Asian Journal of Information Technology 15 (3): 563-566, 2016
ISSN: 1682-3915

Assessing the Reliability of Adhoc Network Using UGF: Probabilistic Approach

[1]M. Rajeswari and [2]P. Uma Maheswari
[1]Angel College of Engineering and Technology, Tiruppur, India
[2]Anna University, Coimbatore, India

Abstract: Mobile Adhoc network has enormous usage in our real life that includes battlefield situation, flooding, firing and other emergency situations. The main focus in every application is to transfer reliable information from a source node to destination. Also, VANET is a subset of MANET which becomes a central focus of many researchers today. Due to increase in vehicular nodes, there is an increasing demand and a big challenge to control the traffic in Vehicular Ad-hoc Network (VANET). Here, the traffic information is communicated to vehicles in the form of V2V (Vehicle-to-Vehicle) or V2I (Vehicle-to-Infrastructure) where generally loss of reliable information occurs while transmission. This study demonstrates different approaches in disseminating the reliable information in MANET and VANET. In addition to general techniques, approaches and protocols, Universal Generating Function (UGF) is used to test the reliability among the nodes.

Key words: MANET, VANET, reliability, UGF, challenge

INTRODUCTION

In Adhoc network (Shu and Krunz, 2015), any node is supposed to diverge from a network at any time and any number of nodes may join a network at any time since there is no centralized administration. Nodes in this network, act as a router to route the information from a node to other nodes. Node discovery and maintenance are important and challenging in Adhoc network eventhough, there are many routing procedures available. Now a days plenty of routing protocols (Rajeswari, 2012) have been developed to disseminate the information in Adhoc network. But, it invites competition to transfer the knowledge from a mobile node to group of nodes in a reliable manner. The same is important when the road safety information is disseminated from a vehicular node to group of vehicular nodes on the road. Reliable message delivery involves specific route discovery mechanism when a node failure or link breakage occurs. Broadcasting in MANET is defined as a message dissemination operation in which any node sends a message to all the other nodes in the network. This is the fundamental technique for route discovery for finding a valid path from source and route maintenance which in turn finds the alternative path to reach the destination when node failure or link breakage occurs. Flooding is considered as the alternative form of broadcasting. If a node receives the same message again and again then it is called as flooding. Hence, number of broadcasts should be reduced when a node finds a path to its destination.

In Vehicular Ad-hoc Network (VANET communication is more challenging task due to its fundamental characteristics like infrastructure less nature, dynamic topology, lack of association, resource constrained and physical vulnerability of node. In a dynamic network, it is critical to maintain the multicast routing when the topology changes. Conventional multicast protocols generally, do not have good reliability. It becomes very critical to handle this situation when the destination is at very far distance from source. Due to this, the gradient of the message decreases and hence the clarity of the message also gets reduced when the distance increases which incase leads to a chance for adding unnecessary details in the message and finally, causes damage to vehicle and leaves it in a miserable circumstances considering numerous vehicles available in VANETs, one distinctly inviting technique to define the reliability for transmitting information in terms of probabilistic approaches. One such technique includes the concept of Universal Generating Function (UGF) (Jafary and Fiondella, 2016) which was introduced to define reliability to evaluate the performance of real time systems. Reliability is the probability that a system will ensure a defined function over a period of time under certain operating conditions. The reliability of a network system is determined as probability that any source node can successfully communicate with any terminal node. Reliability of the MANET is defined as the probability that the successful delivery of information from a node to other node without any delay. Here reliability of VANET (Maheswari and Rajeswari, 2014a) is defined as the probability of transmitting road traffic information from a source vehicular node to destination node without missing the clarity in a successful manner.

Corresponding Author: M. Rajeswari, Angel College of Engineering and Technology, Tiruppur, India

Table 1: Characteristics of various multicast routing protocols

Protocol name	Multicast topology	Initialization	Maintenance approach
ABAM	Source-Tree	Source	Hard state
BEMRP	Source-Tree	Receiver	Hard state
DDM	Source-Tree	Receiver	Soft state
MCEDAR	Source-Tree over mesh	Receiver or source	Hard state
MZRP	Source-Tree	Source	Hard state
WBM	Source-Tree	Receiver	Hard state
PLBM	Source-Tree	Receiver	Hard state
MAODV	Source-Tree	Receiver	Hard state
ODMRP	Mesh	Source	Soft state
DCMP	Mesh	Source	Soft state
FGMP	Mesh	Receiver	Soft state
CAMP	Mesh	Source or receiver	Hard state
NSMP	Mesh	Source	Soft state

ABAM: Associatively-Based Ad Hoc Multicast routing; BEMRP: Bandwidth Efficient Multicast Routing Protocol; DDM: Differential Destination Multicast routing protocol; MCEDAR: Multicast Core Extraction Distributed Adhoc Routing; MZRP: Multicast Routing Protocol based on Zone Routing; WBM: Weight-Based Multicast protocol; PLBM: Preferred Link-Based Multicast protocol; MAODV: Multicast Ad hoc On-Demand distance Vector routing protocol ODMRP: On-Demand Multicast Routing Protocol; DCMP: Dynamic Core-based Multicast routing Protocol; FGMP : Forwarding Group Multicast Protocol; CAMP: Core-Assisted Mesh Protocol; NSMP: Neighbor Supporting Adhoc Multicast routing Protocol

Source node has to find the reliable and optimal path to transfer the information in MANET and also in VANET. But, it is difficult due to the mobility of nodes that causes variation in distance between the nodes randomly. Hence, there should be a standard technique to ensure the reliability while disseminating the information among mobile nodes. This study defines UGF technique in a fuzzy reputation system to define the reliability from source vehicle to destination vehicle.

MATERIALS AND METHODS

Protocol classification-manet

Multicast routing protocols in MANET: Proactive routing protocols (Abdulleh *et al*., 2015) update the topology information periodically when there is a change or not in a network. Unnecessary routing overhead occurs to update the information at all times eventhough there is no change in the network. Table 1 describes the characteristics of some of the multicast routing protocols (Rajeswari, 2012; Aparna, 2010).

Multicast topology is used to find the path from source to destination. In Tree based approach, there is a single path from source to destination where as Mesh based approach uses multiple paths from source to destination. In source initiated protocols, broadcasting is done by the source node. If the initiation is started by the receiver to find the path to source then it is called receiver initiated approach. In soft state maintenance approach, receiver will not send acknowledge once it receives the information. But, in hard state approach, receiver sends acknowledge to the sender after receiving the information successfully.

Protocol classification-vanet

Problem definition: VANET exhibit the characteristics of high mobility of nodes and rapid changing network. Due to these atmospheres the network environment should be organized to encounter these problems. The path for the dissemination is not always constant and the intermediate node that carry the packets too dynamic. In a dynamic network, it is critical to maintain the multicast routing when the topology changes. It becomes very critical to handle this situation when the destination is at very far distance from source. The nodes in VANET are liable to attack.

Problem description: Considering the VANET characteristics, it is clear that the routing protocols must be designed challenging. The nodes in VANET move frequently. Adhoc routing protocols do not maintain the routes unless they are needed. Source needs to send the message to the destination. If the destination is nearer to its range the source can directly send. If it is not in its coverage the source relies on other intermediate nodes by calculating the shortest path. But, when the intermediate node does not meet the destination then the packet is dropped. Also, the intermediate vehicle is overloaded on unnecessary carrying of messages. When, the node carrying the packets enters the intersection may also drop the packets if they took another way form destination. When the nodes move into the sparse situation that is the density of the vehicle is very low, the packets are dropped. So, to avoid all these, the road side infrastructures are deployed. By this, the source or the intermediate nodes can broadcasts the message to the infrastructure. Then, the infrastructure store and forward the packets whenever appropriate.

RFRS (Reliable Fuzzy Reputation System): RFRS is designed to disseminate the road safety information in the presence of selfish nodes (Ros *et al*., 2009; Uma Maheswari and Rajeswari, 2014b). Selfish nodes are

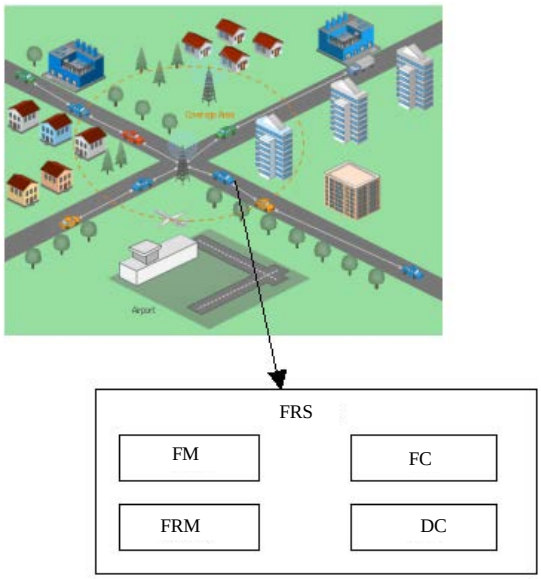

Fig. 1: VANET message dissemination using RFRS

the one which do not forward the traffic information to other vehicles. They just utilize the network resources. These selfish nodes would contain valid information to forward but they are not willing to forward the information. They just wish use other resources. RFRS is used to find the selfish nodes from non-selfish nodes and gather information from selfish nodes and forward to other ongoing vehicles effectively. This system uses FM (Forward Manager) and FRM (Fuzzy Reputation Manager) to forward the information from selfish nodes. Here, FM maintains FC (Forward Count) and DC (Discard Count). FC maintains the total number of forwards count which will be used by FM. FRS (Praveena *et al*., 2013) gathers information from DC which identifies the number of vehicles that do not forward the valid information to other vehicles. These nodes are termed as selfish nodes that are segregated from the network by FRS. Hence, FRM extracts valuable information from the selfish nodes and mark them as forwarders to participate in the message dissemination operation.

Figure 1 represents the four way road scenario consisting of number of vehicles that forward road safety information by using RFRS. Each vehicle is equipped with GPS to know their current position. Working nature of RFRS is defined. Reliability is achieved using this concept. The same is proved mathematically by using universal generating function which is explained in the study.

RESULTS AND DISCUSSION

Reliability calculation using UGF: Reliability engineering (Yeh and Yeh, 2011) is used to ensure that a system will be reliable when explored in a specified manner. Network reliability plays a vital role in planning, designing and controlling network. Designing, developing and testing real solicitation for this network pays a particular attention by MANET community. In VANETs, the information is passed by a flow of transition from node to node to reach the required destination. For a successful packet delivery, reliable routes are necessary. The routes are reliable only in all the connections from source to destination exist. A link UGF is proposed in order to analyze the link reliability by combining the node UGF of both selfish and non-selfish nodes, UGF of FM, UGF of FRM and link UGF. The UGFT is a common technique because one can use the same procedures for network with different size and different types of node interaction. UGF allows one to assess an output performance for a wide range of networks characterized by different protocol. This can be done by introducing different composition operators over UGF which will predict the happenings of the physical environment. UGF is a standard mathematical technique in finding out the expected capacity for each transmitting path involved in the VANET and also in the evaluation of VANET reliability.

Proposed UGF: UGF allows one to evaluate an output performance distribution for a wide range of systems characterized by various topology, divergent natures of interaction among system elements and the different physical nature of elements with its performance measures (Yeh, 2006; Levitin, 2005). This can be done by introducing composition operator over UGF which will predict the happenings of the physical problem.UGF plays an important role in finding out the expected capacity for each traffic-path involved in the VANET and also in the evaluation of system reliability (Maheswari *et al*., 2015).

Definition 1: The UGF of non-selfish nodes (Good) is defined as a polynomial in X such that $u(iG) = P_{i_G:FM} X^{FM}$, i = 1,2… n-r where, $P_{i_G:FM}$ is the probability of passing the information from node i to FM if there are n-r good nodes in the VANET.

Definition 2: The UGF of selfish nodes are defined as $u(iS)\ P_{i_s:FRM} X^{FRM}$, i = 1,2…r where $P_{i_s:FRM}$ represents the probability of collecting the information from the selfish nodes by using FRM. Here, r denotes the total number of selfish nodes in the VANET.

Definition 3: The UGF of Forward Manager (FM) is defined as:

$$u = (FM) = \prod_{i=1}^{N_{n-r}} P_{FM:N_i} X^{N_i}$$

where, $P_{FM:N_i}$ is the probability that the packets are received by nodes N_i from FM.

Definition 4: The UGF of Forward Reputation Manager (FRM) is defined as:

$$u=(FRM)=\prod_{i=1}^{N_r} P_{FRM:N_i} X^{N_i}$$

where, $P_{FRM:N_i}$ is the probability that the packets are received by nodes N_i from FRM.

Definition 5: The reliability of the VANET is defined as the successful transmission of the information by either selfish or non-selfish nodes through FM or FRM to the destination nodes:

$$R_{VAN}=\sum_{i=1}^{N_G} u(i_G)\times u(FM)+\sum_{i=1}^{N_S} u(i_s)\times u(FRM)$$

In this study, definition for reliability calculation of VANET has been discussed. Example vehicular network would be assigned state dependent probabilities from any vehicular node to other vehicles via FRM and FM. Probabilities are chosen randomly between nodes and also between node and FRM/FM. This will be an interesting approach to test the reliability of any adhoc network.

CONCLUSION

The primary focus of researchers, today, is to disseminate reliable information from source node to destination node in MANET and VANET. Many approaches and routing protocols have been developed and applied by the researchers. But, still we need to ensure that the information is forwarded to the destination in a reliable manner. This study provides an insight into some of the multicasting protocols used in MANET and an innovative technique used in VANET. Here, Universal Generating Function (UGF) is defined to ensure the reliability among the nodes when the information is disseminated from a source to destination. In future, the defined protocols for MANET and VANET would be tested by using UGF to evaluate the performance.

REFERENCES

Abdulleh, M.N., S. Yussof and H.S. Jassim, 2015. Comparative study of proactive, reactive and geographical MANET routing protocols. Commun. Netw., 7: 125-137.

Aparna, K., 2010. Performance comparison of MANET (Mobile ad hoc Network) Protocols (ODMRP with AMRIS and MAODV). Int. J. Comput. Appl., 1: 55-59.

Jafary, B. and L. Fiondella, 2016. A universal generating function-based multi-state system performance model subject to correlated failures. Reliab. Eng. Syst. Saf., 152: 16-27.

Levitin, G., 2005. The Universal Generating Function in Reliability Analysis and Optimization. Springer, London, England, Pages: 442.

Maheswari, P.U. and M. Rajeswari, 2014a. Reliability calculation of VANET with RSU and SP. Res. J. Appl. Sci. Eng. Technol., 8: 1607-1612.

Maheswari, P.U. and M. Rajeswari, 2014b. Reliable fuzzy reputation system to enhance the performance of disseminating the information in VANET. Int. J. Eng. Technol., 6: 1856-1866.

Maheswari, P.U., M. Rajeswari, K.S. Meena and T. Vasanthi, 2015. Recent trends in computer science: Reliability calculation of VANET with RSU using UGFT. Int. J. Adv. Found. Res. Comput., 2: 7-17.

Praveena, R., M. Rajeswari, U. Maheswari, P. Aswiga, R.V. Jayanthi, 2013. Reputation based and trust based model in VANET. Int. J. Mobile Ad Hoc Netw., 3: 293-296.

Rajeswari, M., 2012. Survey on efficient multicast routing protocols to achieve group communication in MANET. Int. J. Eng. Innovative Technol., 1: 87-98.

Ros, F.J., P.M. Ruiz and I. Stojmenovic, 2009. Reliable and efficient broadcasting in vehicular ad hoc networks. Proceedings of the IEEE 69th Vehicular Technology Conference, April 26-29, 2009, Barcelona, Spain, pp: 1-5.

Shu, T. and M. Krunz, 2015. Privacy-preserving and truthful detection of packet dropping attacks in wireless ad hoc networks. Mobile Comput. IEEE. Trans., 14: 813-828.

Yeh, W.C. and Y.M. Yeh, 2011. A novel label universal generating function method for evaluating the one-to-all-subsets general multistate information network reliability. Reliab. IEEE. Trans., 60: 470-478.

Yeh, W.C., 2006. The k-out-of-n acyclic multistate-node networks reliability evaluation using the universal generating function method. Reliab. Eng. Syst. Saf., 91: 800-808.