iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2 **Issue:** IV **Month of publication:** April 2014

DOI:

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

Evaluation of Routing Protocols with respect to VANET Security and Presenting an Architectural Proposal

Mohd . Akbar[1], Mohammad Suaib[2]

#Dept. Of CSE Integral University, Lucknow, India

Abstract*— *VANET (Vehicular Ad-hoc Network) is just an advance form or a subclass of Mobile Ad-hoc network evolved in recent past with huge research opportunities in the field of Ad-hoc network. For a secure and robust wireless communication the network architecture and routing approach must be strong enough to ensure a certain or expected level of efficient performance incorporating the QoS. The performance of communication in the network depends on how better the routing takes place in the network. Routing ultimately depends on the routing protocols and approach being used in the network. Although routing protocols have already been analyzed and compared in the past, simulations and comparisons are also always being done considering specific parametrical issues of routings in Ad-hoc networks in a specific scenario yet a huge security threats still persist in traditional VANET architecture.In this paper a secure and robust wireless communication particularly routing protocols and associated security threats are analyzed and discussed and finally come-up with a development of an architectural proposal to enforce a certain level of security for VANET implementation. The work performs an analysis over earlier developed VANET's routing protocols and discusses about various issue regarding those existing protocols eg; security and efficiency etc. it is intended to explores the motivation behind the design of these protocols and trace their evolution. In this a comparative study is done among different Ad-hoc routing protocols for VANET. Finally, it concludes the suggestions and proposals by developing an architectural proposal for mitigating Security issues & threats and pointing out some parametrical issues (specially security transparency through the network) to enhance the performance of routing protocol in order to improve the quality of service (QoS) provided by VANET and possible direction of future research pertaining to VANET routing as well.

Keywords*— *VANET, MANET, Comparative Study, performance Quality of Service (QoS), Architectural Proposal, Security Threats.

I. Introduction

Vehicular Ad-hoc Network (VANET) is a form of mobile ad-hoc network MANET) that provides vehicle-to-vehicle and vehicle-to-roadside equipments(units) network architecture that can be easily deployed without relying on expensive network infrastructure. In fact VANET represents a challenging class of mobile Ad-hoc network.

Today, the actual trend is leading to the development of preventive systems, i.e., systems able to anticipate a dangerous situation. Examples of such systems are radars or camera-based sensors installed in cars which are able to detect the proximity of other cars or obstacles.

So the VANET is aimed to have such a safe and secure network among fast moving vehicles so as to enable them to share and exchange of information (eg; their current position, traffic status etc.) in order to anticipate unforeseen obstacle or avoid the possible traffic.

Vehicular Ad-hoc Networks are characterized by the broad range of their applications and types of communication and self-organization. On one side, uni-cast- and geo-cast (addressing messages to a specific area) applications will be implemented to transport/exchange information to/with one or multiple parties. On the other side, most safety applications will likely work in a broadcast fashion since safety information can be beneficial for all vehicles around a sender. To detect non-safe situations and to spread emergency messages, communication protocols are required to have a high reliability. Unfortunately, vehicular scenarios present adverse channel conditions due to the potential high density of

ISSN: 2321-9653

nodes and high number of objects able to degrade the quality of the transmitted signal.

One of the critical aspects when evaluating routing protocols for VANETs is the employment of mobility models that reflect as closely as possible the real behaviour of vehicular traffic. Simple random models cannot describe vehicular mobility in a realistic way, since they ignore the peculiar aspects of vehicular traffic, such as cars acceleration and deceleration in presence of nearby vehicles, queuing at roads intersections or traffic bursts caused by traffic lights. All these situations greatly affect the network performance, since they act on network connectivity, which makes vehicular specific performance evaluations fundamental when studying routing protocols for VANETs.

A critical aspect is to use the appropriate parameters in order to evaluate routing protocols. A crucial parameter influencing the performance of VANET is referred by the generic term *mobility*. In simple models, mobility is equal to velocity. However, on the eve of realistic mobility models, it becomes hard to understand the real parameters controlling this *mobility*. However, no study has been done illustrating how realistic motion patterns influence the mobility and other configuration parameters.

II. Past Related Work

In the recent past VANET expose a new research area covering issues like protocol applicability and performance measure, security threats evaluation and mitigation , Application specific scenario etc. The more work is done specially over protocols and VANET implementations.

A simple routing protocol broadcasts received message to all the neighbouring vehicles, called flooding protocol. However, flooding-based routing method occupies the whole network resources and data packets are unnecessarily received by irrelevant nodes. When the number of nodes is large, broadcast storm problem occurs. Thus non-flooding based light-weighted methods using different routing metrics have been proposed in the literature. With the assistant of fixed infrastructure (i.e., road-side equipments), packets can be propagated among vehicles, even when the traffic is sparse. Some well-known flooding-based routing protocols such as AODV [6], DSR [7] and DSDV [8], proposed originally for MANET and extendable to VANET. Some other protocols such as Biswas [9], Murthy [10], Abedi [11] and DisjLi [12] are proposed on the basis of flooding as well.

Also In some proposals/implementations of VANET, fixed infrastructure such as Road Side Units (RSU), bridges, buildings, cellular base stations and even routine buses is used. The infrastructure helps to increase the robustness and security of VANET communication. It relays or even buffers packets until next vehicle is available. With the assistance of infrastructure, packets can be propagated among vehicles, even when the traffic is sparse. Protocols such as DRR [17], SARC [18] and Bus [19] adopt fixed infrastructure to propagate messages.GPS receiver is a handy device in modern vehicles. VANET can use GPS location coordinates to locate other vehicles and to guide vehicles to find destinations (addresses, shops, hotels, etc.). Therefore, geographic location can be used to construct an efficient routing path. Probability theory is often used in dynamical systems to describe the likelihood of certain events, e.g., the probability of link breakage with a certain transmission power or a certain mobility parameter. In a probability-model-based routing protocol, a probability model is first built for the wireless communication link between two nodes.

In order to improve safety in vehicular environments, these projects consider that all vehicles will exchange safety messages making use of a unique wireless channel, the so called control channel , using a variant of IEEE 802.11a. In the case of the USA, DSRC considers another 6 channels to exchange non-safety related information, having a total of 7 communications channels. The lack of a centralized entity to manage the network and the high mobility of the nodes requires, in general, exchanging all messages in an ad-hoc manner. This is why these types of networks are commonly referred to as VANETs (Vehicular Ad hoc Networks).

In the USA we can find the Vehicle Safety Communications Consortium (VSCC) [1] developing the DSRC technology [2]. In Japan, the effort is led by the Internet ITS Consortium [3]. In Europe, several initiatives have also been started, such as the Car-to-Car Communication Consortium (C2CCC) [4], the PReVENT project [5] or the German ‘Network on Wheels’ (NoW) [6]. Although these projects also consider transport efficiency, comfort and environment, safety is their main and common goal.

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

III. THE CLASSIFICATION OF VANET ROUTING

A. VANET has several properties that can be exploited for routing. They are connectivity, mobility, infrastructure, geographic location, and probability of its dynamics. According to which property is used, VANET routing techniques can therefore be classified as connectivity-based, mobility based , infrastructure-based, geographic-location-based and probability-model-based. The communication network is a platform to propagate messages. The simplest routing m0ethod is based on flooding, where route request messages are broadcasted to every node in the network.

B.

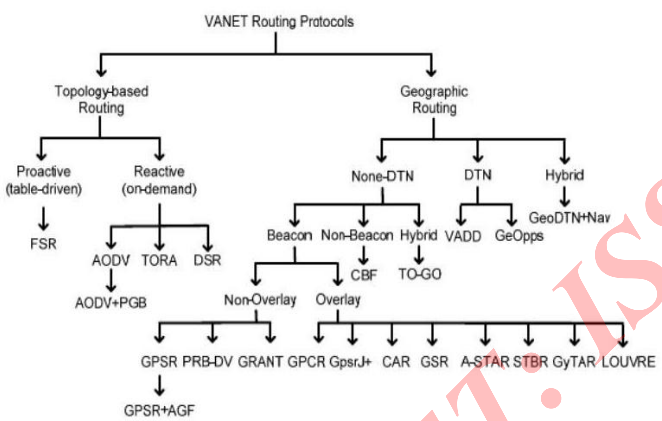

Fig. a-1: Ref[30]

There are some well-known flooding-based routing protocols such as AODV [6], DSR [7] and DSDV [8], proposed originally for MANET and extendable to VANET. Some other protocols such as Biswas [9], Murthy [10], Abedi [11] and DisjLi [12] are proposed on the basis of flooding as well.Mobility is a unique property that does not exist in traditional fixed networks like Ethernet and ATM. It is normally described by relative distance, relative speed, and relative acceleration. Compared with other MANET instances, nodes (i.e., vehicles) in VANET have larger mobility scale (e.g; higher moving speed) and additional mobility constraints (e.g; traffic regulations). They have to follow the directions or moving patterns defined by maps. These mobility features may be used to predict the lifetime/duration of routing paths. PBR [13], DisjLi [12], Taleb [14], Abedi [11], and NiuDe [16] utilize the mobility parameters to route messages.

The durations (i.e; stability) of the links in the network will be used as a major routing parameter. The protocol selectively probes, rather than brute-force floods, possible links and selects a reliable multi hop routing path. Protocols such as, Yan [20], GVGrid [21], NiuDe [16], CAR [22], and REAR [23] belong to this category.

Infrastructure relays or even buffers packets until next vehicle is available. Use of geographic position was suggested to optimize the routing process. Vehicles knowing the geographic position of neighbors can select a greedy/efficient routing path to transmit packets. Both infrastructure based and geographic position based routing methods need extra device or information. The vehicle mobility is used to predict that if the link between two vehicles will break or not after a certain time interval, in mobility based methods.

IV. AN OBSERVATIONS OVER PAST RELATED WORK

paper Several studies non specific to VANETs have been published comparing the performance of routing protocols using different mobility models or performance metrics. One of the first comprehensive studies was done by the Monarch project [15]. This study compared AODV, DSDV, DSR and TORA and introduced some standard metrics that were then used in further studies of wireless routing protocols. A paper by Das et al. [20] compared a larger number of protocols. However, link level details and MAC interference are not modelled. Another study [24] compared the same protocols as the work by Broch et al. [15], yet for specific scenarios as the authors understood that random mobility would not correctly model realistic network behaviours, and consequently the performance of the protocols tested. Globally, all of these papers concluded that reactive routing protocols perform better than proactive routing protocols.Although that the proactive OLSR protocol has been developed in 2002, very few studies compared it with other ad hoc network protocols. Clausen *et al.* [25] evaluated AODV, DSR and OLSR in varying network conditions (node mobility, network density) and with varying traffic conditions (TCP, UDP). They showed that unlike previous studies, OLSR performs comparatively to the reactive protocols.

Following the developments started with scenarios-based testing, it also became obvious that, as scenarios were able to alter protocol performances, so would realistic node-to-node or node-to-environment correlations. This approach became recently more exciting as VANETs that attracted more attention and a new wave of vehicles-specific models appeared. The most comprehensive studies have been performed by the FleetNet project [26]. In a first study [21], authors compared AODV, DSR, FSR and TORA on highway scenarios, while [22] compared the same protocols in city traffic scenarios. They found for example that AODV and FSR are the two best suited protocols, and that TORA or DSR are completely unsuitable for VANET. Another study [27] compared a position-based routing protocol (LORA) with the two non-position-based protocols AODV and DSR. Their conclusions are that, although AODV and DSR perform almost equally well under vehicular mobility, the location-based routing schema provides excellent performance. A similar results has been reached by members of the NoW project [28], which was their major justification for the design of Position-based forwarding techniques.

V. Ad-Hoc On-Demand Distance Vector (AODV)

For our performance comparison study, we picked up one ad hoc routing protocols that reached the IETF RFC level, the on-demand AODV protocol (RFC[3561] [29]). We shortly address this protocol in the rest of this section.For a more detailed description, the reader is referred to the RFC. In AODV, when a source node has data traffic to send to a destination node, it first initiates a route discovery process. In this process, the source node broadcasts a Route Request (RREQ) packet. Neighbor nodes which do not know an active route for the requested destination node forward the packet to their neighbors until an active route is found or the maximum number of hops is reached. When an intermediate node knows an active route to the requested destination node, it sends a Route Reply (RREP) packet back to source node in unicast mode. Eventually, the source node receives the RREP packet and opens the route paragraphs must be indented.

VI. Optimized Link State Routing Protocol (OLSR)

OLSR [6] is considered as a topology-based routing protocol. Nodes using OLSR periodically broadcast their routing table to the rest of nodes in the network which incurs a large communication overhead. OLSR limits the number of nodes that forward the control messages using multi point relays. It uses two primary control messages: topology control messages and HELLO messages. Topology Control messages are forwarded across the network. HELLO messages are sent to each one hop neighbor. If a node does not receive a HELLO messages from one neighbor during a certain time period then the link is considered down. The source using this link to forward messages is not aware that the route is broken until that intermediate node broadcasts its next topology control message. In VANETs, the movement of nodes may cause the network topology to change frequently which causes deterioration in network performance as it introduces congestion in the communication channel. These limitations of the topology based protocols make them unsuitable for VANETs.

VII. Multi-Hop Routing Protocol for Urban VANETs

In Multi-Hop Routing Protocol for Urban VANETs it is assumed that each node has a static street map and that there is a location service that gives the source node information about the location of destinations. In order to find a route, therefore, the source node calculates the shortest path to the destination based on a static street map and the location of both the source and the destination. MURU provides routes that minimize the hop count. At the same time, it proposes the “expected disconnection degree” (EDD) to estimate the quality of the routes. EDD of a given route represents the probability that this route will fail during a given time period. MURU uses EDD to construct an optimal path based on predicted speed, location, and road geometry. Each node broadcasts route request packets, which are routed on paths that are constrained by node movement trajectory. However, since MURU uses the local information available to the forwarding node, it is susceptible to local optimum which would significantly decrease the scalability of the routing protocol.

VIII. Optimized An Analytical Observation

So far we have seen in this study the different routing methods have their own features (pros and cons) and applications. Table-1 gives a brief summary of the routing protocols in VANET.

Vol. 2 Issue IV, April 2014

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

TABLE I: Protocols and its Security Functions

Function	SAODV	ARAN	SRP(Old)	SDSR
Key Distribution	Assumed	Integrated	Assumed	Integrated
Node Authentication	Endpoints	All	Endpoints	All
Secure RREQ	Yes (Can Extended)	Yes (Can Extended)	No	Yes
Secure RREP	Yes	Yes	Yes	Yes
Freshness Guarantee	Yes	Yes	Yes	Yes
Exchange of Session Keys	No	No	No	Yes
Use of Cached Route	Yes	No	No	No
Performance	+	Θ	++	o
Assumptions	None	Synchronous Clock	None	None

1. The possible potential attacks on position-based routing can includes;
2. Forged Positions (Blackhole / Selfish)
3. Multiple Identities/Sybil-Attack (Blackhole / Selfish)
4. Drop packets (selfish / DoS)
5. Overflown neighbouring caches (Flooding/DoS)
6. Eavesdrop
7. Modify data

Taking all these issues into consideration we have following table that shows status value between Application v/s Security specific parameters.

TABLE III: Application Specific Security Requirements

Appli cati-ons	Confidentiality	Authenticity	Availability	Integrity	Non-Repudiation	Access Controle	Privacy	
Intersec. Collm. Warnin	—	?	?	×	?	—	×	C2C eSafety
Autom. Lane Margin	—	?	×	×	?	—	×	
Emerg. Vehicle Warn	—	×	×	×	?	?	—	
Road Work Warn	—	×	—	—	—	?	—	C2I eS
Car-2-Car Messag	×	×	—	—	—	?	?	C2I eS

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

IX. PROPOSAL

Application should declare their security requirements encapsulating Security modules on each level that would be configured according to their specifications (Application, Routing, MAC).

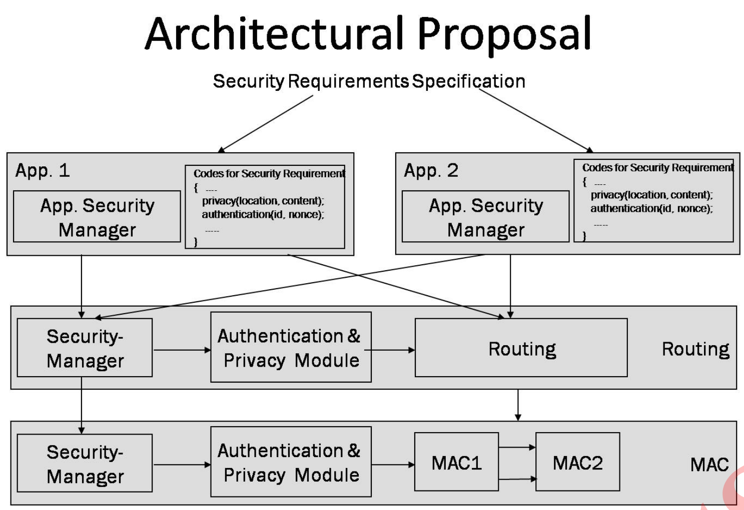

Fig-B

1. Architectural Suggestion

   a. Design / choose Security Requirements Declaration Language (SRDL)

   b. Decide on modules on Routing & MAC layer

2. Security Issues that must be resolved using SRDL.

   1. Confidentiality/Integrity

   2. Position Verification

   3. Availability / Denial of Service(DoS) Protection

   4. Authentication/ Secure Beaconing

Moreover, while designing and implementing a VANET routing protocol, one can combine several of these methods for improved performance. Exemplarily, Probability-based-Model Routing can be combined with Mobility-based Routing as the latter can strengthen the former when the traffic motions change.

X. CONCLUSION

In this paper, we have addressed the problem of routing in vehicular ad hoc networks (VANET). On the basis of criteria used for routing. Existing VANET routing methods have been classified into four categories and representative protocols are introduced for each category. Different routing methods have their own features (pros and cons) and applications.

Table-1 gives a brief summary such (Highly concerned) routing protocols in VANET.

We have also observed that No security solution fits all application requirements even contradicting requirements between multiple concurrent applications (Table-2) yet we have proposed an architectural proposal for mitigating security issues or threats in order to improve Quality of Service(QoS) and reliance over the VANET.

Also from the results as a consequence of our comparative study and analysis, we have observed that A-STAR shows better performance in terms of high throughput and low packet drop as compared to AODV and GPSR in city environment,

1) while GPSR shows better performance as compared to AODV in both highway and city environment of VANET. Based on the results of performance metrics in different environments of VANET,

2) It is realized that Position Based Routing method for VANET outperformed the traditional ad-hoc topology-based routing. In VANET the protocol performance depends on vehicle speed, driving environment etc. that may vary from one environment of network to another environment.

Each level of all the three layers (Application, Routing, MAC) should declare their security requirements according to their specifications by encapsulating a

ISSN: 2321-9653

Security modules as per configuration.Moreover, contradicting requirements can be resolved by assigning the priorities over them.

REFERENCES

[1] *"Vehicle Safety Communications Consortium," http://wwwnrd.nhtsa.dot.gov/pdf/nrd-12/CAMP3/pages/VSCC.htm.*

[2] *[2]"Dedicated Short Range Communications Project,"http://www.leearmstrong.com/DSRC/DSRCHomeset.htm.*

[3] *"Internet ITS Consortium," http://www.internetits.org.*

[4] *"Car2Car Communication Consortium," http://www.car-to- car.org/.*

[5] *"The PReVENT Project," http://www.prevent-ip.org.*

[6] C. E. Perkins, E. M. Belding-Royer, and S. R. Das, *"Ad hoc On demand distance vector (aodv) routing," RFC Experimental 3561, July 2003.[Online]. Available: http://rfc.net/rfc3561.txt*

[7] *D. B. Johnson, D. A. Maltz, and Y. C. Hu, "The dynamic source routing protocol for mobile ad hoc networks (dsr)," Published Online, IETFMANET Working Group, Tech. Rep., February 2007.*

[8] *C. E. Perkins and P. Bhagwat, "Highly dynamic destination-sequenced distance-vector routing (dsdv) for mobile computers," SIGCOMM Comput. Commun. Rev., vol. 24, no. 4, pp. 234–244, 1994. [9] S. Biswas, R. Tatchikou, and F. Dion, "Vehicle-to-vehicle wireless communication protocols for enhancing highway traffic safety," Communications Magazine, IEEE, vol. 44, no. 1, pp. 74–82, Jan. 2006.*

[9] *S. Biswas, R. Tatchikou, and F. Dion, "Vehicle-to-vehicle wireless communication protocols for enhancing highway traffic safety," Communications Magazine, IEEE, vol. 44, no. 1, pp. 74–82, Jan. 2006.*

[10] *S. Murthy and J. J. Garcia-Luna-Aceves, "An efficient routing protocol for wireless networks," Mob. Netw. Appl., vol. 1, no. 2, pp. 183–197, 1996.*

[11] *O. Abedi, M. Fathy, and J. Taghiloo, "Enhancing aodv routing protocol using mobility parameters in vanet," in Proceedings of the 2008 IEEE/ACS International Conference on Computer Systems and Applications (AICCSA08). Washington, DC, USA: IEEE Computer Society, 2008, pp. 229–235.*

[12] *X. Li and L. Cuthbert, "On-demand node-disjoint multipath routing in wireless ad hoc network," in Proceedings of the 29th Annual IEEE International Conference on Local Computer Networks (LCN04).Washington, DC, USA: IEEE Computer Society, 2004, pp. 419–420.*

[13] *V. Namboodiri and L. Gao, "Prediction-based routing for vehicular adhoc networks," Vehicular Technology, IEEE Transactions on, vol. 56, no. 4, pp. 2332–2345, July 2007.*

[14] *T. Taleb, E. Sakhaee, A. Jamalipour, K. Hashimoto, N. Kato, and Y. Nemoto, "A stable routing protocol to support its services in vanet networks," Vehicular Technology, IEEE Transactions on, vol. 56, no. 6, pp. 3337–3347, Nov. 2007.*

[15] *J. Broch et al. "A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols", In Proc. ACM MOBICOM 98, Dallas, TX, October 1998.*

[16] *Z. Niu, W. Yao, Q. Ni, and Y. Song, "Dereq: a qos routing algorithm for multimedia communications in vehicular ad hoc networks," in Proceedings of the 2007 international conference on Wireless communications and mobile computing (IWCMC07). New York, NY, USA: ACM, 2007, pp. 393–398.*

[17] *R. He, H. Rutagemwa, and X. Shen, "Differentiated reliable routing in hybrid vehicular ad-hoc networks," May 2008, pp. 2353–2358.*

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

[18] *H. Kim, J. Paik, B. Lee, and D. Lee, "Sarc: A street-based anonymous vehicular ad hoc routing protocol for city environment," in Proceedings of the 2008 IEEE/IFIP International Conference on Embedded and Ubiquitous Computing (EUC08). Washington, DC, USA: IEEE Computer Society, 2008, pp. 324–329.*

[19] *T. Kitani, T. Shinkawa, N. Shibata, K. Yasumoto, M. Ito, and T. Higashino, "Efficient vanet-based traffic information sharing using buses on regular routes," May 2008, pp. 3031–3036.*

[20] *S. R. Das et al., "Comparative Performance Evaluation of Routing Protocols for Mobile Ad-Hoc Networks", In 7th Int. Conf. on Comp. Communication and Networks, pp. 153?161, Lafayette, LA, Oct. 1998.*

[21] *Sven Jaap, Marc Bechler, and Lars Wolf, "Evaluation of Routing Protocols for Vehicular Ad Hoc Networks in Typical Road Traffic Scenarios", in Proc of the 11th EUNICE Open European*

[26] *ols for Mobile Ad-hoc Networks",in 1st IFIP MedHocNet Conference, 2002.*

[27] *The FleetNet Project, http://www.et2.tu-harburg.de/fleetnet/english/vision.html*

[28] *.A. Santos et al., "Performance Evaluation of Routing Protocols in Vehicular Ad Hoc Networks", in International Journal of Ad Hoc and Ubiquitous Computing 2005, Vol. 1, No.1/2, pp. 80 - 91.*

[29] *The Network on Wheels Project, http://www.informatik.uni-mannheim.de/pi4/lib/projects/now/*

[30] *C. Perkins, E. Belding-Royer, S. Das, quet, "Ad hoc On-Demand Distance Vector (AODV) Routing", RFC 3561, July 2003.*

[31] *Kevin C. Lee, UCLA, USA Uichin Lee, UCLA, USA Mario Gerla, UCLA, "Survey of Routing Protocols in Vehicular Ad Hoc Networks"*

Summer School on Networked Applications, Colmenarejo, Spain, July 2005.

[22] *D. W. Franz, "Car-to-car Communication – Anwendungen und aktuelle Forschungsprogramme in Europa, USA und Japan", in Kongressband zum VDE-Kongress 2004 Innovation fur Menschen, VDE, October 2004*

[23] *Jerome Haerri, Marco Fiore, Fethi Filali, Christian Bonnet, "VanetMobiSim: generating realistic mobility patterns for VANETs, in VANET 2006, 3rd ACM International Workshop on Vehicular Ad Hoc Networks, September 29, 2006, Los Angeles, USA.*

[24] *P. Johansson et al. , "Scenario-based Performance Analysis of Routing Protocols for Mobile Ad-Hoc Networks", In Proc. IEEE/ACM Mobicom'99, pp. 195-206, Seattle, WA, Aug. 1999.*

[25] *Thomas Heide Clausen, Philippe Jacquet, Laurent Viennot, "Comparative Study of Routing Protoc*

http://handbook5.com/s/survey-of-routing-protocols-in-vanets-w12980.html