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A Review of Congestion Control in MANET

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Abstract: **Congestion is a important factor, in estimating the quality of network. It also determines the dependability and sustainability of a network. Congestion is an unwanted situation in networked systems. "Congestion Control" means the mechanism of fighting congestion, which makes sure the resources are used optimally and the system has maximum data throughput with the given conditions. Due to popularity of wireless ad hoc network technology in the market it has become necessary to study and manage the effects of congestion in the wireless networks. Although TCP was initially designed and optimized for wired networks, the rising popularity of wireless data applications has lead third generation wireless networks such as CDMA2000 and UMTS networks to extend TCP to wireless communications as well. Rate based congestion control or buffer based congestion control method by which the network bandwidth is distributed across multiple end to end connections.**

***Index Terms*— Congestion Control, Proactive and reactive control, Need for congestion control in networks, EERCCP.**

I. INTRODUCTION

Numbers of techniques and applications have been used usually for transmitting information through heterogeneous wireless networks. In general, a wireless network may belong to one of the two types: infrastructure network and ad hoc network [1]. Wireless Ad Hoc Networks are multi-hop wireless networks. A Wireless Ad Hoc Network consists of mobile platforms (e.g.a router with multiple hosts and wireless communication devices) – herein simply termed to as "nodes" – which are free to move about arbitrarily. Figure 1-1 is an example Ad Hoc network which uses gateways as the connection between the wired and wireless parts, which is referred to as a Wireless Ad Hoc Access Networks [2].

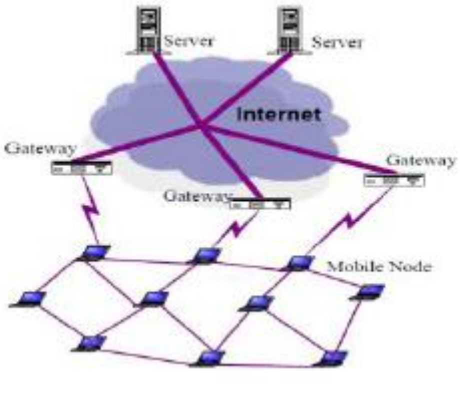

Figure 1: An Example Wireless Ad Hoc Access Network [2].

Congestion control

When the number of packets increases beyond the maximum value that can be handled by the network resources which results degradation in network performance is called congestion. Congestion is an unwanted situation where network face the problem of more traffic than its rated capability. Congestion is overcrowding or blockage due to overloading. Congestion control technique is the method by which the network bandwidth is scattered across multiple end to end connections [8]. Congestion can be rate based congestion control or buffer based congestion control [3].

Window Based Congestion Control:

In Window based congestion control; the sender window size is calculated by the available buffer size in receiver (rwnd).

Rate Based Congestion Control

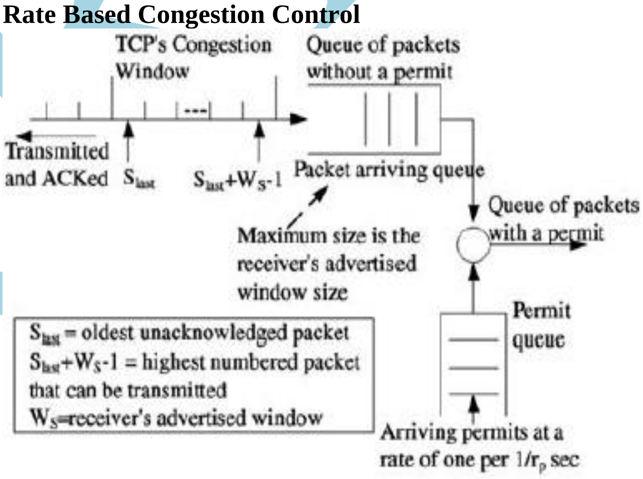

Figure 2: Rate control mechanism

TCP's congestion prevention mechanisms are not tuned for request-response traffic like HTTP. One such problem has to do with some TCP implementations forcing slow-start in the middle of a connection that has been inactive for a certain amount of time, even if there is no packet loss. Other existing TCP implementations do not treat idle time as a special case and use the prior value of the congestion window to send data. It can lead to deprivation of performance.

Rate based algorithms requires the following changes to TCP:

1. Idle time detection and warning that RBP requests to be started.
2. Bandwidth estimation.
3. Calculation of the window that we expect to send in RBP and the timing between segments in that window.
4. A mechanism that clocks the segments sent in RBP [4].

Proactive and reactive control

Congestion is the loss of utility to a user due to an increase in the network load. Hence congestion control is defined to be the set of mechanisms that avoid or reduce such deterioration. Practically speaking, a network can be said to control congestion if it provides each user with mechanisms to denote and achieve utility from the network. For example, if some user desires low queuing delays, then the system should provide a mechanism that allows the user to achieve this objective. If the network is unable to avoid a loss of utility to a user, then it should try to limit the loss to the extent possible, and, further, it should try to be fair to all the affected parties. Thus, in reservation less networks, where a loss of utility at high loads is inevitable, we are concerned not only with the extent to which utility is lost, but also the degree to which the loss of utility is fairly circulated to the affected users. A network can provide utility in one of two ways. First, it can request that each user specify a performance requirement, and can reserve resources so that this level of performance is always accessible to the user. This is proactive or reservation-oriented congestion control. Alternatively, users can be allowed to send data without reserving resources, but with the prospect that, if the network is heavily loaded, they may receive low utility from the network. The second method is applicable in reservation less networks. In this case, users must adjust to changes in the network state, and congestion control refers to ways in which a network can allow users to detect changes in network state, and corresponding mechanisms that adjust the user's flow to changes in this state. In a proactive scheme, the congestion control mechanism is to make reservations of network resources so that resource availability is deterministically assured to admitted conversations. In a reactive scheme the owners of conversations need to monitor and react to changes in network state to avert congestion [5]

Advantages and disadvantages of proactive &reactive control.

Proactive control

Users can be guaranteed that they will never experience loss of utility. On the other hand, to be able to make this guarantee, the number of users has to be restricted, and this could lead to underutilization of the network.

Reactive control

It allows much more flexibility in the allocation of resources. Since users are typically not guaranteed a level of utility by the network, resources can be statistically multiplexed.

However, there is always a chance that correlated traffic bursts will overload the network, causing performance degradation, and hence, congestion. It is important to realize that proactive and reactive controls are not mutually exclusive. Hybrid schemes can combine aspects of both approaches. One such hybrid scheme is for the network to provide statistical guarantees. For example, a user could be guaranteed an end to end delay of less than 10 seconds with 0.9 probabilities. These statistical guarantees allow a network administrator to overbook resources in a controlled manner. Thus, statistical multiplexing gains are aquired, but without completely giving up performance guarantees. Another hybrid scheme is for the network to support two types of users: Guaranteed service users and Best-effort users. Guaranteed service (GS) Users are given a assurance of quality of service, and resources are reserved for them. Best-effort (BE) [6]

CONGESTION CONTROL PROTOCOL IN (MANETs)

Congestion is condition in communication network when too much traffic is offered and the Congestion on MANET leads to Packet losses, Bandwidth degradation, Wasting of time (i.e. long delay), High overhead. So, many routing protocols have been used to overcome the congestion in MANET.

AODV

It is one of the popular routing protocols and is used to send the messages over MANET and also to surmount the congestion in MANET. But, it depends on individual receivers to detect congestion and adjust their receiving rates.

EERCCP

It is better than AODV but sometimes it fails when relay node gets in problem cause there is no other mechanism to select an alternative relay nodes i.e. Lack of cooperativeness [5].

Need for congestion control in networks

Congestion is a severe trouble in current reservation less networks. However, in networks the available bandwidths and switching speeds will be several orders of magnitude larger.

Why should congestion arise in such networks?

There are several reasons:-

Large bandwidth-delay product

The service rate of a circuit multiplied by the round trip time determines the amount of data that a conversation must have outstanding in order to fully utilize the network. The round trip time is bounded from below by the speed-of-light propagation delay through the network. Hence, as the raw trunk bandwidth and the service rate of a conversation increases, so does the amount of outstanding data per conversation.

Speed Mismatch

If a switch connects a high speed line to a slower line, then a Conversation can, when sending data at the peak rate, fill up its buffer share, and subsequently lose packets at the switch. This creates congestion for loss-sensitive conversations. This source of congestion will persist in high-speed networks; in fact, it is probably more likely in such networks.

Topology

If several input lines simultaneously send data through a switch to a single outgoing line, the outgoing line can be overloaded, leading to large queuing delays, and possible congestion for delay-sensitive traffic. This is a special case of the speed mismatch problem noted earlier.

II. LITERATURE SURVEY

T. Senthil kumaran et al. (2013) In mobile ad hoc networks (MANETs), congestion can occur in any intermediate node, often due to restriction in resources, when data packets are being transmitted from the source to the destination. Congestion will lead to high packet loss, long delay and waste of resource utilization time. The principal objective of congestion control is to best utilize the available network resources and keep the load below the capacity. The congestion control techniques to deal with TCP have been found insufficient to handle congestion in ad hoc networks, because ad hoc networks involve special challenges like high mobility of nodes and frequent changes of topology. This paper suggests a method for dynamic congestion detection and control routing (DCDR) in ad hoc networks based on the estimations of the average queue length at the node level. Using the average queue length, a node detects the current congestion level and sends a warning message to its neighbors. The neighbors then attempt to locate a congestion-free alternative path to the destination. This dynamic congestion approximate mechanism supporting congestion control in ad hoc networks ensures reliable communication within the MANET. According to simulation outcome, the DCDR showed better performance than the EDOCR, EDCSCAODV, EDAODV and AODV routing protocols.

Parminder Kaur et al. (2013) Transmission Control Protocol (TCP) is a reliable, end-to-end transport protocol, which is most broadly used for data services and is very efficient for wired networks. However, experiments and research showed that TCP's congestion control algorithm performs very badly over Wireless Ad Hoc Networks with degraded throughputs and severe unfairness among flows.In this paper, a deep study has been conducted in order to study the factors of reason congestion in an ad hoc wireless network. Our main focus in this report has been to simulate and study the effect of change in topology and number of users on network congestion. Apart from that, the impacts of network congestion and the importance of its study have also been highlighted. Congestion is a critical factor, in determining the quality of network. It also finds out the dependability and sustainability of a network. Deploying new network infrastructure to tackle congestion problem is not economically viable solution, hence it is important to understand the reasons after such network operation conditions and then design suitable methods to overcome them. In this paper, various network behaviors' have been simulated using OPNET Modeler 14.5 to learn how node's buffer space gives impact to the in-flight packets in ad hoc environment by also taking mobility and power consumption into consideration.

Anju et al. (2015) An ad-hoc wireless network is a collection of wireless devices which for temporary network without the aid of any established infrastructure or centralized administration. Though traffic control seems to be an effectual method for controlling congestion, it presents a number of drawbacks which are not easy to ignore. The most important drawback steams from the fact that elevated traffic load occurs when the monitored event takes place. At this instance there is a higher probability of congestion occurrence in the network. "Congestion Control" is a mechanism which confirms that resources are used optimally & the system has maximum throughput for the given condition. The main aim of the congestion control is to assure that system is running at its rated capability even in worst condition (overload situation). By controlling the rate with which packets are injected in the network, the amount of information that reaches the data sinks minimizes. This fact can jeopardize the purpose of the network. Moreover, network connectivity issues arise since in most cases, this approach utilizes the shortest path from source to sink. Thus, in case of heavy data burden, this path of nodes can easily become power exhausted. To achieve this, author take advantage of the fact that mobile nodes are frequently redundantly and/or densely deployed. In this thesis, author focus on congestion detection and prevent the congestion using Ad hoc on demand routing protocol (AODV) using MATLAB.

Alhamali Masoud Alfrgani et al. (2014) Congestion control in wireless networks has been extensively investigated over the years and several schemes and techniques have been developed, all with the aim of improving performance in wireless net-work. With the speedy expansion and implementation of wireless technology it is essential that the congestion control problem be solved. This paper gives a congestion control schemes which are different in slow start threshold calculation, bandwidth estimation, and congestion window manipulation. A comprehensive comparison of these strategies is given in relation to assumptions, bandwidth estimation, congestion window size manipulation, performance evaluation, fairness and friendliness and improved throughput.

Md. Imran Chowdhury et al. (2012) this paper presents energy efficient and cooperative congestion control protocol to control the congestion in mobile adhoc networks (MANETs). The proposed method overcomes the disadvantages of existing multicast congestion control protocols which depend on individual receivers to detect congestion and adjust their receiving rates. In the first phase of the projected protocol, it builds a cooperative multicast tree rooted at the source, by including the nodes with higher residual energy towards the receivers. In the second phase of the projected protocol, it proposes an admission control scheme in which a cooperative multicast flow is admitted or rejected depending upon on the output queue size. In the third phase of the projected protocol, it proposes a scheme which tests whether the relay node has the potential path to the required destination, if not then choose the another node which has the second highest left over energy as a new relay node. That is more generally introduction of cooperativeness and making it. In the fourth phase, we propose a scheme which adjusts the multicast traffic rate at each bottleneck of a multicast tree. Because of the immediate information collection and rate control, this scheme has very limited control traffic overhead and delay. Moreover, the proposed scheme does not impose any important changes on the queuing, scheduling or forwarding policies of existing networks. Simulation results shows that the proposed protocol has better delivery ratio and throughput with less delay and energy expenditure when compared with existing protocol.

Addisu Eshete et al. (2011) This paper presents S-SFQ which is a single queue design and implementation of the well-known Start-time Fair Queueing (SFQ). This collective queue orders packets based on their timestamps rather than order of arrivals. Through simulation, define the performance gains of S-SFQ over other default single-queue schemes such as RED and FIFO in terms of link utilization and flow fairness. When sources implement end to-end (e2e) congestion control, S-SFQ can fairly estimated the fairness, both simple and weighted, of per flow queues. In addition, discuss in detail the adverse effect of packet loss synchronization problem common in such collective queues. The qualities of aggregate queue based router scheme may easily and single-handedly be taken away by this problem. Loss synchronization may surface during overloaded (rather than early) drops when the buffer becomes filled (e.g., FIFO) or certain (upper) buffer thresholds are exceeded (e.g., RED).Index Terms—Fairness, Scheduling, Queuing, SFQ,

Michael Menth et al. (2012) Pre congestion notification (PCN) is a packet-marking technique for IP networks to notify egress nodes of a so-called PCN domain whether the traffic rate on some links exceeds definite configurable bounds. This feedback is used by decision points for admission control (AC) to block new flows when the traffic load is already high. PCN-based AC is simpler than other AC methods because interior routers do not require keeping per-flow states. Therefore, it is currently being standardized by the IETF. We discuss various realization options and study their performance in the presence of flash crowds or with multipath routing by means of simulation and mathematical modeling. Such situations can be aggravated by insufficient flow aggregation, long round-trip times, on/off traffic, delayed media, unsuitable marker configuration, and smoothed feedback.

Brachman, B. et al. (1998) presents a framework for the design of application level store-and-forward message move systems. Flow control and congestion control issues in the message handling environment are discussed. A new model for message transport, the message stream, is proposed as the basis of the flow and congestion control functionality. Important design aspects, including message fragmentation and management of transit and recipient buffers are addressed.

Ref. No.	**Year**	**Tech/Method used**	**Findings**
1	2013	Dynamic congestion detection and control routing in ad hoc networks	The DCDR algorithm shows considerable performance over the EDOCR,EDAODV, EDCSCAODV and AODV
2	2013	A Systematic Approach for Congestion Control in Wireless Ad hoc Network using Opnet.	The changes of node's buffer space availability in ad hoc environment plays an important point in order to have better the network performance.
3	2015	Modified AODV for Congestion Control in MANET	Traffic control method is an effective method for transient congestion occurrences but can be proven inappropriate when application needs all data to be transferred to sink.
4	2014	Congestion Control Technique for Wireless Networks	The need for an efficient method to optimally utilize available bandwidth is essential in the wireless links of combined wired and wireless networks.
5	2012	EECCCP protocol	protocol EECCCP, incorporates the benefits of energy efficiency and cooperativeness which in turn reduces the congestion effectively.
6	2011	intuitive SFQ design using a single queue.	S-SFQ fairness performance can be Heavily impaired. The problem may manifest itself during full buffers in FIFO and S-SFQ and forced drops in RED.
7	2012	Performance of PCN-Based Admission Control Under Challenging Conditions	to add probe traffic in case of empty ingress–egress aggregate showed that this solves observed problems.
8	1998	A new model for message transport, the message stream, is used as the basis of the flow and congestion control functionality	Considerably improves the system

III. CONCLUSION

Congestion control techniques have been mainly designed for multimedia applications. Network characteristics like congestion and route failure need to be detected and remedied with a reliable mechanism. To solve the congestion problem lots of techniques and methods suggested. DCDR is a uni-cast routing protocol for MANET. It reduces network congestion by ways of reducing the needless flooding of packets and finding a congestion-free path between the source and the destination. The need for an efficient method to optimally utilize available bandwidth is essential in the wireless links of combined wired and wireless networks. Congestion control protocol (EECCCP) overcomes the disadvantages of existing multicast congestion control protocols such as AODV and EERCCP. The protocol EECCCP, incorporates the benefits of energy efficiency and cooperativeness which in turn reduces the congestion effectively. Larger node's buffer size and also elevated power level at even a random mobility will makes network performance degradation more serious compared to the "small node buffer".

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