A SURVEY ON CROSS LAYER DESIGN APPROACHES IN VANETS

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Abstract : Vehicular Ad-hoc Network (VANET) is a disseminated and self-organized network, have developed as another incredible innovation to develop driving safety and traffic management. In VANET path stability is more important for sending data to destination. While routing protocols dependent on the customary layered open system interconnection (OSI) model are promptly accessible, they frequently don't utilize parameters at the lower layers of the OSI model when settling on routing decision. Henceforth, for settling on optimal routing decision to increase better network execution there is need than configuration cross-layer routing that enables data to be traded and shared crosswise over layer limits so as to empower productive and robust protocols. There have been a few research endeavors that approved the significance of cross-layer plan in vehicular networks. In this article, a survey of present work on cross-layer correspondence solutions for VANETs is introduced.

IndexTerms - VANET, Routing in VANET, Cross-Layer approach, Vehicular networks.

I. INTRODUCTION

VANET is a subclass of mobile ad hoc networks. The VANET gives wireless communication among vehicles and vehicle to roadside gear [1]. It helps the vehicle drivers to convey and coordinate among themselves to keep away from any basic circumstance through V2V communication. Cross-Layer Design has gotten the new pattern in remote correspondence frameworks as it looks to improve the limit of remote networks essentially through the joint optimization of numerous layers in the network. Cross-layer configuration stresses on the network execution optimization by empowering various layers of the communication stack to share state data or to move toward facilitating their activities so as to mutually upgrade network execution. The cross-layer can be alluded to as a convention configuration dependent on effectively using the reliance between convention layers to upgrade the network execution. This contrasts from the conventional layered methodology where the protocols at the various layers are planned freely.

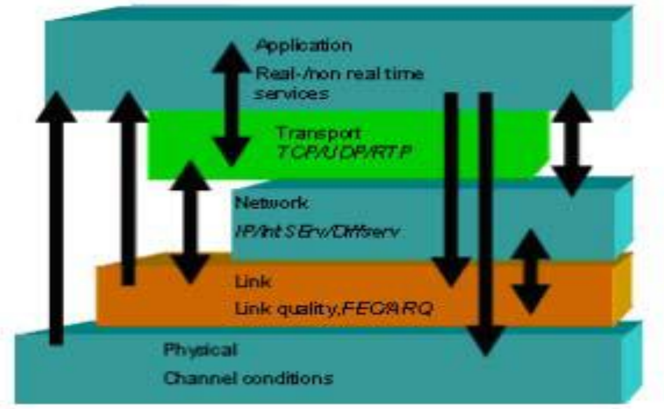

Figure 1 Cross-Layer for Wireless Protocol Stack

II.CROSS-LAYER DESIGN APPROACHES

There have been countless recommendations for cross layer plan in wireless networks. The cross-layer design alludes to a protocol design that endeavors the reliance between convention layers to accomplish attractive execution gains. The designs approach can be ordered dependent on how the data is traded between layers. In [2], the authors demonstrated that cross-layer designs should be possible by means four various methods are as follows. Figure 2 shown below gives the details of the methods.

1. The upward and downward flow of information: In actual layered structure, conventions in every layer work in a measured manner to upgrade their very own arrangement of parameters. Interestingly, this class of cross-layer structures allows the data stream between layers by means of specific interfaces. Data acquired from different layers offer valuable information on network status and correspondence attributes, which would then be able to be abused in better basic leadership, in altering parameters, and so forth. The data stream interface can be practiced through extra database that is shared among layers, or through warning fields inside parcels, which are passed between layers.

2. Combining of adjacent layers: As per this approach, the service and functionalities of neighboring layers are consolidated to shape a single layer called super layer. Since the layers are merged, joint optimization should be possible legitimately on the super layer as though we are building a solitary huge uniform protocol. Clearly, this strategy doesn't require any extra interfaces. Be that as it may, this methodology is outrageous and it extraordinary because of the intricacy it acquires to the super layer. Additionally, this strategy may have serious effect on upkeep and framework stability.

3. Design coupling of layers: In this method, numerous layers are planned in a cooperative way. We plan one layer by looking at the functionality in another layer, in this way making reliance even at the hour of planning. The preferred layer is called the fixed layer (FL) and the other layer is called designed layer (DL). Since DL is constructed dependent on FL, there is no requirement for an express interface between them. For instance, in the event that the physical layer is fit for various parcel gathering, at that point the media access control layer must be balanced in like manner. In this specific case, physical layer is the fixed layer though media access layer is the design layer. Note that, any adjustment in fixed layer must be pursued with an equal change in design layer.

4. Vertical tuning across layers: This method alludes to altering parameters that span numerous layers in the protocol stack. Since the performance seen at the degree of application layer relies upon the parameter settings of every single downstream layer, it is frequently alluring to mutually upgrade the parameters from every single downstream layer. Such a technique accomplishes better execution when contrasted with a strategy that tunes the parameters in each layer freely. The optimization can either be static i.e., performed at configuration time or dynamic i.e., performed at run-time. Dynamic optimization is clearly increasingly intricate and it requires consistent data update crosswise over layers to guarantee accuracy. Algorithms that fall into this classification regularly maintain a database.

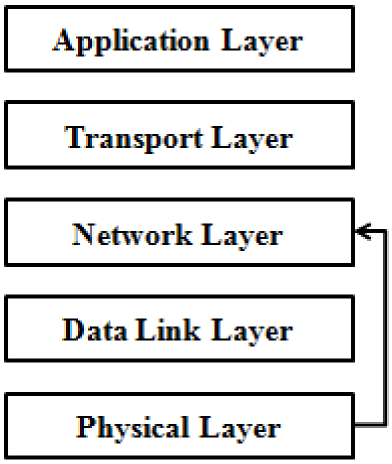

Figure 2 (a)

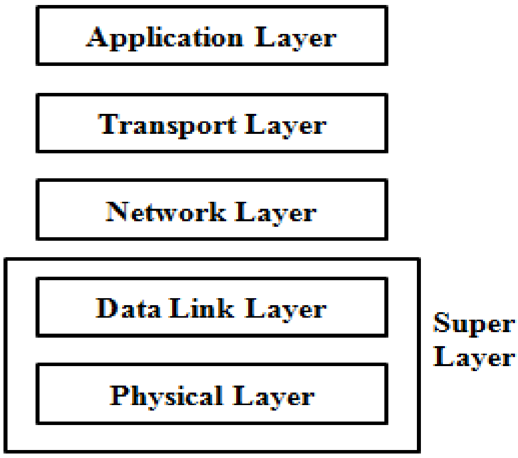

Figure 2 (b)

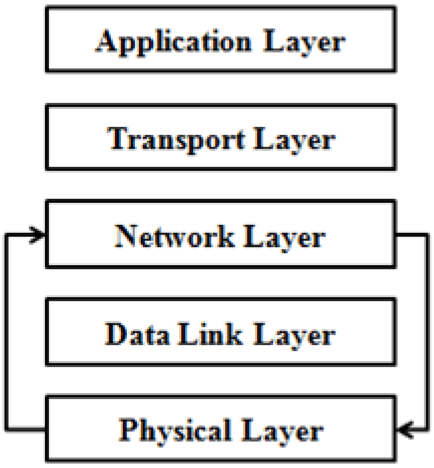

Figure 2 (c)

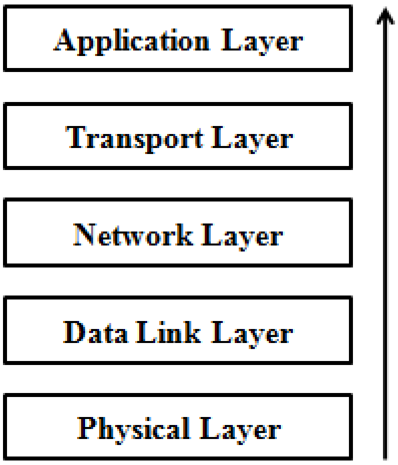

Figure 2 (d)

Fig 2 Cross-layer design approaches (2) (a) Information flow with new interfaces, (b) Merging of adjacent layers, (c) Design coupling without new interfaces, and (d)Vertical calibration across layers.

III. LITERATURE SURVEY

The research that has been done so far in designing cross-layer solutions for VANETs is categorize existing work into different sections based on the type of interactions that the protocols demand**.**

Cross-layer design for PHY-MAC layers:

Physical layer (PHY) links several vehicles within the transmission range through the wireless channel. Wireless communication at PHY layer in VANETs is severely affected by time and space varying channel properties due to the vehicle movement and environmental obstacles. Thus, many cross-layer solutions provide ability for PHY layer to observe the channel condition and to opportunistically transmit messages when current channel condition is good. The channel condition not only affects the transmitting ability but it is also affects the receiving ability of vehicles. The CL-DEM protocol[3] which the optimal one-bounce forwarder selection dependent on various measurements likes separation, position, and speed instead of choosing an irregular most distant vehicle as a forwarder. One-jump forwarder vehicle is chosen which is moving a similar way as that of source by figuring its moving course. To give administration separation to crisis messages, 802.11e MAC is changed with a differential access class. A variable information rate is picked to scatter crisis messages as opposed to a base information rate. The presented method utilizes cross-layer coupling of the system, PHY and MAC layer to broadcast the messages through a co-operative hand-off in the system. Jhihoon Joo *et al.* [4] had implement a new cross layer design using the parameters of physical (PHY) and medium access control (MAC) layers called PHY/MAC cross-layer design in VANET. In actual method, the approaches namely; information flow with/without new interfaces approach is used as the cross layer design where it has some limitations over its performance connectivity, delay and in throughput. In developed new scheme, the PHY layer gives increase in communication coverage during transmission due to increase in power. The MAC layer size of contention window (CW) and retransmission limit can be modified so that the throughput is improved. Hence the developed design gives much improvement in all aspects like performance connectivity, delay and throughput as compared with the actual method.

Cross-layer design of PHY-MAC-network layers:

Due to high mobility of VANETs, the wireless link between two vehicles is short-lived. The channel quality information from physical layer helps the sender in predicting the link connection time, subsequently the sender can find a new receiver before the current link is disconnected. Thus cross-layer interaction between physical layer and higher layers is desirable to maintain link connectivity and improve system performance.

A cross-layer design that uses a metric known as Link Residual Time (LRT) [5] that is computed based on the received power that is observed at the physical layer. Developed a model for the separation subordinate change in received power after some time as two hubs move comparatively with each other. After eliminating noise incited by little scale and shadow blurring to the conceivable extent, gauges for the parameters of the model. This empowers us to distinguish whether the received power level increments or diminishes after some time, produce assessments of the connection quality in future time focuses by means of extrapolation and identify the connection breakage point. Link lingering time is characterized as the left-out measure of time during which the connection will stay valuable for information transmission; in other words the normal got control will stay over a predetermined edge. Given the given parameters of the model directing the time reliance of received power on the enormous scale, an estimation of the time point on which this will fall underneath a predetermined edge can be obtained. [6] The paper presented a scheme for selecting one-jump neighbour transfer which acted as a potential forwarder to relay the Bdcast messages. The optimal relay with multi QoS metrics like vehicle density, velocity and the geographical location manifested the broadcast messages with least bandwidth consumption and with least overhead. The proposed scheme using cross-layer coupling between MAC layer, PHY layer, and network layer is important to maintain link connectivity and develop framework execution.

CO-GPSR protocol is the extension of GPSR to enhance the routing performance [7]. This CO-GPSR used lay nodes with the radio path in the vehicular network and define Multi-objective decision making (MODM) scheme for selecting optimal relay nodes. Relay selection is done by selecting the nearest hub to the quick hop as relay instead of the link with maximum SNR. When GPRS is in greedy mode, the selected next hop is consistently in the bound of the coverage area of the forwarding node. Due to this it can experience high level of packet loss due to PHY layer errors. The proposed method informs the network layer about MAC layer that neglects to deliver a bundle due to poor radio connectivity. For this optimization process, the authors had utilized cross-layer information. [8] CL-RVR protocol utilizes connect assurance and sending development separation of a hub for choosing next jump sending hub. Link guarantees between the two imparting hubs the sender and the receiver depends on multiple factors that are movement angle, speed and expected region for forwarding movement separation. The author considered the sending progress separation of a hub during the selection process of the following hop. This parameter reduces the number of hops a data bundle has to travel to reach the destination node. The neighbour node whose progress is maximum receives the packet. To compute the expected forwarding movement distance (EFMD) of a candidate node is depends on its expected situation at the moment of information forwarding, in order to adapt the high node mobility in a vehicular network. The weighted work is utilized by normalizing all QoS measurements. The node with the lager esteem of the weighted capacity is given the higher priority and likewise we select the optimum node for next-hop determination.

Cross-layer design of network-MAC layers:

One of the foremost challenges in vehicular networks is to design protocols that can handle the high mobility of vehicles and constant changes in the underlying topology. The routing protocols must deal with frequent changes in the routing topology and maintain link stability between vehicles. If the route is disconnected, a new route must be discovered instantly. In order to effectively maintain the route information in such dynamic networks, most routing protocols rely on geographic information as opposed to address-based identification that is typically used in MANETs. These techniques can be complemented with cross-layer designs that exploit the relation between MAC and network layers. For example, the routing function can leverage the information shared by the MAC function in predicting the life-time of various links, and subsequently adjust the routes, if necessary. We now present various cross-layer approaches that make use of connections between MAC and network layers. [9] In Position based forwarding, every node will maintain a set of neighbors nearest to the position of the destination. At the time of route establishment only these nodes will be selected. Hence the route lifetime improves. By a cross layer approach we design a MAC layer based approach to calculate the received power of the packets from other nodes. If the power of the packets is not sufficient then MAC layer informs the network layer which interns removes those nodes from the routing table.

[10] LD-CROP captures the genuine information traffic conditions in the system and delegates the route choices to the source by leaving the detailed forwarding functions to intermediate nodes. The LD-CROP protocol can adjust to changes in parcel traffic conditions because of the proposed cross-layer structure among MAC and directing capacities. The MAC gathers different nearby bundle traffic information points by watching the channel. These traffic focuses are then utilized by the steering capacity in deciding the best accessible way through a postpone estimation model. The protocol has two communication steps: beacon advertising and data delivery. Before forwarding the beacon, the vehicles appends its present location to the PATH field and add local packet traffic information it has gathered to CPQ. CPQ consist of the accompanying three statistics I) Administration time: The entirety of channel dispute time and real transmission time. ii) Inter-arrival time: The time distinction between two

continuous appearances into the bundle line. iii). Packet train size: The normal number of information parcels sent in one transmission period. Movement Prediction-based Routing (MOPR) [11] is an example for one of the earliest approaches that propose a movement prediction based routing protocol for V2V communication in VANETs. It improves the routing process by taking the vehicle movement information that is typically available in MAC layer such as position, direction, speed, and network topology into consideration. Based on such vehicular information, MOPR predicts the future location of intermediate relay nodes, which can subsequently be used to estimate the life-time of point-to-point links. As a result, MOPR is capable of dynamically select the most stable routes containing stable nodes that are traveling in the same direction or with the similar speed or on the same road as of the destination/source nodes. To facilitate the routing process, the vehicular information such as position and speed are explicitly maintained in the routing table. Such position prediction techniques can further be improved by making use of digital maps and navigation systems.

Cross-layer design for transport-network layers:

There exist several cross-layer protocols that operate between the transport layer and lower layers. Most of these protocols are aimed at supporting real-time and multimedia applications that require a reliable end-to-end connectivity with critical QoS requirements. Cross-layer protocols are developed to assist in dealing with issues that emerge in vehicular networks. In this section, we first review the functionality of transport layer protocols, and discuss challenges that these protocols must address in the context of vehicular networks. We then explore existing cross-layer solutions between transport and routing functions. Ben-Jye Chang et *al.* [12] has proposed the cross-layer based real-time local repair (RTLR) way to deal with fix breaks in multicast VANETs. The stage I incorporates three angles are 1. Every hub maintains the multi-hop neighbour data dependent on MAODV Hi message. The circulated multi-hop neighbour data is utilized for cell phone hubs to decide the ideal substitute hubs for repairing joint breaks. 2. Two repair orders: I) the nearest neighbour first, and ii) the least hop count first is proposed to diminish the separation between the repair hub and the gathering chief. 3. The four unicast type repair messages lessen the complete number of control messages. In stage II a cross-layer instrument utilized between the TCP and MAC layers so as to expand TCP great put.

Cross-layer design for transport-MAC layers:

The cross-layer design between transport and MAC layers helps in distinguishing between route interruption and channel congestion. The link disconnection problems that occur at the level of individual hops must be dealt at MAC layer. MAC protocols such as 802.11 handle link disconnection via packet retransmissions. If the sender does not receive the acknowledgements within a fixed number of retransmissions then the packet is dropped. In multihop vehicular networks, the issue of link disconnection is likely to be severe since the underlying network topology changes dynamically, thereby resulting in frequent packet retransmissions. In multi-hop VANETs, the sequence of relay nodes between the source and destination nodes can be treated as a chain. Different links in such a chain experience different levels of interference. In [13], Majeed et al. studied the impact of these different MAC-level interference on the performance of TCP in multi-hop networks. Through an extensive simulation, they rank ordered chains with different MAC interactions based on the position of senders and receivers. For instance, sender-connected interaction, also known as exposed node terminal problem, occurs when two senders interfere each other transmissions. Authors found that sender-connected chains provide best performance in term of throughput and retransmission overhead. The difference in levels of interference among these chains contributes up to 25% difference in system throughput. Generally, the multi-hop chain requires high number of retransmissions. This retransmission wastes the bandwidth usage and potentially increases the delay and degrades throughput of the system. Labiod *et al.*[14] author had proposed high proficiency video coding with low defer temporal prediction structure based adaptive mapping mechanism. With the support of the proposed algorithm, video bundles were routed to the high suitable buffer on the MAC layer. The HEVC with low temporal prediction structure has three mode predictions namely; low delay (LD), all intra (AI), and random access (RA). A cross-layer mechanism used between the MAC layer and application layer is proposed to improve video streaming.

Table 1 Comparison Table for Cross-layer approach in VANET

	PDR	End to End Delay	Throughput	Bandwidth consumption	Packet Drop Rate
CL-DEM[3]	High	Less	High	ND	Less
LRT[5]	Medium	High	Less	ND	High
CL-MHB[6]	High	Less	ND	Less	High
CO-GPSR[7]	Less	ND	Less	High	High
CL-RVR[8]	High	Less	High	Less	ND
LD-CROP[10]	Less	High	High	ND	High
RTLR[12]	High	ND	High	Less	Less
HEVC[14]	High	Medium	ND	Less	Less

IV.CONCLUSION

VANETs assume a crucial role in ITS and routing is an important aspect of VANETs application. From above review, it very well may be repeated that the incorporation of cross-layer data while routing assumes a basic job in developing the exhibition of a routing protocol. Notwithstanding, routing protocol developer needs to consider the exchange offs that exist between different steering draws near. The routing approach must adapt well to characteristics and dynamic system topology of the vehicular ad hoc network. At long last, a portion of the research issue is additionally routed to go before further research in a similar direction.

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