoor and Bakar, 2010). Video quality at the receivers is affected by distortion due to packet loss and delay. As mentioned before, this may happen for different reasons such as VANETs dynamic topology, limited shared bandwidth and disconnected platoons leading to link breakage. In addition, collision among hidden nodes is a reason for packet loss which has been addressed in a number of studies (Omar *et al*., 2013; Li *et al*., 2014; Korkmaz *et al*., 2004). As for the delay, its effect on video quality is highly related to the type of video application. In fact, delay requirements are less challenging in stored playback videos and video streaming compared to interactive and safety-related video applications.

Link layer techniques: Link layer techniques are the essential elements of all network solutions. This layer mainly manages the interaction of devices with the shared wired or wireless medium using the Media Access Control (MAC) sub-layer. An enhancement and higher layer of 802.11p is the IEEE 1609 family which has developed a set of standards to provide resource management via. multi-channel operation and also deal with communication coordination and security issues. Table 5 summarizes each standard in the 1609 family.

With all the 802.11p mentioned standard improvements for data transmission over vehicular networks, there are still some issues such as large end-to-end delays due to switching between different channels and lack of guaranteed bandwidth in high congestion networks that makes it unsuitable to be used as-is for video broadcasting applications. Therefore, a number of techniques have been introduced to enhance the functionality of IEEE 802.11 standards and MAC layer for broadcasting over VANETs. In addition to EDCA, another scheme called HCF Controlled Channel Access (HCCA) scheme is also available under the HCF but is not utilized by 802.11p as a medium access method (Naeimipoor, 2013). The EDCA takes advantage of the Listen Before Talk (LBT) and back-off time that are defined based on random wait times and a channel access parameter known as the Arbitration Inter-Frame Space (AIFS). This scheme prioritizes packet queues from the same source according to a virtual resolution function and retransmitting lowest priority packets to increase packet delivery probability. The WAVE architecture distinguishes two types of channels: Six Service Channels (SCH) that are used to exchange non-safety and long stream data as well as one Control Channel (CCH) that is reserved for communication coordination and safety message delivery (Amadeo *et al*., 2012). Vehicles adapt to this approach by periodically switching to the control channel for monitoring emergency and warning messages when all communication via. SCH are suspended. Once the emergency presented by the safety message is resolved, vehicles switch to the SCH and data transmission over the CCH stop until the next channel switch. In order to achieve multi-channel accessibility in WAVE, two separated EDCA functions should be deployed for SCH and CCH which handle different sets of queues for packets (Amadeo *et al*., 2012).

Network congestion control: Network congestion is one of the challenges that must be addressed in vehicular networks especially when large a number of bits should transfer per second. IEEE 802.11 technologies may offer more adaptive solutions to guarantee fair sharing of bandwidth which significantly reduces the impact of network congestion. Adjusting the frame rate and controlling the back-off time and contention window size are reliable solutions for network congestion control that can be addressed in different ways.

Selective frame rate: Bonuccelli *et al*. (2007) propose a solution that applies frame skipping and transcoding together with a rate reduction technique over IEEE 802.11 to improve the video quality of real time services in highly congested vehicular scenarios. Frame skipping can occur when the sender monitors the channel access delay for a video frame transmission. If the sender detects a real-time frame loss, it avoids wasting the bandwidth by dropping this frame F. In this case, temporal transcoding applies and the decoding process at the receivers end relies on the previously received frame (i.e., F-1). If the frame is transmitted over the network, it delivers after an acceptable delay and will not be displayed at the receivers side. However, this frame participates in the decoding of the next arriving frame (i.e., F+1). In the case two consecutive frames are skipped, the sender assumes that the network is congested and consequently reduces the frame rate.

However, increasing the minimum value of the contention window is not always a practical solution especially for safety applications where vehicles exchange Co-operative Awareness Messages (CAMs) periodically and bigger values of C Wmin increase the beacon waiting time at the MAC layer. The longer waiting time may result in transmission of expired CAMs that transfer outdated information to the vehicles and waste shared bandwidth. To handle CAM expiration by Stanica *et al*. (2011) have suggested a method for back-off time modification to guarantee a balance between collisions and expiring beacons. According this approach, the CW value is set to the maximum size as a default and is divided by two after any CAM expiration. Whenever a beacon transmits successfully, the contention window size resets to its maximum value. This method has been used to address the hidden nodes problem by giving transmission priority to the vehicles that have experienced higher numbers of expired CAMs and reduced collision by decreasing the probability of back-off timers expiration at the same time (Table 6).

QoS-based solutions: As discussed, the WAVE spectrum is composed of seven channels of 10 MHz (Naeimipoor, 2013) each including six SCHs and a single CCH channel. According to the original idea of 80.11p, messages over VANETs are divided into safety and non-safety and are prioritized based on this classification. To improve QoS over 802.11p, further classification of applications can enhance services provided in terms of delay and shared bandwidth.

Several video applications have been developed to provide infotainment services. However, 802.11p is more suitable for safety applications. Since, the main goal of this study is on video dissemination approaches, investigating on proposed protocols for infotainment video services provide a more in-depth focus towards this goal. The W-HCF (WAVE-based Hybrid Coordination

Table 6: Layered view of vehicular networks

		Network vehicular		
Scope	Network type	Application type	Communication type	Quality of service
Wide area, local	Ad hoc, infrastructure based	Comfort application, intelligent transport application, safety application	V2V, V2I	Hard-real-time, non-real-time, soft-real-time

Function) is a MAC protocol (Amadeo *et al*., 2009) that has been proposed by Amadeo *et al*. (2012) to provide infotainment applications by enhancing IEEE 802.11p standards. This protocol distinguishes between QoS-sensitive and non-QoS sensitive applications in non-safety services. The W-HCF treats QoS-sensitive services in a different way than 802.11p while keeping the bandwidth available for non QoS-sensitive services. This method relies on resource reservation by using extra signalling which does not have a negative effect on the safety services delivered over the CCH. However, QoS-sensitive service Providers (Q-Prs) keep track of the vehicles on their coverage by adapting a polling technique to avoid unnecessary resource reservation for out of range QoS-sensitive service users.

Network layer techniques: A significant number of video streaming protocols in VANETs are tightly dependent on routing approaches (Cho *et al*., 2011; Lai *et al*., 2009). Most of these protocols are extensions of proposed routing schemes for video data dissemination in MANETs that are redesigned based on the nature of VANETs (Boukerche, 2008). Involved techniques in the routing protocols can be classified as network-layer-centric techniques, since the main task of the network layer is forwarding data packets as well as providing routing for these packets. Generally, routing protocols can be divided into four major categories: broadcasting, multicasting, unicasting and geo-casting. In this study, the main focus is on broadcasting approaches as enablers for video dissemination over vehicular networks. Several applications including safety and emergency related applications should deliver messages to all vehicles in the network with high delivery ratio and minimum packet arrival time. As mentioned before, multimedia data is naturally large and packet collisions are a very common issue in high density video broadcasting. Moreover, broadcast storms problem can happen easily when large number of vehicles in the same vicinity rebroadcast the packets at the same time. Therefore, a reliable broadcasting approach is needed to avoid high number of packet collision and the broadcast storm problem in video dissemination.

Topology aware: Nowadays, significant numbers of vehicles on the roads are equipped with OBUs. As a result, each vehicle has adequate information about its geographical location and its position relative to other vehicles in the same region. Adapting wireless communication capabilities allows vehicles to share their topology information with others to facilitate service and application delivery on the roads.

Intersection-based: Vehicles are able to detect road intersections using preloaded digital maps and GPS information. Several proposed approaches (Korkmaz *et al*., 2004; Cho *et al*., 2011) have de-ployed these technologies to improve broadcasting performance by handling the network in a different manner in the case where an intersection appears in the packet dissemination path. Cho *et al*. (2011) has proposed an intersection-based approach to reduce the end-to-end delay of a suggested Reliable Data Pouring (RDP) method (Zhao *et al*., 2007). This approach suggests broadcasting packets to the listed multiple relay vehicles in all direction simultaneously and wait before rebroadcasting the packet for only one back-off slot. Urban multi-hop broadcast (Korkmaz *et al*., 2004) is another intersection-based technique that has suggested the installation of repeaters in road intersections. In this approach, if the source node is inside the transmission range of a repeater, the node sends the packet to the repeater using the point-to-point IEEE 802.11 protocol and the repeater forwards this packet to all road directions except in the direction where it has received the packet from.

Density-aware: In VANETs, the distribution of vehicles through the network is not homogeneous as vehicles density varies significantly depending on route popularity, traffic seasonality, traffic lights, accidents and other unexpected events. Solutions that consider a uniform distribution of vehicles may suffer from either communication disruption through low density regions or excessive overhead and congestion in dense areas. For this reason, some works (Bakhouya *et al*., 2011; Nekovee and Bogason, 2007) have designed ways of estimating local density and based on such information take different measures.

Movement similarity: Next hop relay selection is a critical issue to ensure accept- able reliability and effciency in multi-hop broadcasting over VANETs. Road maps and topology information such as vehicles position, direction and velocity make vehicles movement more predictable and this mobility forecasting can be exploited to improve routing features. In addition to these factors, a reliable broadcasting routing scheme based on Mobility

Prediction (RB-MP) (Lai *et al*., 2009) has considered the delay of position updating also known as Prediction Holding Time of the connection (PHT) to ensure the reliability in Broadcast Routing. RB-MP divides the neighbors into several sets according to the movement direction and then utilizes the position and velocity to predict the maintain time of all neighbors. In this approach, movement information and node direction are calculated based on the node movement history and its current situation.

Node selection: As discussed previously, intermediate relay nodes can be used as an appropriate solution in data broadcasting if selected in an optimal manner to minimize packet redundancy as well as collision and packet latency. Since, in this method, only a subset of receiver nodes participate in the rebroadcasting, it is important to choose nodes as relays appropriately in such a way that optimizes the network throughput. In this study, we study relay node selection techniques based on the participant nodes nature which can fall into one of the following two categories: sender-based selection or receiver-based selection.

Sender-based: Generally, in the sender-based selection techniques, the source node is responsible for assigning forwarding duty to the one or more potential relay nodes. In order to evaluate forwarding capability of these potential relay nodes, data sources need to keep track of their neighbours local information such as their position, direction and speed. Therefore, all nodes should distribute their local information via a broadcasting message. After being aware of all potential relay nodes local information, different criteria could be used to select the optimal relay node to that sender. Some approaches make their decision based on the movement direction of the packet to be forwarded compared to the movement direction of the potential relay nodes (Mittal, 2010), the maximum transmission range of the potential relay nodes compared to other nodes (Soldo *et al*., 2008) and the velocity of those potential relay nodes traveling in the same direction as the packet being forwarded. These factors may vary depending on the application type in order to optimize QoS in video disseminations accordingly.

Receiver-based: The receiver-based techniques are dependent on each receiver nodes decision to either broadcast a received message further or to drop it. In contrast to the source-based methods, receiver-based techniques are mostly reactive and do not rely on topology information. To satisfy optimal relay selection requirements, potential relay nodes employ other techniques such as using a re-broadcasting timer which is set based on their distance from the original source and/or final receiver (Nekovee and Bogason, 2007; Ros *et al*., 2009) calculating inter-arrival time between consecutive duplicate packets (Bakhouya *et al*., 2011) or sending an acknowledgment message from the first receiver to stop rebroadcasting the same message by other potential relay nodes in the same hop level (Mittal, 2010). Mittal (2010) proposed the receiver-based forwarding scheme outperforms the sender-based forwarding scheme in the terms of packet delay, collisions and overhead and is therefore, more suitable to provide video dissemination services over vehicular networks.

Comparison of video streaming protocols: As has been highlighted in Table 7 techniques provide high delivery ratio: topology aware intersection-based approach, receiver-based node selection technique, multi description coding and network coding.

Table 7: Video streaming techniques

Protocol stack layer	Category	Technique	Delivery ratio	Latency	Overhead
Link layer	Network congestion control	Selective frame rate	Medium	Medium	Low
		Back-off time and CW control	Medium	Medium	Low
	QoS aware		Adaptive	Adaptive	Medium
	Node selection		Medium	High	Low
Network layer	Topology aware	Intersection-based	High	Low	Low
		Density-aware	Medium	Low	Low
		Movement similarity	Medium	Medium	Medium
	Node selection	Sender-based	Low	Medium	Low
		Receiver-based	High	High	High
Application layer	Multiple video layers	Layered coding	Medium	Medium	Medium
		Multi description coding	High	Medium	High
	Error resilience techniques	Erasure coding	Medium	Low	High
		Network coding	High	Medium	Medium

CONCLUSION

This study presented different aspects of the vehicular technology. The concept of Intelligent Transportation Systems (ITS) has been introduced. Following that discussed vehicle-to-vehicle, vehicle-to-infrastructure and the hybrid communication models have been presented as the scenarios for the vehicle network. There are a number of outstanding services envisioned for vehicular networks that require the provision of video streaming and multimedia dissemination support. Due to stringent requirements for video streaming and the highly dynamic topology of vehicular networks, the design of an efficient protocol for the dissemination high-quality video over VANETs becomes extremely challenging. This study presented related background by introducing basic definitions, concepts and measurement criteria related to video dissemination routing protocols processes on the vehicular environment. This layer-wise classification provided a broad view of the current existing video dissemination techniques and protocols for VANETs. As a future research, ability have a protocol that can take many active outcomes for both VANET and MANET environments and a further enhanced routing protocol for VANET is required to be created for implementing healthy throughput, PDR and to reduce the end-to-end delay, packet loss. An improvement can be made in on-demand routing like AODV for greater flexibility in VANET environment.

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