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A Survey on Packet Delivery in Hybrid Wireless Network

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***Abstract*---Hybrid wireless network is an integrated infrastructure that provides seamless services over the several networks. In telecommunication and computer industries have made wireless networks increasingly popular and ubiquitous. The hybrid wireless networks are more desirable because of its low cost, plug-and-play convenience and flexibility. Its usage of bandwidth and battery power is more efficient. Hybrid wireless networks are having the problem of packet delivery delay. The nodes that are not within the transmission range require other nodes to transmit the data. It will increase the packet delivery delay. so the cooperative packet delivery is used to deliver the packet without much delay . This paper gives a survey on several packet delivery methods that are used in hybrid wireless networks. This paper also provides methodology and limitations these techniques. The performance of existing cooperative packet delivery methods are analyzed using various parameters.**

Index Terms-Hybrid wireless networks, cooperative packet delivery, ad hoc network, BS oriented networks

I. INTRODUCTION

Wireless networks and mobile host is widely available and popular. Wireless communications and network topology is the key to supporting a variety of applications such as safety and emergency notification. For such applications, which are provide through public wireless networks, base station(BS)/access points(AP) sporadically deployed across the roads act as the gateways between mobile nodes and other terrestrial networks for data communication. Wireless network have become attractive communication. Many cities and public places have deployed wireless networks to provide internet access to residents and local business. When the wireless link condition between the base station and a mobile node is poor carry and forward based cooperative data delivery will be useful to reduce the delay of data delivery.

Intelligent transport system (ITS) architecture provides a collision free and effective data transmission to vehicular adhoc networks. It is provides public safety message delivery and multimedia communication to vehicular networks and road side users. The primary goal of the techniques is collision avoidance, route planning, automatic tolling and traffic control. There are several methods has been proposed to achieved the above primary goals of ITS.

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In the vehicular networks there are no end to end path between the communications sources and destinations due to sparse node density and unpredictable node mobility. In such kind of networks, traditional ad hoc routing protocols,which relay on the end to end paths,fail to work.so it is necessary to maintain the end to end path between the communication source and destination.

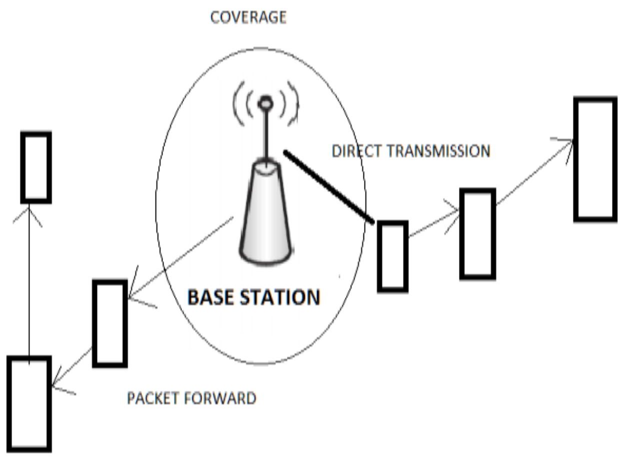

Fig. 1: Hybrid wireless network

This paper reviews several data transmission techniques that involved in hybrid wireless networks such as vehicular ad hoc networks and mobile ad hoc networks. The following section contains the methodology of these data transmission techniques.

II. METHODOLOGY

A. *Cluster based multichannel communication*

The cluster based multichannel communication method enables short range multimedia communication for vehicular networks. This scheme integrates clustering with contention free and medium access control protocols. The elected cluster head as a coordinator collects a safety messages within the cluster and also forward it to the neighborhood cluster head. The analytical model has been proposed to study the delay for the safety messages that is transmitted by cluster heads. Based on these analytical approaches, desirable contention window size has been derived to control the delay in delivery of the

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safety messages. The analytical model works both real time and non-real time traffic scenarios.

1)Cluster configuration protocol

When a vehicles entering into the highway traffic the cluster configuration protocols send an invite message to the vehicle. The invitation messages referred as invite to join (ITJ) message transmitted in every tj time. The vehicle, receives the message and it checks the signal strength. The vehicle confirms the request by sending a ACK message to the cluster head. Whenever cluster members lost the communication with the cluster head, the cluster member discarded from the cluster. The cluster configuration protocol performs a selection of new cluster head and also merging a cluster head with other cluster head.

2) Intra cluster coordination

It is based on the MMAC protocol. Where each cluster head employs a scheduling scheme over the CRC channel to collect/broadcast safety message and coordinate the cluster member vehicles to transmit the non-real time traffic data within the clusters. First , the cluster head creates the TDMS schedule and it transmitted to the each cluster members in the same cluster.

B. Cluster based data propagation protocol

Vehicular Ad hoc network is to enable the dissemination of traffic. There are some routing protocols used. Directional propagation protocols (DPP) utilize the directionality of the data and vehicles for information propagation. DPP comprises the three components: a custody transfer protocol, an inter cluster routing protocol, an intra-cluster routing protocol. The data propagations are forward propagation and reverse propagation.

1) Custody transfer protocol

The custody transfer mechanism has been adopted by delay tolerant networks concept for the purpose of overcoming the lack of sustained end to end path between source and destination. In most message passing schemes, a message is buffered until an acknowledgment from the destination is received. However due to network fragmentation in a VANET and the resultant lack of continuous end to end connectivity at any given instant the message can require buffering for an indeterminate amount of time. The result translates to the requirement for larger buffer size or dropped messages and difficulty to exchanging the acknowledgments. For applications that do not require continuous end to end connectivity. Store and forward approach can be used a message is buffered for retransmission from originating cluster until it receives an acknowledgement from the next hop cluster. The custody is implicitly to transferred to another cluster that is in front along the direction of propagation and is logically the next hop in terms of the message path the traffic in opposing direction act as abridge but is never given the custody of message. The cluster is not released until an acknowledgement is received from the cluster in front. Once the message reaches the next hop cluster it has the custody of message and the responsibility for further relaying the message is vested in this cluster. The custody of the message can be accepted or denied by a cluster by virtue of it being unable to satisfy the requirement of the message

2) Inter cluster routing protocol

The inter cluster communication the message exchange between nodes within in a cluster, is a cluster mechanisms.

3) Intra cluster routing protocol

The intra cluster routing protocol governs the communication between clusters to achieve the global routing goal. This scheme operating in store and forward mode permits the bridging of network partitions.

Forward Propagation

In forward propagation the vehicle is assumed to be travelling along the N direction. The data also can be propagated in the N direction. The data can travel at the minimum rate of the speed of the vehicle. Since the data are travelling along the vehicle. The data are propagated to the header of the cluster. The header now tries to propagate the data further along the N direction, trying to communicate with other clusters located ahead of this cluster.

Reverse Propagation

In reverse propagation, the data are travelling along the car in N direction. The data propagation rate is c m/s.

C. Non cooperative game

Source has the self-interest to maximize their own benefit. Vehicular delay tolerant networks (VDTN) are introduced for communication between the traffic and sink. In VDTN the source and sink do not have a direct transmission path. Vehicular delay tolerant networks support the packet delivery in the preceding network. Mobile routers are installed. It supports the packet delivery of the preceding network. It has the two components. One is Roadside unit (RU) and other is onboard unit (OU). RU is the packet transmission of the traffic source and reception of sink. Mobile routers have the carrier to carry the data. OU is the packet reception and transmission of the mobile router, split the queues to buffer the packets to be delivered to different destinations.

1) Constrained Markov decision Process (CMDP)

CMDP is obtained the correct decision of mobile routers whether to accept the packet from the traffic source. It is based on the two criteria: first, as the packet from the different sources have the different weights, the mobile router has an objective to maximize the reward define based on the weights of the packets from the sources. Second, the quality of service (QOS) requirements of the traffic sources is met, the packet blocking probability needs to maintain below the threshold. The mobile router optimizes it based on the optimal policy, the

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traffic source make the decision in choosing the packet transmission rate, which is equivalently packet arrival rate at the mobile router. since not all packets will accepted by the mobile router due to the buffer size. A traffic source maximizeits benefit by minimizing the number of blocked packets, which is considered to be the cost. The packet transmission rate is obtained by the Nash equilibrium. CMDP is mainly used to allow or prevent the packet to enter the queue, the decision for each queue corresponds to different sinks, is independently made, the same formulation is applied for all queues in the mobile router.

The composite state of CMDP formulation for a queue at mobile router n buffering packets with n destination at sinks i' is defined as follows

$$\Delta = \{(\mathcal{V}, \mathcal{X}, \mathcal{A}, \mathcal{D});\ \mathcal{V} \in V_n,\ \mathcal{X} \in \{0,1,\ldots\ldots,X\}$$

$$\mathcal{A} \in A, \mathcal{D} \in \{1,\ldots\ldots H_{n \to i'}\}$$

Where $\mathcal{V}$ is the mobile router location, $\mathcal{X}$is the number of packet in the queue, $\mathcal{A}$ is the composite phase of the packet arrival and $\mathcal{D}$ is the phase of the packet departure, X is the maximum size of queue.

The action space is defined as U = {0,1},u = 0 andu = 1 correspond to accepting and refusing the incoming packet by the mobile router respectively, here the decision of refusing the incoming packet from traffic sources at the mobile router may be required to avoid congestion. Incoming packets are accepted and stored in the queue of the mobile router the packets from traffic source i can arrive at the queue only when the mobile router in the location i, therefore the probability transition matrix for a packet arrivals from traffic source i with phase transition of all other source $j \neq i$ can be expressed as follows

$$B_i^{(a)}(u=0) = (_{j \in S_{n,j<1}} \otimes A_{j \to n}) \otimes A_{i \to n}^{(a)} \otimes (\otimes_{j \in s_{n},\, j>1}, A_{j \to n})$$

For a $\in \{0,1\ldots..,a_m\}$ and $i \in S_n$, where $\otimes$is the kronecker product

The packet departure is the process of the queue of mobile router n for the packet with destination at sink i'. U=1 at this condition incoming packets are refused by a mobile router. the probability transition matrix for a packet arrival from traffic source i becomes

$$B_i^{(a)}(u = 1) = \{_{j \in S_n} \otimes A_{j \to n},\ a=0;$$

In VDTN's the packets from different traffic sources may have different weights, depending on the values of information included in packets, a mobile router has to make a decision such that the reward defined as the sum of weights of delivered packets is maximized. The immediate reward of mobile router n is a function of the number of accepted packets. The packets is blocked due to either the lack of available space in queue or the action of a mobile router. The packet blocking probability is the ratio of the number of blocked packets to the total transmitted packets upon each action of the mobile router.

2) Optimal Policy

The policy of the CMDP for the mobile router is defined as U = π(S) which is a mapping of the state S to action U. for the normalized policy, the probability distribution is defined as the policy π^* is defined as the policy where in the long term objective is maximized. Optimal policy the noncooperative game is used. The players are the traffic sources. The plan of each player is a set of the transmission packet rates. If all traffic sources are rational to maximize their payoffs, the Nash equilibrium is considered to be the solution. The equilibrium of a noncooperative game is a set of strategies λ^*_I with the property that number of player can increase his payoff by choosing a different strategy set λ_{-i}^*. it can be obtained from the best response of each player.

D) Routing Protocol

Many broadcast protocols have been proposed to cope with broadcast storm problem in VANET's which can be divided into two categories: beaconless and beacon based. Most of the beacon less approaches used in VANET's are also a kind of contention-based schemes which allow each node to calculate its own rebroadcast probability or forwarding delay according its position information. Weighted-p scheme assigns higher rebroadcasting probability to nodes that are located further away from the sending node. In dynamic delayed broadcasting protocol it calculates the rebroadcast waiting time by considering the additional covered area when received duplicated packet each time.

These contention based schemes can mitigate contention effectively by allowing nodes rebroadcasting with different priority based on relative distance between itself and sender. The performances of these schemes are highly sensitive to the chosen threshold which are hard to predict and cannot be changed according to various density.

1) Vehicular multi hop protocol (VMP)

Design the forwarding strategy based on neighboring information by periodic exchange hello message. It combines a set of mechanisms including designating multiple forwarder candidates with different forwarding delay, helper strategy based on cooperative forwarding and optimization to discard unnecessary discarding.

In real vehicular scenarios, nodes can experience packet loss due to signal attenuation which is caused by multipath, reflection and distortion between radio waves and environment. Thus realistic radio propagation model should be considered. The Nakagami m fading model is utilized as a suitable model for highway scenarios due to the good match with empirical data.

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It shows the probability of successful packet reception rate without interferences from other nodes and transmission range is intended to 520km. in the deterministic channel model such as two-ray ground model the packet is always successfully received within the transmission range otherwise, the Nakagami-m fading model shows the non-deterministic behaves with different value of fading factor m. CSMA-CA based distributed function (DCF) is used in IEE 802.11p in case of adhoc communications. Several things should be taken into consideration when using broadcast communications first there is no ACK mechanism to indicate the transmission is successful or not at the mac layer. Second there is no RTS/CTS exchange is to avoid hidden terminal problem. Third there is no automatic retransmission mechanism when packet losses happen. Enhanced distributed channel access (EDCA) is adopted in IEEE 802.11p to provide differentiated channel access to data traffic with different priorities.

2) Cooperative forwarding

It is the mechanism to prevent random packet loss due to hidden terminal problem, radio attenuation and heavy link load in dense traffic situations. Thus in order to packet loss and guarantee high reachability, it help forwarding when all the specified forwarder candidates fail to transmit the message it checks the header information to decide whether it is the sender designated forwarder candidates are not. As the forwarder candidates it prepare rebroadcasting with its own forwarding delay based on the holder information, which includes two fields. The number of forwarder and forwarder ID list arranged through priority the forwarder delay easy calculated as forwarder priority sequence multiples one hop delay.

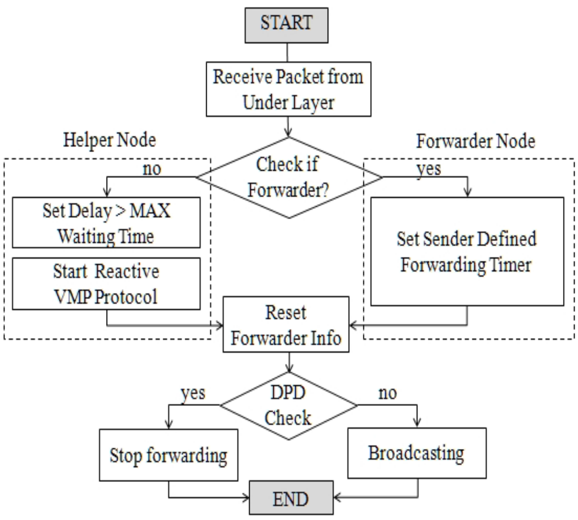

Figure3: Cooperative forwarding

Maximum waiting time = $\tau \times$ number of forwarder

In this period if no duplicated packet is received. It means all the specified forwarder candidates fail to transmit the message.

Forwarding delay = $\tau \times [N_s(1-\min[d_{ij},k]/k]$

3) Optimization

In order to discard unnecessary rebroadcasting packets, it has the duplicate procedure, which counts received number of packets during the forwarding delay. If the counting value is larger than certain threshold it will stop forwarding process DPD threshold is changed dynamically depending on the estimation of vehicle density according to neighborhood information.

E.Social Selfishness Aware Routing Protocol (SSAR)

SSAR formulates the data forwarding process as a multiple knapsack problem. In which a node only forwards packets for those with social ties, and it gives priority to packets received from those with stronger social ties when these are not enough resources. Since each node only forwards packet for part of the nodes, it is affect the routing performance. To achieve high performance, SSAR consider both user willingness and contact opportunity when selecting relays. It combines the two methods through mathematical modeling and machine learning technique and obtains a new metric to measure the forwarding capability of a relay with SSAR, a packet will most likely be forwarded to the relay that has strong willingness to forward as well as high direct or indirect or transitive contact opportunity with the destination improve the performance SSAR formulates the forwarding process as a multiple knapsack problem with assignment restrictions. It provides a heuristic based solution that forwards the most effective packets for social selfishness and routing performance. SSAR can achieve good performance with low transmission cost. In DTNs nodes have limited bandwidth and computational capability each node maintains a table that contains its willingness values for other nodes in the network. The value of willingness is a real number within [0,1] where 0 means unwilling to forward and 1 means most willing to forward.

A node’s willingness value for another node depends on the social tie between them user does not need to know all other user’s in the network.Each user manages it willingness table in an offline style through some user interface provided by the mobile device. The willingness table has one item for each node with a social ties and an additional item for all other nodes. A user only needs to manually configure its willingness table when she joints the network or migrates to a new mobile device and update the table. When user has new social ties or old social ties have changed. SSAR have the several components packet priority manager, buffer manager, delivery probability estimator, forwarding set manager. A node assigns a priority between 0 and 1 to each buffered packet based on its willingness for the source node and the previous hop. A packet measures the priority of social importance of this packet for this node this works is done by the packet priority manager. A node manages buffer based on packet priority(i)

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packets with priority 0 with not be buffered (ii) packets of low priority are dropped first when the buffer overflow. The buffer policy together with the priority assignment method it is done by the buffer manager. It estimates a node's delivery probability for a packet, which is used to measure the node's forwarding capability for the packet when two nodes are in contact;each packet is forwarded from the node with lower delivery probability to the node with a higher delivery probability. SSAR measures the delivery probability of a node based on both of its contact opportunity to the destination and its willingness to forward. It is that a node with a low contact opportunity should not be a relay it is done by delivery probability manager. After a node determines a set of packets that should be forwarded to better relay, bandwidth will be wasted if the transmitted packets are dropped due to buffer overflow. To address this issue, the forwarding set may decides with packet to transmit by solving a multiple knapsack problem with assignment restrictions. It considers the buffer limitation and transmits the packets that are the most effective for social selfishness and routing performance.

SSAR can work in two modes that are forwarding mode and replication mode. In the forwarding mode, a node detects its own copy after it's transmits a packet to its neighbor. Thus any packet can simultaneously have at most one copy in the network. In the replication mode, the node keeps its own copy after transmitting the packet therefore the packet may have many replicas in the network. The number of replicas depends on the mobility pattern and is non-deterministic the replication mode can deliver more packets than the forwarding mode but it also requires more resources such as buffer and bandwidth which mode to use should be application specific. When a node receives a packet from a previous hop, it assigns a priority to the packet. To be socially selfish, the node only forwards the packet if it is from a node with a social tie. These are two cases first, the sources of the packet has a social tie with this node, and hence forwarding the packet means helping the source. Second, the previous hop has a social tie with this node, this node should still relay the packet to help the previous hop has taken over the responsibility to deliver the packet. Thus even if the source does not have a social tie with thus node, this node should still relay the packet to help the previous hop this is motivated by the real world like to help a friend's friend. The priority should also measure the social importance of the packet to this node.letP_{curr} denote the new priority of a packet in the current hop and P_{prev} denote old priority of the packet in the previous hop, let w_{src}andw_{prev} denote the current hop's willingness for the packet source and previous hop respectively. If neither the source not the previous hop has a social tie with the current hop then $P_{curr}=0$ if the source has a social tie but the previous hop does not then $P_{curr}=W_{src}$ if the previous hop has a social tie but the source does not. The expiration dropping probability is expressed as

$$P_{exp}= P \{ X>t_{exp} - \hat{t} \} <= E(X)/(t_{exp}-\hat{t})$$

SSAR have two types of social networks graphs. The first type is contact dependent graph, where contact frequency between nodes probabilistically determines hoe degree are assigned to nodes and how edges are connected.

III PERFORMANCE ANALYSIS

The cluster based communication enables only the short range communication for vehicular networks.it reduced the data congestion it is used cluster based multi-channel and inter and intra communication. Cluster configuration protocol groups all vehicles in the same direction into clusters. Inter cluster protocol dictates the transmission. The vehicles which are located in the same area form a cluster and help each other deliver data.it is the limitation of the cluster based communication. The vehicular speed is 50 km. it have the delay of 151 ms. It consider network is 250m×250m. The cluster based data propagation protocol is message exchanged between the clusters. The custody transfer protocol adopted from the DTN concepts for the purpose of overcoming the lack of a sustained end to end path between source and destination. Inter cluster protocol the message exchange between nodes within in a cluster, intra cluster protocol governs the communication between cluster to achieve the global routing goal.it have the limitation of nearby vehicles form a cluster of vehicles in order to disseminate message. The vehicle is have the speed of 1000m/s. cost 20m/s. non cooperative game source has the self-interest to maximize their own benefit. The vehicular have the speed is 45km/h it have the cost are 0.975, 1175, 1.375. The packet size is 20 it have the limitations of each source node is rational to compete for transmission to the relay node. Vehicular multi hop protocol based on neighboring information by periodic exchange hello message. It is also based on the optimal policy. It have the limitations of nodes are willing to forward a packet for nodes with whom they have social ties but not others. Social selfishness aware routing protocol is have the multiple knapsack problem it is have the limitations of only infrastructure to vehicles communication is considered.

IV CONCLUSION

This research paper addresses the packet delivery in hybrid wireless networks which is more important in terms of the environment. An effort has been made to concentrate on packet delivery delay without affecting the communications in the mobile networks.

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