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A Survey on Issues and Challenges in Congestion Adaptive Routing in Mobile Ad Hoc Network

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Abstract- Mobile ad hoc networks is the future wireless communication systems have recently emerged as an important trend. Mobile adhoc network is self-configurable and adaptive. Due to the mobility of nodes, the network congestion occurs and it is difficult to predict load on the network which leads to congestion. Mobile adhoc network suffers from a severe congestion controlling problem due to the nature of shared communication and mobility. Standard TCP controlling mechanism for congestion is not fit to the dynamic changing topology of MANETs. This provides a wide scope of research work in mobile ad hoc network. The purpose of this survey is to study and analyze various issues and challenges in congestion control mechanisms in adaptive routing protocols in Mobile Adhoc Network (MANET).

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ASURVEYONISSUESANDCHALLENGESINCONGESTIONADAPTIVEROUTINGINMOBILEADHOCNETWORK

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A Survey on Issues and Challenges in Congestion Adaptive Routing in Mobile Ad Hoc Network

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Abstract- Mobile ad hoc networks is the future wireless communication systems have recently emerged as an important trend. Mobile adhoc network is self-configurable and adaptive. Due to the mobility of nodes, the network congestion occurs and it is difficult to predict load on the network which leads to congestion. Mobile adhoc network suffers from a severe congestion controlling problem due to the nature of shared communication and mobility. Standard TCP controlling mechanism for congestion is not fit to the dynamic changing topology of MANETs. This provides a wide scope of research work in mobile ad hoc network. The purpose of this survey is to study and analyze various issues and challenges in congestion control mechanisms in adaptive routing protocols in Mobile Adhoc Network (MANET).
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I. Introduction

In recent times, there was a large leap in the field of development communication. Now, mobility communication has become one of the most needed. Mobile networks (MANETS) is one of the most mobile and flexible, powerful and effective way of communication. It is self-organized and configures itself on the fly. As it is lack of infrastructure these networks are quick to deploy environment and provide applications in diverse domains. Most commonly it is established for military areas, emergency and rescue operations, business applications and many more, just because they are economical.

In Adhoc networks routing protocols [4], it is necessary to use the potential of providing high-quality communication. There are a lot of network resources that limit the portability of the device, to manage the size and weight. Hence the need for the distribution of traffic between the mobile host nodes in the MANET suffers due to limited buffer, bandwidth, and battery power. In MANET routing protocol, the tasks should be distributed fairly between the mobile hosts.

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In wireless communication, devices will be equipped with the mobile hosts. The main features of MANET are self-configurable and deployable with multi-hop communication environments without a central coordinator. It faces frequent link breakage due to bandwidth, processing power, battery life, and resources such as mobility limitations. So this is fully distributed and often MANET positive changes in the topology of the routing protocol, often linked to the breakup of the major challenges.

II. Routing in Manets

Wireless network in disasters is to deliver information to law enforcement and the military to coordinate the distribution of mobile computers for many applications to provides quick access to information irrespective of the locations and distance. It was stated that, an adhoc assembly of wireless mobile hosts working deprived of the aid of any established infrastructure or centralized administration to make temporary communication [1].

In MANET routing structure depends on many factors, including the selection of routers, and finds a way to quickly and efficiently solving the basic and typical requests, which is to serve [6]. These networks are to guide the effective use of limited resources, the availability of the right-peer network, and therefore need to be motivated.

Also, most of the aggressive natures of these networks, which aim at achieving the stability of the routing protocols, are designed specifically for motivating the study of various protocols.

a) *Classification of Routing Protocols in MANET*

Routing protocols in MANET are classified based on the structure of the network and routing strategy. The flat routing, hierarchical routing and geographical position assisted routing are based on the structure of the network. Routing protocols are classified as table-driven and source routing protocols can be categorized based on the routing strategy:

i. *Proactive – Table driven Routing Protocol*

Proactive based routing protocols maintain regular and accurate information for data routing through periodical message exchange between the nodes. Transmission of data to the destination node, the path can be calculated based on the routing table information. Keeping regular update of the routing information in this routing is an overhead in this protocol. A large number of dynamic topology update operation is required to turn adhoc wireless networks node mobility. Limited resources, bandwidth usage, and performance, has a negative impact on the wireless devices. This category of extension to protocols generally is wired operators protocols. For example: DSDV - Destination Sequence Distance Vector, OLSR - Optimized Links State Routing, WRP - Wireless Routing Protocol and many mores [2]. Without the need to find practical operation of the Protocol is the main advantage of adhoc network process, is always low as a result of periodic updates and overhead disadvantage of this operation and the main destinations are available to all protocols.

ii. *Reactive – On-Demand Routing Protocols*

Reactive protocols are termed as On-Demand routing protocols, it does not know the way to find a mechanism to node until a destination path for communicating with it has started. It can respond quickly to changes that could occur on the mobile ad hoc network nodes in their operation. Reactive carriers significantly lower than the cost, performing better than the practical operation of carriers and still less (or removed) to change the time or lower where network operators accessories are included. It is broadly classified into two main activities know as route discovery and route maintenance. Few examples of reactive routing protocols are DSR, AODV, TORA etc., and many discussed in literatures [3].

iii. *Hybrid Routing Protocol*

The proactive and reactive approach both form a hybrid routing, consisting of the ZRP - Zone Routing Protocol [7], CEDAR - Core Extraction Distributed Ad Hoc Routing. ZRP splits network into zones for the proactive and reactive routing. Protocol operating reactive operation protocol and the protocol in the directive of a dynamic protocol. When a node needs to send data to the destination in the region, and this directly to the proactive operation with carriers, when more information is already in the destination in tables. If operation of the source node is in the transmission line until it reaches the target area. The edge nodes in the target road send back a message by back route reply. It further noted the request referred to in any way address nodes. This information will be used to show the way back to the source. If broken links are found, the reconstruction does not exist locally, possible, and upgrade path will be sent to the source, or may be the first place to start to find the way to become global.

III. Transmission Control Protocol (TCP) in MANETs

TCP and MANETs both are based on the transport layer protocol for communication but MANET follows multi hop communication for data routing [8][9]. It is the atmosphere of a traditional wired network between the hosts which provides a reliable end-to-end data delivery. TCP durability is achieved by retransmitting lost packets. Therefore, the estimated round-trip delay of each TCP sender and the average deviation derived from it maintains a running average. The sender receives a receipt if any within a specified timeout interval is retransmitted packets will be duplicated or received. Dependability on the tradition wired network, no packet loss due to congestion is an implicit assumption that the TCP is made. To reduce congestion TCP congestion control [10] [11] is used when packet loss is detected.

TCP is well tuned for many applications that support Web access, file transfer and e-mail, which has become the de facto transport protocol in internet. The Internet has its widespread use within the wireless networks and wireless networks TCP provides reliable data transfer services for wired communications across the Internet [12]. TCP for wired internet in order to extend the wireless world is crucial to be well over the wireless network types. Given the specific challenges of wireless, TCP behavior to understand and improve the performance of TCP over wireless networks, has been considerable research and proposed various schemes.

The investigation is still active in this area, and many issues are still wide open, in hopes that the good readers of TCP over wireless networks to pinpoint the primary cause of performance degradation and solution covering the spectrum is state of the art in understanding the problems and propose solutions thus improved on the basis of the current ones .

TCP as a Transport Layer Protocol perform the flow control, error handling and Congestion control, and the state of modern technology methods of retransmission and fast recovery of selected acknowledgment, and how quickly and efficiently respond to network congestion.

By examining the TCP's performance studies over MANETs we identified the following major problems:

- TCP accesses are not the way to distinguish between losses due to network congestion and route failures.
- TCP accesses frequently suffer from route failures.

a) *Challenges in TCP Communication*

Wireless ad hoc networks are some of the features [12] of TCP performance that will significantly deteriorate if they do not do anything. Basically, these features, such as channel burst errors, mobility and communication asymmetry.

i. *Channel Error*

In Wireless channels, due to multipath fading and shadowing, high bit error rate of transmission occurs and it can corrupt packet transmission and may lead to loss of TCP data segments or ACK packets. If it does not receive ACK within timeout retransmissions, TCP congestion window of the sender as soon as a section of the RTO to significantly reduce the number of back and retransmits and lost packets. Channel errors can cause intermittent congestion window size by the sender to remain low, leading to low TCP throughput.

ii. *Mobility*

Due to user mobility, Wireless networks are characterized by handoffs. Typically, handoffs may cause temporary disconnections, due to packet loss and delay. TCP congestion will suffer many losses and unnecessary congestion control mechanisms to deal with such calls. Handoffs are expected to occur more frequently in the next generation mobile network should be allowed to adapt to the increasing number of users of micro-cellular structure. TCP could be worse things that cannot gracefully handle handoffs. Similar problems may occur in wireless LAN, mobile users will encounter during user mobility which cause disruption of network access due to the communication range.

The TCP equation-based approach within the TCP-friendly congestion control methods described by D. Bansal et al. in [3], Y.R. Yang in [2] is a method that relies on the TCP throughput in a network path with certain loss rate and round-trip time (RTT). The TCP equation method has demonstrated a reasonably good performance for wired networks, however has been found to decrease the performance of mobile ad hoc networks that recently led to the research of TCP friendly congestion control schemes for avoiding TCP's retransmission strategy which is expensive or unnecessary in real-time multimedia streaming applications.

A method of Explicit Congestion Notification (ECN) proposed by K. Ramakrishnan et al. in paper [15] evaluates the network congestion state, by marking a bit in passing packets IP header by each router to determine the possibility of network congestion, simultaneously monitoring the routers queue size. In this Explicit Congestion Notification approach the congestion is detected quickly however it does not give information about the size of the congestion. So the systems with ECN experience issues similar to those caused by AIMD algorithm over MANET.

IV. Congestion Control in Manets

MANETs will be crowded with limited resources. This network of shared wireless channel interference and fading at the time of packet switching and dynamic topology leads Victims and bandwidth packet deterioration due to congestion caused, and therefore, the time and energy are wasted on its recovery. By avoiding traffic congestion know the protocol to avoid using the affected links. Recognizing the serious problems of congestion problems related to the throughput degradation and fairness are huge [16].

Congestion control is the main problem associated with the incoming traffic control in a telecommunications network. The sending packets to prevent a wide range of intermediate nodes and networks, traffic control to reduce the rate used for congestive beaten or link capabilities. Traffic patterns, traffic control and dependability of the place and the presence of discontinuous directly without intermediate nodes are added by TCP to manage the traffic control without a clear opinion [17].

The principles of conservation of the packet, the additive multiplicative decrease in the growth rate of the fixed network are sending. End flow control system, traffic control network, including basic techniques and resources to control or prevent a traffic based on network traffic [18].

Mainly due to the obstruction caused by the failure of the packet MANETs. Mobility and adaptive routing network layer protocol over a failure to control congestion involving packet loss can reduce. Non-adaptive traffic carriers and operators face the following difficulties.

- Heavy Delay: Congestion control mechanism takes more time to find all the traffic. Sometimes it is advisable to use of new routes in critical situations. The main problem is the delay in the on-demand routing protocol in search of route.
- Heavy Overhead: To discover new paths for the traffic control system, Congestion management mechanism efforts are needed for the processing and communication. Multipath-routing protocol for managing multiple ways, even in spite of the hard effort it takes new protocol.
- Heavy Packet Lost: After the traffic load identified packet can be lost. Reducing the transmission rate at the sender or dropping packets at the intermediate nodes or both techniques were applied to control congestion. High rate of packet loss results in small bandwidth.

A new self-tuning RED for congestion control and QoS improvement in MANET [19] proposed by Jianyong Chen et al. increases the performance of TCP-RED network. The effects of the packet size and random early detection (RED) parameters [20] on trTCM and srTCM for congestion control and QoS improvement in MANET is studied by Hesham N. Elmahdy et al.

V. Congestion Detection in Manets

Incoming traffic is much larger than the capacity of the network traffic in a network that may occur during the particular period. End of the main problems affecting the performance of the entire network congestion and retransmissions of packets of data loss are rising. Recovery always leads to waste of time and energy, traffic congestion, packet loss and bandwidth levels. A variety of network routing algorithms have been used to reduce congestion [1].

Congestion can be classified into four different types:

- Immediate Congestion: This congestion is caused by mild bursts, created naturally by heaviness of IP traffic.
- Standard congestion: Under the manner in which the traffic capacity of the network or hop will be engineering.
- Flash congestion: The traffic bursts from individual sources add up to create the hills, where significant packet loss in a highly utilized network overload often refers to the momentary periods.
- Spiky delay: This is a condition where the number of packets is transmitted for a long time - a few milliseconds to tens of seconds of the packets transport delay from the time that shoots up.

Accurate and efficient detection sensor networks traffic congestion control plays an important role. Power and low cost in terms of computational complexity is the need for introducing new methods of traffic detection. Several methods are possible [21].

Kumaran et.al [22] proposed "Early Detection congestion and control routing" known as EDAODV. It is well ahead in time, and bi-directionally describes the findings of a non-congest hour looks for an alternative route. Kumaran et.al also proposed EDOCR [22] as "Early congestion detection and optimal control routing". It's rare in the general neighborhood, and network nodes and dense phases are separated, density of the network nodes are separated and a non-busy looking for an alternative way.

a) *Buffer Queue Length*

Queue length for traffic management is often used to identify the traditional data network. However, the queue length and link layer showed that the traffic indicator which can be used to link some of these applications can save weight for the indication of congestion and buffer utilization. It is based on buffer inductive functions traffic jam which is difficult to quantify the level of minimum or racing. Bimodal effect is responsible for the smooth and effective enough, and traffic control, to provide a very coarse [9].Peter Marbach [24] proposed a distributed scheduling and congestion control and QoS in the network for the development of active queue management mechanism for wireless adhoc networks based on a random-access scheduler.

For network congestions active-queue-management (AQM) strategies for managing traffic problems and a reduced effective buffer of a node based on prevention rules proposed by many researchers [25], such as RED [26] – "Random Early Detection", "Random Exponential Marking", etc. Braden proposed RED which describe the average size of the queue by monitoring the traffic of the future for the sake of the next generation Internet routers, among others, is approved by the IETF. Future study on buffer overflow traffic at the MAC layer and the network layer by supporting a non-traffic congestion problem by finding solutions that will give narrow solution. This strategy of avoiding or cutting of packet loss, delay and the amount of the reduction will be applied for improving the performance of the network.

An active queue management algorithm, termed as BLUE is proposed and evaluated by Wu-chang Feng, et al. [27]. The performance of blue is comparatively better than RED. Also another algorithm, Stochastic Fair BLUE (SFB) proposed for queue management use an infinitesimal amount of state information to identify and rate-limit nonresponsive flows.

b) *Channel Loading*

Channel load in the network is busy, but in fact, it provides detailed information about the local mitigation mechanism. Limited force, for example, the data traffic caused by the thrust generated by the high-level sources in large-scale congestion detection is low. Listening to channel a large part of the energy is consumed in a node [9].

In MANET networks, reducing the end-to-end delay and amount of traffic methods are proposed by Ehssan Sakhaee et al. [28]. Other benefits arising are linked to the duration of the growth, reduction in end-to-end delay, the less disturbance of the flow of data and lower path settings. In this mechanism, a new procedure is employed for route discovery unlike earlier reactive routing protocol in which only disjoint paths are chosen. A unique routing algorithm reduces the frequency of flood requests by extending the duration of the link.

VI. Congestion Problems in Manets

TCP provides a reliable communication link; because it uses the basic technique confirm data delivery, but more delay as compared to the UDP packet, so that if the sender share a common intermediate node, that congestion increases, and the maximum delay. A TCP packet loss due to congestion of the wireless channel errors, link approval, mobility and multi-path routing for mobile ad-hoc networks that can significantly harm because of an implicit supposition is invalid, TCP, networks (MANETs) mobile in the delivery of packages poorly run or disordered.

Adjusting the data rate used by each sender to avoid burdening the network with a network of shared resources is a necessary condition where multiple senders to fight for the channel capacity. Packets that cannot be transferred, removed when they arrive at the router. Accordingly, an excessive number of packets destined for the network bottlenecks leading to numerous discards the packet. These missing packets may have already passed a long path of the network, and thus, considerable resources are devoured. In addition, the transfer of power on even more lost packets, which is a sign of additional packets sent over the network. These factors result in a serious deterioration in the network throughput capacity and if the appropriate measures are not taken for the traffic control network congestion, resulting in the collapse and a zero delivery of data. This situation occurs at the early Internet, which leads to the development of the mechanism of congestion control TCP [8][18].

VII. Congestion Control Techniques for Adaptive Routing

Congestion adaptive routing protocol (CARP) that appears to control a route, will alert the node of congestion is likely to happen at all [29]. Thereafter, the node "bypass" in order to take a detour route to avoid congestion using non-congestion in the potential of the first node. When this happens, use the previous node a "bypass" the route to take a detour to avoid the potential overloading of the first non-congested node on the route. L. Shrivastava et al. [30] present a study of congestion adaptive routing protocols and congestion aware routing in DLAR - Dynamic Load-aware Routing, CADV - Congestion Aware Distance Vector, CARM - Congestion Aware Routing Protocol for different MANETs.

a) *Congestion Monitoring*

For a node to keep a check on the state of congestion, you can use a variety of metrics. Some key is the percentage of all queue length, packets retransmitted, standard delay and packets dropped. Increase of packet drop indicates that congestion is springing up. Either method can work virtually with CARP. The three levels of congestion that are more nodes and categorized as “red”, green” and “yellow” If a node from it being very busy, "yellow", "green" is free from congestion as "red" and more likely or already crowded.

b) *Primary Route Discovery*

Broadcaster receiver is to find a way to upgrade the receiver to transmit a package. REP packet sent by the sender to the receiver, which is the first copy, upgrade to meet. REP update before the return is the same way. This will be the primary route between the sender and recipient. Nodes along this route will be called as the first node. Both tactics are often employed by us to the discovery of the route to reduce traffic and provide advance hold on the congestion problems: (1) Upgrading dropped which already have a path to get to the destination, and (2) if it reaches a node is upgraded to a "red" status if a packet is dropped due to node congestion [29].

c) *Traffic Splitting and Congestion Adaptability*

The probability p of transmitting data from the beginning of the first link is set to 1, which must pass through each node. Periodic changes in the status of the next node based on the path congestion bypass overload. Congestion status of each node state funded pass-through. The important thing is that we must increase the amount of traffic on main line, if the main channel leading to less congestion and reduce a node.

d) *Multi-path Minimization*

The protocol is aimed at reducing the use of multiple ways to reduce the burden of CARP. P is the probability of the node to the next head long bypass overloaded or very busy, suggests that there is a way to send data over 1.0, if the base value is approaching. In this case, the bypass current node is excluded. The next primary node is too busy, then bypass routes or disabilities, as well as the main channel, will be required. CARP is only a pass-through to the nodes, the protocol is a very simple and light. Through the use of a bypass, burden is reduced because of the short length of the bypass. The first node must be connected to the bottom of each bypass the load after only a few hops, not a crowded place.

e) *Failure Recovery*

CARP elegantly and quickly take the help of a link to bypass the currently available that is capable of recommencing a popular routing protocol connectivity after breakage.

An end-to-end threshold-based algorithm developed by Mohammad Amin KheirandishFard et.al [31] improves congestion control and deals with link failure loss in MANET.A single queue variant of Start time Fair Queuing (SFQ), S-SFQ is proposed by Yuming Jiang et al. [32] which are accountability mechanism for the efficient flow control, congestion avoidance. RED and FIFO queue schemes as compared to other single-link the use of S-SFQ performance is superior flow constraints with respect and fairness.

Lijun Chen et. al. [33] proposed temporary traffic control for wireless networks, a combination of routing and scheduling. They refer to different types of networks and the ability to allocate resources in the network as the ratio between the generating utility problem previously with limitations, dual algorithm further increased to manage the network with a different channel and controlling device multi-rate for the high congestion control and quality of service in MANET.

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VIII. Conclusion

In this paper we have explored the congestion control techniques used in mobile adhoc networks. Congestion in adhoc networks can be controlled either through routing or using the standard TCP congestion control mechanisms used in wired networks with modification and compatibility for wireless networks. Due to high node mobility and topology changes, the TCP control techniques applied to adhoc networks are inadequate to handle congestion. Heterogeneity of application scenarios does not let a conclusion and general-purpose solution for all possible scenarios of MANET applications. Thus, there is still considerable scope for solutions is open to solve problems of overloading and congestion issues. In future research work we will present a congestion prediction algorithm, a traffic data prioritization approach and a traffic normalization approach for congestion avoidance in mobile ad hoc network for achieving high quality of service, minimizing the delay.

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