A Survey on Cooperation for VDTN

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Abstract— **Vehicular Delay-Tolerant Networks (VDTNs) are composed of mobile nodes (vehicles) that communicate with each other wirelessly and using store carry and forward paradigm to forward data despite intermittent connectivity. There are major challenges in establishing effective communications between nodes in Vehicular Ad Hoc Networks (VANETs). In them the systems are subject to wireless interference and disconnections, thus hindering the availability and reliability of source-destination connections. Another major problem arises when VANETs are sparse, causing excessive retransmissions and delays due to long periods without maintaing connection between pair of vehicles. This article reviews the literature related to Vehicular Delay Tolerant Network with focus on Cooperation. It starts by examining definitions of some of the fields of research in VDTN. An overview of VDTN with cooperative networks is presented.**

Keywords-component; Cooperative Networks, Vehicular Delay Tolerant Network, Cooperation.

Introduction

This survey will present cooperation for VDTN and how those systems incorporate cooperation. VDTN gathers contributions from opportunistic and cooperative networks as a communication infrasturcture for the network to carry and disseminate data. Data communication in VDTN presents new challenges when compared with other kinds of network. VDTN network can be partitioned. This results in a few transmission opportunities and unpredictable delays [3].
Running internet protocol performs transmission control protocol/internet protocol making implicit assumptions of continuous, path short round trip and symmetric data rates. Although wide range of emerging networks usually referred to opportunistic networks connected networks, or episodic networks violate these assumptions.
Delay tolerant networking is a network research topic focus on the design implementation, evaluation and application of architectures that intend to enable data communication among heterogenous networks in an environment [6].

Vehicular delay tolerant networking appears as a novel network achitecture that provide innovative solutions for challenging vehicular communication [20].

Effective operation of DTNs and VDTNs relies on the cooperation of network nodes to store-carry-and-forward data over partitioned and challenged network environments as shown in Figure 1, [6].

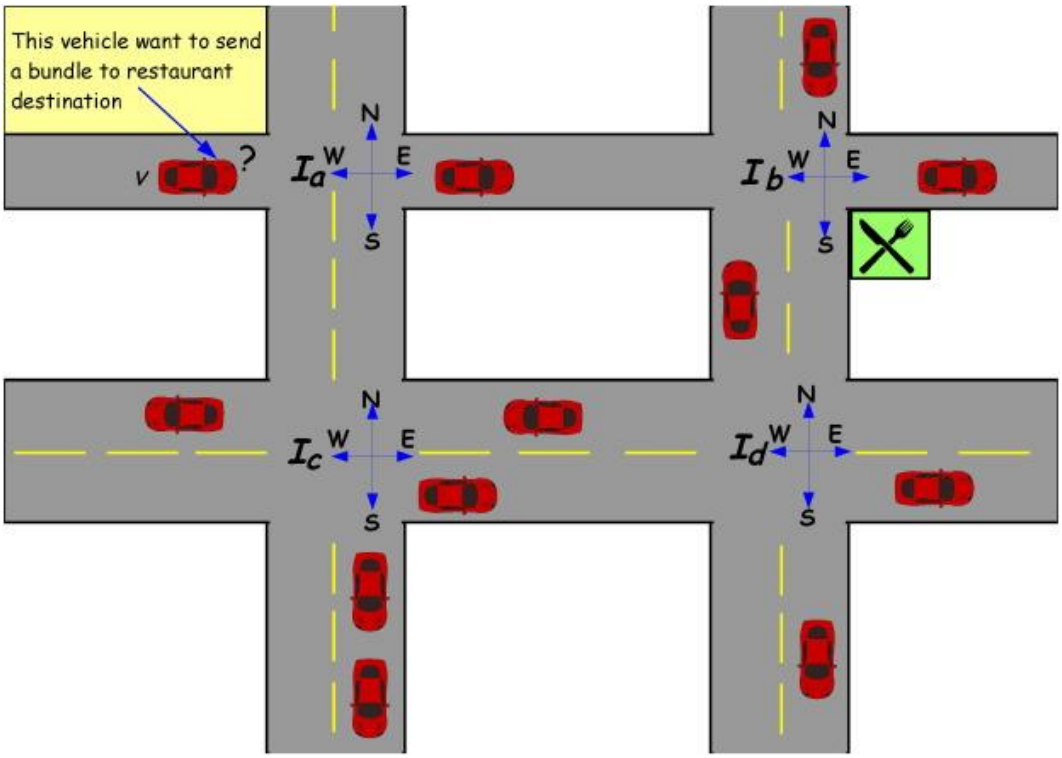

Figure 1, VDTN Architecture.

We would like to advise that the oen of the focus in this area should be to provide a mathematical framework for studying user cooperation in an ad hoc networks, and to define strategies leading to an optimal user behavior.

Cooperation is the basic characteristic of multiagent system, while cooperation structure is central to the study of multiagent cooperation. At present, all the previous studies focus on the description to the negotiation, the conflict, the benefit distribution, the cooperation process and the cooperation evolution with game theory or multimodal theory and, very little is known about the analysis of the multiagent cooperation structure. Two kinds of multiagent cooperation structures were provided in literature the complete cooperation structure and the incomplete structure, but the objective exchanging and the number of both sides were neglected. This paper begins with an introduction of the current status of research on the multiagent cooperation and definition of multiagent cooperation, then sixteen cooperation structures are provided according to the three dimensions, whether cooperation is complete, whether the objective exchanging of both sides exists, and the number of both sides. Furthermore, a set of communication primitives is designed for multiagent cooperation [8].

User-cooperation or relaying through other nodes is an efficient approach to obtain diversity in wireless networks. In this paper, we consider a coded cooperative system under quasi-static Rayleigh fading to find conditions on the inter-user and user-to-destination channel qualities for cooperation to be beneficial. We define the user cooperation gain as the gain in frame error rates due to cooperation when a particular channel code is used. We introduce the cooperation decision parameter which is only a function of user-to-destination channel qualities and demonstrate that whether cooperation is useful or not depends only on the cooperation decision parameter and not inter-user link quality.

We make use of the analytical formulation of the CDP to explore how user cooperation gain behaves in high signal to noise ratios and how relative link qualities of user-to-user and user-to-destination channels affect cooperation benefits in this asymptotic range. Furthermore, we investigate how one can choose a partner from candidate nodes such that the user cooperation gain is larger. All of our theoretical results are supported by simulations[9]. Further research is required to devise an algorithm that enables the nodes to accrue over time the system information needed to implement the proposed strategies.

What is Cooperation

The Oxford Dictionary define it ‘to corporate ‘ as ‘to work together act in conjunction (with another person or thing, to end or purpose, or in a work)’.

The broadcast nature of the radio medium may be used to improve the system performance by having a node(s), other than the source and the destination, actively help deliver data frame correctly to the destination. This practice is referred to as cooperative communications.

Overview of Vehicular Delay Tolerant Network

Vehicular delay-tolerant network is a proposal for a DTN-based architecture. It create a communication infrastructure consist of vehicular nodes and fixed nodes, offering a low cost connectivity solution in challenging scenarios where a infrastructure is unreliable. Despite of its rapid growth around the world Internet is still far from becoming universal. Old Internet access is usually not available in remote and

populated areas or undeveloped regions. Internet access may also be unavailable due to natural disasters where network infrastructures are vanished [2].

Cooperation in Delay Tolerant Networks

The DTN concept was initially developed for interplanetary networking [5]. However, over the last years, a number of real-world environments where DTN techniques are required have been emerging in the literature.

It is necesary to notice that limited network bandwidth , limited storage capacity and limited energy influenece the performance and the capapcity of delay tolerant networks. Cooperation is a key issue to the success of data communication in DTN. Where nodes use their storage, bandwidth, and energy resources to mutually enhance the overall network performance

In a cooperative environment, network nodes work together, storing and distributing bundles not only in their own interest, but also in the interest of other nodes. Such a behavior improve the number of transmission paths improving the storngness to failure of individual nodes[6].

Although cooperation is higly important to improve the capability of network nodes and increasing the overall network performance to the best of out knowledge, little bit research has been done in this field.

The Delay Tolerant Networking paradigm is characterized by the lack of guaranteed connectivity and the typically low frequency of encounters between a given pair of nodes within the network. The routing algorithms proposed for DTNs rely on node mobility for message delivery and may be categorized into single- and multiple-copy algorithms depending on whether they allow the multiplication of the message within the network [24].
Cooperation has been studied under the framework of peer to- peer and ad-hoc networks. Main issues typically considered are the effect that cooperation might have on the network performance [25], the detection of non-cooperative behavior, and the design of mechanisms to enforce cooperation [26]. Simple mechanisms have been designed to address cooperation problems, based on game theoretic approaches aiming to provide incentives in order for the nodes to cooperate [27].

Cooperation in Ad-hoc network

More than a decade the research community has been quite intensivley studying the mobile adhoc networks. Generaly known as MANETs [28]. A greate in size of work has been done towards solving research problems related to wireless ad hoc networks [29]. Although up to greate extent amount of successful research is done, especially when considering military ad hoc networks, the deployment of large-scale ad hoc networks in the civilian context has been limited to very few cases. There are certainly many reasons for this lack of commercial success, one of those being that the time has not been ripe for ad hoc networking, and certainly many practical engineering problems have been underestimated during the first phase of enthusiasm [4].

In the case of ad hoc networks have to be careful to understand that there are two distinct co-operation domains

1: Communications Cooperation, in the strict communications stack domain, means that we need to provide a common set of communications protocols and transmission methods for all the corresponding hosts so that the network can be established. This problem is shared with all communication systems, but the dynamical nature of the ad hoc networks makes this quite difficult [4].

2: Social Cooperation of the forwarding nodes for a common good is another aspect. There the challenge is the question how to guarantee that nodes between the source and the destination are cooperating on packety. forwarding. In the case of the closed ad hoc network applications (such as military or emergency networks) this is easier to ensure than if one is considering highly dynamic privately owned network hosts [4].

Ad hoc networks hold the key to the future of wireless communication, promising adaptive connectivity without the need for expensive infrastructure. In ad hoc networks, the lack of centralized control implies that the behavior of individual users has a profound effect on network performance. For example, by choosing to leave a network or refusing to honor relay requests, a user can severely inhibit communication between other users. This is a stark contrast with fixed wireless systems [23] where a single user has much less influence on other users. The influence of user behavior on network performance, in combination with the fact that nodes in an ad hoc network are constrained by their finite energy capacity, motivates the need for a rational and efficient resource allocation scheme [4].

Cooperation in Wireless Ad Hoc Networks

Wireless adhoc have been matured as viable means
to provide ubquitous communication. In order to enhance network connectivity, a source communication with far off destinations by using intermediate modes as relays [1].

When applied to singlehop networks, this practice can be embedded into the MAC protocol as follows. The data frame is transmitted by the source to the destination, while a third node(s) — the relay node(s) — overhears the transmission of the data frame and may help improve the delivery success rate over the radio link [12].
The essence of the idea is that, the destination benefits from data frames arriving via two (or more) statistically independent paths, i.e., spatial diversity. The advantages of cooperative communications include the ability to increase the radio link capacity [13] and reduce the latency of automatic retransmission request protocols [14].

Cooperation for VDTN

Vehicular delay tolerant networks also take advantage of the benefits introduced by the cooperative behavior of the network nodes, in order to gain significant enhancement of the network performance [22]. In particular, all VDTN network functions are based on the principle of cooperation between network nodes. Then, for instance, this encompasses the strategies for signaling and resources reservation (e.g, storage and bandwidth). A large amount of research has been done towards Vehicular Delay Tolerant Network. Although there are still some problems that needs to be solved, we comment certain mature technologies that have emerged. We believe that the major part of the future research work will be directed to new problem domains [21]. In fact, some engineering problems needs to be solved even before intelligent link-aware routing solutions can be implemented easily [4].

Conclusion

Cooperation is a key success for multi agent research system, and such it has received a large amount of intension in the multi agent system literature. However little known about systematic treatments of cooperation structure. In future work we wish to use our framework and algorithms to design the mechanism of punishment and stimulation. In addition, we aim to apply them to electronic commerce [11].

Ad hoc network hold the key to future of wireless communication, promising adaptive connectivity without the need for expansive infrastutrcure [14], [15] and [16].

We would like to emphasize that the aim of this work was to provide a mathematical framework for studying user cooperation in ad hoc networks, and to define strategies leading to an optimal user behavior. Further research is required to devise an algorithm that enables the nodes to accrue over time the system information needed to implement the proposed strategies [17], [18].

Future research directions on VDTNs may involve the study of bundle assembly and bundle fragmentation mechanisms, enabling congestion control and introducing support for traffic differentiation and 'quality of service' routing capabilities [19].

References

[1] T Jamal, P Amaral, A Khan, SAB, Kiramat, "Denial of Service Attack in Wireless LAN", in Proc of 12th ICDS 2018, Rome Italy.

[2] T. Jamal and P. Mendes, "Relay Selection Approaches for Wireless Cooperative Networks," in Proc. of IEEE WiMob, Niagara Falls, Canada, Oct. 2010.

[3] T. Jamal, P. Mendes, and A. Zúquete, "Opportunistic Relay Selection for Wireless Cooperative Network," in Proc. of IEEE IFIP NTMS, Istanbul, Turkey, May 2012.

[4] T. Jamal and P. Mendes, "Cooperative relaying in user-centric networking under interference conditions," IEEE Communications Magazine, vol. 52, no. 12, pp. 18–24, dec 2014

[5] P. Mendes,W. Moreira, T. Jamal and Huiling Zhu, "Cooperative Networking In User-Centric Wireless Networks", Springer Lecture Notes in Social Networks, User-Centric Networking: Future Perspectives, ISBN 978-3-319- 05217-5, May 2014.

[6] T. Jamal, P. Mendes, and A. Zúquete, "Relayspot: A Framework for Opportunistic Cooperative Relaying," in Proc. of IARIA ACCESS, Luxembourg, June 2011.

[7] T. Jamal, SA Butt, "Malicious node analysis in MANETS", International Journal of Information Technology, Springer Publisher 2018.

[8] T. JAMAL AND P. MENDES. "COOPERATIVE RELAYING FOR DYNAMIC NETWORKS", EU PATENT, (EP13182366.8), AUGUST 2013.

[9] T. Jamal and P. Mendes, "802.11 Medium Access Control In MiXiM," Tech Rep. SITILabs-TR-13-02, University Lusófona, Mar. 2013.

[10] T Jamal, M Alam, MM Umair, "Detection and prevention against RTS attacks in wireless LANs", in Proc of IEEE C-CODE, Mar 2017.

[11] L. Lopes, T. Jamal & P. Mendes, "Towards Implementing Cooperative Relaying" In Technical Report COPE-TR13-06, CopeLabs University Lusofona Portugal, Jan 2013.

[12] T. Jamal, P. Mendes, and A. Zúquete, "Interference-aware opportunistic relay selection", In Proceedings of The ACM CoNEXT Student Workshop, Tokyo, Japan, 2011.

[13] T. Jamal, "Cooperative MAC for Wireless Network" In 1st MAP tele Workshop, Porto, Portugal, 2010.

[14] T. Jamal and P. Mendes. Analysis of Hybrid Relaying in Cooperative WLAN. In Proc. of IFIP WirelessDays, Valencia, Spain, November 2013.

[15] T. Jamal and P. Mendes, "Cooperative Relaying for Dynamic WLAN," Chapter WiNeMO Book (Springer LNCS Editor), Feb. 2014.

[16] T. Jamal, and SA Butt, "Cooperative Cloudlet for Pervasive Networks", in proc. of Asia Pacific Journal of Multidisciplinary Research, vol 5, issue 3, Aug 2017.

[17] T. Jamal, P. Mendes, and A. Zúquete, "Wireless Cooperative Relaying Based on Opportunistic Relay Selection," International Journal on Advances in Networks and Services, vol. 05, no. 2, pp. 116-127, Jun. 2012.

[18] T. Jamal, P. Amaral, and SA Butt, "Denial of Service Attack in Wireless LAN", in proc. of IARIA ICDS, Rome, Italy, Mar. 2018.

[19] T. Jamal, and P. Amaral, "Flow Table Congestion in Software Defined Networks", in proc. of IARIA ICDS, Rome, Italy, Mar. 2018.

[20] R. Sofia, P. Mendes, W. Moreira, A. Ribeiro, S. Queiroz, A. Junior, T. Jamal, N. Chama, and L. Carvalho, "Upns: User provided networks, technical report: Living-examples, challenges, advantages", Tech. Rep. SITI-TR-11- 03, Research Unit in Informatics Systems and Technologies (SITI), University Lusofona, Mar. 2011.

[21] T. Jamal, and P. Mendes, "Cooperative relaying in wireless user-centric networks", In: Aldini, A., Bogliolo, A. (eds.) User Centric Networking - Future Perspectives. LNSN, pp. 171–195. Springer, Heidelberg (2014).

[22] T. Jamal and P. Mendes, "Cooperative relaying for Wireless Local Area Networks", In proc. of Wireless Networks Moving Objects, Springer LNCS WiNeMo, March 2014.

[23] T. Jamal, P. Mendes, and A. Zuquete, "RelaySpot: Cooperative Wireless Relaying", in proc. of MAP-Tele Workshop, Aveiro, Portugal, May 2011.

[24] T. Jamal and P. Mendes, "Cooperative Wireless Relaying, Key Factors for Relay Selection", in MAP-Tele Workshop, Porto, Portugal, Dec. 2009.

[25] SA Butt, T. Jamal, "Study of Black Hole Attack in AODV", in Proc of International Journal of Future Generation Communication and Networking, Vol.10, No.9 (2017), pp.37-48.

[26] T. Jamal and SA Butt, Low-Energy Adaptive Clustering Hierarchy (LEACH) Enhancement for Military Security Operations, ISSN 2090-4304 Journal of Basic and Applied Scientific Research, 2017.

[27] T. Jamal, and P. Mendes, "RelaySpot, OMNET++ module", In COPE-SW-13-05, 2013.

[28] T. Jamal, P. Mendes, and A. Zúquete, "Design and Performance of Wireless Cooperative Relaying", PhD Thesis MAP Tele, University of Aveiro, 2013.

[29] SA Butt, T. Jamal, "Frequent Change Request From User to Handle Cost on Project in Agile Model" in Proc. of Asia Pacific Journal of Multidisciplinary Research 5 (2), 26-42.