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A Survey of Routing Protocols Based on Bandwidth

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Abstract:
Quality of service (QoS) in Mobile Ad-hoc Network (MANET) which is universally growing area. A mobile ad-hoc network is a collection of mobile devices which form a communication network with no pre-existing infrastructure. Due to rapid expansion of multimedia technology, mobile technology and real time applications has need to strictly support quality of service such as throughput, delay, energy consumption, jitter etc. For obtaining QoS (Quality of Service) on a MANET, it is not sufficient to provide a basic routing functionality. Other aspects should also be taken into consideration such as bandwidth constraints due generally to a shared media, dynamic topology. This paper present the details of survey of routing protocols based on Bandwidth.

Keywords: *Mobile Ad-hoc Network, QoS, AODV, Bandwidth Estimation, Routing Protocol*

1. Introduction

Ad hoc networks are networks that can be rapidly deployed .They do not rely on pre-existing infrastructure and set of nodes is continuously changing. An Ad Hoc network self adapt to the connectivity, propagation patterns and adapts to the traffic and mobility patterns. However there are some challenges in Ad Hoc network which includes limited wireless transmission range, broadcast nature of the wireless medium, packet losses due to transmission errors, mobility-induced route changes/packet losses, battery constraints and Ease of snooping on wireless transmissions. This is illustrated in Figure 1.Suppose, node C wants to communicate with node A. At time t1, the routing path is C→E→A. At time t2 (>t1), node E moves out of range of node C. Because of this, the changed route for node B at time t2 is C→B→A.

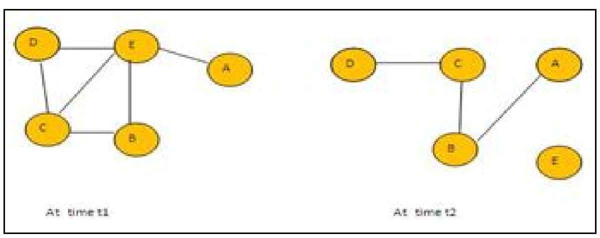

Figure 1: Node Mobility

2. QoS in MANETs

A set of service requirements that should be satisfied by the network when routing is performed, is defined as QoS in MANETs[3]. Set of measurable requirements are maximum delay, minimum bandwidth, minimum packet delivery ratio, and maximum jitter. The network has to ensure that the QoS requirements of the data session are satisfied throughout the connection duration by checking all the QoS metrics at the time of connection establishment, and once a connection is accepted. The above-mentioned QoS metrics are used by applications to specify their QoS requirements. QoS requirements can be defined in terms of a set of metrics. For example, a network topology is displaying in which an application at node A has certain bandwidth (BW >= 5 kbps) and delay (D <= 5 ms) requirements. A route (A→F→G→H→E) is selected by QoS-aware routing protocol that satisfies the QoS requirements of the application instead of selecting the shortest path (A→B→D→E). Providing a multiconstrained QoS aims at optimizing multiple QoS metrics while provisioning QoS over MANETs and is, literally, a complex task.

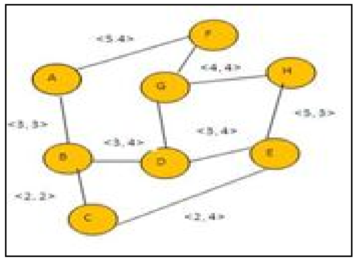

Figure 2: Bandwidth aware routing
Tuple <BW,D>

3. AODV

The AODV Routing Protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. In an on-demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest.

A RouteRequest carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), the destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the time to live (TTL) field. DestSeqNum indicates the freshness of the route that is accepted by the source. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination. The validity of a route at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the RouteRequest packet. If a RouteRequest is received multiple times, which is indicated by the BcastID-SrcID pair, the duplicate copies are discarded. All intermediate nodes having valid routes to the destination, or the destination node itself, are allowed to send RouteReply packets to the source. Every intermediate node, while forwarding a RouteRequest, enters the previous node address and its BcastID When a node receives a RouteReply packet, information about the previous node from which the packet was received is also stored in order to forward the data packet to this next node as the next hop toward the destination.

Increasing demands of various multimedia applications over mobile ad-hoc networks (MANETs) requires various quality-of-service (QoS) provisioning solutions in these networks. In these QOS metrics, bandwidth is the most important QoS metric because delay and jitter can be control up to some extent by controlling the required bandwidth of a multimedia application.

4. Bandwidth Estimation Techniques

In MANET, a host’s available bandwidth refers to amount of bandwidth available to the node to send packets to the network. Many researchers have proposed different methods for Bandwidth estimation.

4.1. Perceptive Admission Control (PAC) protocol

I.D. Chakeres and Elizabeth M.B.Royer[5] proposed Perceptive Admission Control (PAC) protocol that monitors the wireless channel and adapts admission control decisions dynamically to enable high network utilization while preventing congestion. They presented simulation results that show that PAC minimizes loss and delay for all admitted flows. For successful packet reception, they referred sender and receiver are separated by at max R*R and to avoid any possible receiver interference, two senders are separated by at least 2*R*R+RID. For any node, its PAC based available bandwidth measurement is sufficient to make an admission control decision. Two issues are addressed in PAC 1) shared wireless bandwidth and 2) node mobility. PAC is able to compute its available bandwidth and determine whether a flow can be admitted by sensing all transmissions that may interfere. For calculating the available bandwidth, each source adapt its admitted traffic flows to changing wireless channel use. Using results they show that PAC avoid congestion effectively by limiting the amount of data traffic. So throughput is consistent, packet loss and delay are minimize for all admitted flows. That can be explore multiple priority MAC layers i.e. IEEE 802.11e. PAC can be extended to determine the relative utilization of each priority. PAC can be implemented further in a real system to prove its feasibility. Bandwidth consumption of flows and available resources to a node are not only local concepts but also related to the neighboring nodes in carrier-sensing range.

4.2. Contention-aware Admission Control Protocol (CACP)

Yaling Yang and Robin Kravets [6] presented an efficient admission control framework—Contention-aware Admission Control Protocol (CACP),that supports QoS in MANET. They focused on MANET based on single-channel MAC layers like IEEE 802.11. CACP provide QoS guarantee in terms of bandwidth allocation. The main goal of CACP is to maintain bandwidth levels for existing flows and to determine whether the available resources can meet the requirements of a new flow. There are two challenges for CACP to achieve this goal.

1) Prediction of Available Bandwidth - The first challenge for CACP is evaluating the available bandwidth in the network so that the bandwidth requirements of all the flows do not exceed the resources in the network. Bandwidth is estimated in two terms

a) Calculation of Local Available Bandwidth- unconsumed bandwidth at a given node is defined as local available bandwidth.

b) Prediction of c-Neighborhood Available Bandwidth- Maximum amount of bandwidth that a node can use for transmitting without depriving the reserved bandwidth of any existing is defined as C-neighborhood available bandwidth. flows in its carrier-sensing range (c-neighborhood)
2) Bandwidth Consumption - The second challenge for CACP is to quantify the bandwidth that a new flow will consume so that it can be decided whether the available bandwidth can satisfy the requirements.
Simulations results showed that by controlling bandwidth allocation, delay and jitter can also be controlled. Their main focused on the inclusion of information from nodes inside carrier-sensing range and outside transmission range during the admission control process. Using results they showed that CACP effectively manages requests for bandwidth beyond the capabilities of the network, imposing acceptable or even reducing the control message overhead on the network. CACP can be combined further with many existing QoS protocols, such as QoS-aware MAC protocols or end host policing protocols.

4.3. QoS-aware routing protocol

Lei Chen and Wendi B. Heinzelman [7] proposed a QoS-aware routing protocol that incorporates an admission control scheme and a feedback scheme to meet the QoS requirements.This routing protocol use of the approximate bandwidth estimation. There are two phases in QoS routing protocol. The route discovery phase and the bandwidth reservation phase. In the route discovery phase, feasible route is discovered using AODV routing protocol and the minmax approach to choose the route that is most likely to satisfy the QoS requirement. In the bandwidth reservation phase, according to how many neighbouring hosts' free time slots are blocked by this time the weight of each available time slot is calculated by the hosts in the chosen path. There are two scheme in proposed QoS-aware routing protocol, first one is feedback scheme that provides feedback about the available bandwidth to the application and second one is admission scheme that admits a flow with the requested bandwidth .Knowledge of available bandwidth along the route is required for both schemes.So they focused on exploring different ways to estimate the available bandwidth, incorporating QoS. It is must to know available end to end bandwidth along a route. By estimating the bandwidth QoS can be provided. This can be achieved by finding the minimal residual bandwidth available among the hosts in that route. For bandwidth estimation they used two methods.

- Listen‖ Bandwidth Estimation
- Hello‖ Bandwidth Estimation

They gave some results that show that QoS aware routing, the packet delivery ratio remains constantly above 90%, and the delay remains lower than 0.17s. they showed that packet delivery ratio is improved in our QoS-aware routing protocol and does not affect the overall end-to-end throughput. This protocol also decreases the packet delay and the energy consumption. This protocol does not have any predictive way to foresee a route break. Because route break causes a performance degradation in mobile topologies. That can be further improved by incorporated some techniques to achieve required level of QoS

4.4. B-AODV

Xu Zhen, Yang wenzhong [8] presented an algorithm for efficient distributed timeslot assignment. That algorithm used AODV route discovery mechanism to achieve bandwidth-aware QoS routes — B-AODV. In simulation results they showed that packet delivery ratio is increased and end-to-end average packet delay is improved in proposed QoS routing algorithm. Their main focus was to schedule the communication links such a way that any two links in the same timeslots never interfere with each other. The basic working of proposed protocol was that

- A suitable route is selected by Source node for the destination, before starting the transmission. - Delay requirements and bandwidth requirement should be satisfied.
- AODV routing protocol was chosen.
- Assumption was that a connection only uses a single path for transmission. So to provide X bandwidth on a path it is necessary for each node along the path to find at least X slots to transmit to its neighbors'.

Protocol	**Local Bandwidth Estimation**	**Basic Routing Type**	**Cs-neighbor bandwidth estimation process**	**Mobility and QoS violation Detection process**	**Route failure handling method**	**Other Features**
PAC [5]	Channel Idle time Ratio (CITR)	DSR (proactive and source routing)	Passive channel monitoring with low cs-threshold value	Pause effected routes re-routed	Discover fresh routes	Consideration of inter-contention and intra-contention

CACP [6]	Channel Idle time Ratio (CITR)	Source-routing (Combination of AODV and DSR protocols)	Three methods are proposed: passive channel monitoring, querying explicitly and use of higher powered transmission	Data flows are unable to get their requested bandwidth	Pause or reroute the effected sessions and discover new routes	No support to handle mobility and use the cache info if second stage of AC fails
Q-AODV [7]	Channel Idle_time/Busy_time * Weighting_fuN	Reactive (i.e., AODV) or hop-by-Hop	Using Periodic HELLO packet dissemination process	Once admitted session is not monitored for QoS	Update bandwidth using forced HELLO message initiation	Not checking for intra-contention and also the Mobility issues are not handled properly
B-AODV [8]	TDMA-based timeslot assignment	Channel Idle time Ratio (CITR)	Not application as channel is divided in timeslots	Not handled in the protocol	Re-routing is done if any free time-slot is available	exchange local information of timeslot allocation with its neighbours

Table 1: Comparison of Bandwidth Aware Routing Protocols

5. Conclusions and Future Scope

In this paper we have compared bandwidth aware routing protocols with various unique features that incorporate QoS metrics in route finding. We focused on various techniques for estimating the available bandwidth. In PAC and CACP protocols bandwidth estimation is based on chanel Idle Time Ratio (CITR) whenever in Q-AODV, bandwidth is estimated using Channel Idle _time/Busy_time * Weighting_fun and in B-AODV,it is based on TDMA-based timeslot assignment. and discussed bandwidth estimation techniques, routing types, Cs-neighbor bandwidth estimation process, mobility and QoS violation detection process, route failure handling method and other features of these protocols. In the future, to improve end to end throughput we intend to come up with a protocol that incorporate Session Admission Control (SAC) with Cross-layer Communication Module (CLM).

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