Global Journal of Computational Intelligence Research.
ISSN 2249-0000 Volume 2, Number 1 (2012), pp. 15-20

http://www.ripublication.com/gjcir.htm

Adaptive Congestion Control in Ad-hoc Network

Maninder Jit Kaur

Research Scholar,
Dravidian University, Kuppam, Andhra Pradesh, India

Abstract

In mobile ad hoc network congestion is common today. As load on network increases congestion too becomes serious problem. It leads transmission delays and packet losses and causes wastage of time and energy on recovery. Presently, routing protocols are designed to have congestion aware, but not congestion adaptive. These protocols handle the congestion but results longer delay and lost of packets. Also, causes overhead if any new route is needed. This problem increases in case of large-scale transmission of heavy traffic such as multimedia data, where probability of congestion is more and the negative impact of packet loss on the service quality is of more significance. In this paper an adaptive congestion control method is proposed, in which some routing protocols are used for adaptive congestion control. There are considered four popular routing protocols such as AODV, DSR, DSDV and TORA to analyzing the performance of the system.

Keywords: MANET, AODV, DSR, DSDV, TORA

Introduction

Network congestion occurs when a link or node is carrying more data than it can handle. Network congestion causes queuing delay, packet loss or the blocking of new connections. Network protocols which retransmit the lost packets cause further congestion in network.

Wireless ad hoc networks

A wireless ad-hoc network is a wireless network which does not depend on any preexisting infrastructure, as routers rely in wired networks. In this network, each node forward data for other nodes. Ad hoc networks can use flooding for forwarding

the data. The earliest wireless ad-hoc networks were the "packet radio" networks (PRNETs) from the 1970s, sponsored by DARPA after the ALOHA net project. Wireless ad-hoc networks are suitable for a variety of applications where central nodes can't be dependent, due to its decentralized nature. Also scalability of wireless ad-hoc networks is better than wireless managed networks. Ad hoc networks are suitable for emergency situations like natural disasters or military conflicts because of its minimal configuration and effective use.

Classification of Wireless ad hoc networks

Wireless ad hoc networks can be further classified on the basis of application:

- mobile ad-hoc networks (MANET)
- wireless mesh networks (WMN)
- wireless sensor networks (WSN)

Mobile Ad-hoc network (MANET)

A mobile ad hoc network (MANET) is a wireless network, consisting of many mobile nodes connected by wireless links. Each node functions not only as an end-system, but also as a router and depends on each other to keep the network connected. In MANET, nodes are free to move randomly in any direction and change their links to other devices frequently. This random behavior of ad hoc networks causes the topology of wireless network to be hanged rapidly and unpredictably. The growth of laptops and 802.11/Wi-Fi wireless networking has made MANETs a popular research topic since the mid 1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measure such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput etc.

Congestion control

Congestion in network generally means excessive traffic or crowding in network. Congestion occurs when the source sends more packets than the destination can handle. When this congestion occurs performance will degrade. Congestion leads to delay in packets or even loss of packets. Congestion is disastrous for any network. It becomes necessary to control congestion.

Congestion control is categorized in to two types, depending on how the congestion state of the network is measured, implicit congestion control, and explicit congestion control.

1. Implicit Congestion Control: Implicit congestion control is based on end-to-end measurement i.e. the end-systems measure the network congestion state.
2. Explicit Congestion Control: This type of congestion control relies on intermediate gateways, i.e. routers, to measure the network congestion state.

Routing protocols

Various protocols are there for congestion control:

- AODV
- DSR
- DSDV
- TORA
- AODV (Ad hoc On-Demand Distance Vector) Routing

Ad hoc On-Demand Distance Vector (AODV) Routing is a dynamic, self-starting, multi-hop on-demand routing protocol for mobile ad hoc networks (MANETs) and other wireless ad hoc networks. It was jointly developed in Nokia Research Center, University of California, Santa Barbara and University of Cincinnati by C. Perkins, E. Belding-Royer and S. Das. AODV discovers paths without source routing and maintains table instance of route cache. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand, whereas other routing protocols of the Internet are proactive, meaning that they establish routing paths whether paths are in usage or not. It is capable of both unicast and multicast routing. It uses bi-directional links. In this routing the network remains silent until a connection is demanded. Whenever a node needs connection it broadcasts a request for connection to other nodes and those nodes forward this message to further nodes, and record the node from which they get request. When a node receives such a message, which has a route to the desired node, it sends a message backwards to the requesting node.

Advantages

The advantages of AODV are:

- AODV is simple
- It does not require much memory or calculation.
- Routes are established on demand
- Routes are maintained just as long as necessary
- Local movements have local effect
- Connection setup delay is lower.
- No extra traffic for communication along existing links

Disadvantages

The disadvantages of AODV are:

- AODV requires more time to establish a connection
- The initial communication to establish a route is complex
- Inconsistent routes because of Intermediate nodes
- Multiple reply packets for single request packet can cause heavy control overhead.
- Unnecessary bandwidth consumption due to periodic beaconing

DSDV (Destination-Sequenced Distance-Vector) Routing

Destination-Sequenced Distance-Vector Routing (DSDV) developed by C. Perkins and P. Bhagwat in 1994 is a routing protocol for ad hoc mobile networks based on the idea of Bellman-Ford algorithm. It is used to solve the routing loop problem. DSDV is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors and also if there is significant change in its table from the last update sent so that all stations have updated tables. So, the update is both time-driven and event-driven. Each entry in the routing table contains a sequence number. The sequence numbers are generally even if a link is present; and odd if not. The number is generated by the destination, and the emitter needs to send out the next update with this number. The routing table updates can be sent in two ways: a full dump or an incremental update. In full dump, full routing table is sent to the neighbors and could extent many packets on the other hand, in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If space is left in the incremental update packet then those entries whose sequence number has changed may be included in that space.

Disadvantages

The disadvantages of DSDV are:

- DSDV broadcasts every change in the network to every node
- Local movements have global effect.
- Regular update of routing tables uses battery power and low bandwidth.
- New sequence number is needed when topology of network changes.
- Not suitable for highly dynamic networks.

DSR (Dynamic Source Routing)

DSR (Dynamic Source Routing) developed by Johnson 1994, Johnson 1996 and Broch 1999 is reactive, simple and efficient routing protocol for multi-hop wireless ad hoc networks of mobile nodes. It is on demand routing meaning it makes a route on-demand whenever a transmitting computer requests. It uses source routing instead of depending on the routing table at each intermediate device. It is based on two main mechanisms: Route Discovery and Route Maintenance, which works together entirely to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network. Dynamic source routing protocol (DSR) is an on-demand protocol. DSR is beacon-less and hence does not require periodic hello packet (beacon) transmissions. Periodic hello packets are used by a node to inform its neighbors of its presence. This protocol and all other on-demand routing protocols during the route construction phase establish a route by flooding RouteRequest packets in the network.

The destination node, on receiving a RouteRequest packet, responds by sending a RouteReply packet back to the source, which carries the route traversed by the RouteRequest packet received.

Advantages
The advantages of DSR are:

- DSR is reactive protocol. It doesn't periodically flood the network with table update messages.
- A route is established only on demand, so routes to all other nodes in the network are not found.
- Intermediate nodes use the route cache information to reduce the control overhead.
- Protocol performs well in static and low-mobility environments.

Disadvantages
The advantages of DSR are:

- The connection setup delay is higher.
- Route maintenance mechanism does not locally repair a broken link.
- The performance degrades rapidly with increasing mobility.
- Routing overhead is included due to the source-routing mechanism and increases with increase in the length of path.

TORA (The Temporally-Ordered Routing Algorithm)

The Temporally-Ordered Routing Algorithm (TORA) developed by Vincent Park at the University of Maryland and the Naval Research Laboratory, is an adaptive routing protocol for multi-hop networks. It is used for routing data across Wireless Mesh Networks or Mobile ad-hoc networks. TORA is a distributed so that routers only need to maintain knowledge about their neighbors. It is reactive as well as proactive routing. It supports multiple path routing. It minimizes the communication overhead associated with adapting to network topology changes as it keeps multiple paths and does not need to discover a new route when the network topology changes unless all routes in the local route cache fail. It uses the concept of height associated with a certain destination to describe the routing metric used by routers. Like water flows in pipes, routers with higher heights may forward packet flows to neighbors with lower heights. It should be noted that since heights for routers are associated with particular destinations, the paths to forward packets are also associated with the corresponding destinations.

Conclusion

In MANET, congestion is a serious problem which causes heavy loss of packets. Most of the MANET protocols are not adaptive to congestion and cannot handle the heavy traffic load while offering services to multimedia applications. Also, problem

increases with addition of new route. The proposed novel adaptive congestion control protocol leads fewer packet losses than other routing protocols. The non-congested route concept in the algorithm help next node that may go congested. If a node is aware of congestion ahead, it finds a non-congested route that will be used in case congestion is about to occur. AODV is simple, and on demand protocol. DSR provides excellent performance for routing in multi-hop wireless ad hoc networks. It has very low routing overhead and is able to correctly deliver almost all originated data packets, even with continuous, rapid motion of all nodes in the network. AODV is distributed in which a router needs to know only its neighbors. All these protocols not only help in congestion control but also help routers to inform their neighbors about congestion if happened. This paper reveals the congestion in MANET, various routing protocols for congestion control. The researches & industrialist take advantages of these policies and algorithms. .

References

[1] C K Toh, Ad Hoc Mobile Wireless Networks, Prentice Hall Publishers
[2] *David B., Johnson David, A. Maltz Josh Broch* DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks Computer Science Department Carnegie Mellon University Pittsburgh
[3] H K SONI (2011-03-22). "Ad hoc network
[4] J. Postel. RFC 793: Transmission control protocol, 1981.
[5] J.Broch, D. Johnson, and D. Maltz. The dynamic source routing protocol for mobile ad hoc networks. IETF Internet draft, October 1999. Work in progress.
[6] Perkins, C., Belding-Royer, E.; Das, S. (July 2003). *Ad hoc On-Demand Distance Vector (AODV) Routing*. IETF. RFC 3561. http://tools.ietf.org/html/rfc3561. Retrieved 2010-06-18.
[7] Perkins, Charles E. and Bhagwat, Pravin (1994) (pdf). *Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers*. http://www.cs.virginia.edu/~cl7v/cs851-papers/dsdv-sigcomm94.pdf. Retrieved 2006-10-20.
[8] S. Corson and V. Park. Temporally-ordered routing algorithm (tora) version 1 functional specification. Mobile ad hoc network (MANET) working group, IETF, October 1999.