Review on Congestion Avoidance Technique by Caching Information in Manets and IoT

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Abstract - *Mobile Ad hoc networks (MANETs) is a type of ad hoc network that can change locations and configure itself on the fly. In MANET-IoT systems, a large number of transactions takes place which leads to congestion that results in delays, packet loss and loss of resources like bandwidth which is limited in mobile nodes. To overcome such issues, a bandwidth aware routing scheme (BARS) is proposed that will track the remaining bandwidth available in the network and caches the information in queue to adjust the data rates, thereby avoids congestion. The results are implemented using Eclipse IDE to show the influence of the BARS in terms of throughput and end-to-end delay.*

Keywords: Congestion, MANETS, IoT, bandwidth, data rate

I. Introduction

1. MANETS (Mobile Ad hoc Networks)

MANET is a kind of wireless ad hoc network in which every mobile device in a network is autonomous. The mobile devices are free to move haphazardly and organize themselves arbitrarily. In MANETS, the topology of the network changes erratically and dynamically. Minimal configuration and quick deployment make ad hoc networks suitable for emergency situations like natural disasters or military conflicts. The presence of dynamic and adaptive routing protocols enables ad hoc networks to be formed quickly. Some of the applications of MANETS are Vehicular ad hoc networks (VANETs), Smartphone ad hoc networks (SPANs), Army tactical MANETs, Air Force UAV Ad hoc networks, Navy ad hoc networks, Disaster rescue ad hoc network, etc.

The chance of a single point of failure in a MANET is reduced significantly since the data can take multiple paths. Since the MANET architecture evolves with time, it has the potential to resolve issues such as isolation/disconnection from the network. A major limitation with mobile nodes is that they have high mobility, causing links to be frequently broken and re-established. Moreover, the bandwidth of a wireless channel is also limited, and nodes operate on limited battery power, which will eventually be exhausted. These factors make the design of a mobile ad hoc network challenging. Routing protocols in MANETS are categorized into three, namely proactive, reactive and hybrid routing protocols. Proactive protocol (OLSR-Optimized Link State Routing) maintains fresh lists of destinations, reacts very slowly on restructuring and failures, considers only respective amount of data and maintains their routes by periodically distributing routing tables throughout the network. Reactive protocol (AODV-Ad-hoc On-Demand Distance Vector) finds a route based on user and traffic demand, floods the network with route request or discovery packets and further leading to high latency time in route finding. Hybrid protocol (ZRP-Zone Routing Protocol) are adaptive in nature and adapts according to the zone and position of the source and destination mobile nodes. Most wireless ad hoc networks do not implement any network access control, leaving these networks vulnerable to resource consumption attacks where a malicious node injects packets into the network with the goal of depleting the resources of the nodes relaying the packets. To prevent such attacks, it was necessary to employ authentication mechanisms that ensure that only authorized nodes can inject traffic into the network. Even with authentication, these networks are vulnerable to packet dropping or delaying attacks, whereby an intermediate node drops the packet or delays it, rather than promptly sending it to the next hop.

2. Manets in IoT

Interaction between wireless sensor and mobile ad-hoc networks with the Internet of Things allows the creation of a new MANET-IoT systems and IT-based networks. Such system gives the significant mobility for a user and decreases deployment costs of the network. Networking in the MANET-IoT system is dependent on the routing protocols of MANET, routing principles of wireless sensor network and data sensing from things, handling and processing using Internet of Things. The association of different things with limited features to the Internet and synergy with different wireless and mobile ad-hoc networks must assure connectivity, accessibility and reliability of the MANET-IoT system in smart environments.

3. Congestion in Manets

Congestion may arise when the load on the network is more than the capacity of the network. Congestion heads to packet losses and bandwidth demotion and waste time and energy on congestion recovery. The MANET congestion will not overload the mobile nodes but has an effect on the entire coverage area. Routing protocols in MANETS leads to following issues:

- **Delay:** The delay of the network specifies how long it takes for a bit of data to travel across the network from one communication endpoint to another.
- **Overhead:** It is any combination of excess or indirect computation time, memory, bandwidth, or other resources that are required to perform a specific task.
- **Packet losses**: It occurs when one or more packets of data travelling across a computer network fail to reach their destination. It is either caused by errors in data transmission or network congestion.

4. Theoretical Framework

The designing of a stable and dynamic routing strategy is a challenging problem in MANETs because of their mobile nature and limited volume of resources. With a view to use these limited resources efficiently, an intelligent routing strategy is very much required which should be versatile to the changing conditions of the network, like, size of the network, traffic density and network partitioning. Mobile ad-hoc network shows unpredictable functioning with multiple data streams under heavy traffic load such as multimedia data when it is sent to common destination. The main reason for packet loss, protocol overhead, and delay to find new route in MANET is due to congestion. So, in order to deal with all these issues, the routing in MANETs needs to be congestion adaptive, due to these problems service quality is affected.

A good routing protocol controls congestion in the network by increasing network throughput and decreasing its overhead.

Congestion is a state in the network where there are too many data packets present in the subnet. If the selected routing protocol is impotent to handle congestion, issues like increase in delay, high overhead and increase in packet loss might occur within the network. To overcome the above issues, **Bandwidth Aware Routing Scheme (BARS)** which will cache the information in queue to adjust data rates and hence avoids congestion is considered.

II. Related Work

H. Hung-Yun (2001) et al. If there is no proper fairness and if there is decrease in end to end throughput, it is due to bottleneck which is caused by unfair and insufficient resource allocation. In multi-hop network, end-to-end bandwidth and delay are highly dependent on the network topology. The fair allocation of bandwidth among nodes on routing path is via MAC protocol. Therefore, the MAC layer which controls the resource allocation of a node can be a method for throughput fairness among nodes on the same routing path. The load balancing algorithm TDMA scheduling schedules the transmission in a fair manner in terms of throughput per connection. For that reason, the notion of per-flow fairness where the access to the channel is in proportion to the number of flows that traverse them and acts as relays [2].

S. Sheeja (2013) et al. Due to the mobility of nodes, the network congestion occurs. Three steps are considered in avoiding congestion such as: (a) congestion monitoring, (b) effective routing establishment and (c) congestion-based routing. The overall congestion status is measured by congestion monitoring. In routing establishment, the queue length of the packet, overall congestion standard, packet loss rate and packet dropping ratio are used to monitor the congestion status. Based on congestion standard, the congestion-less based routing is established to reduce packet loss, overhead and delay. Finding alternative path, so every node, need to update their data stored in the form of table [4].

T. S. Kumaran (2013) et al. In MANETs, congestion can occur in any intermediate node, often due to limitation in resources. The primary objective of congestion control is to best utilize the available network resources and keep the load below the capacity. This paper proposes a method (DCDR- Dynamic Congestion Detection and Control Routing) in ad-hoc network based on the estimation of average queue length at node level. Using the average queue length, the node detects the current congestion level and sends warning to its neighbors. The neighbors then attempt to locate a congestion free alternative path to the destination. The above method also ensures reliable communication within the MANETS [6].

R. Vadivel (2017) et al. The packet loss can be caused either by link failure or by node failure in MANETS. Multiple paths are constructed and among which the shortest paths are found for efficient data transmission. The congestion is detected on the basis of utilization and capacity of link and paths. When a source node detects congestion on a link along the path, it distributes traffic over alternate paths considering the path availability. If the node cannot resolve the congestion, it signals its neighbours using congestion indication bit [5].

S. Soundararajan (2012) et al. Multipath routing can balance the load better than the single path routing in ad-hoc networks, thereby reducing the congestion by dividing the traffic in several paths. The proposed approach contains an adaptive rate control-based technique in which the destination node copies the estimated rate from the intermediate nodes and the feedback is forwarded to the sender through an acknowledgement packet [3].

Mallapur (2017) et al. In MANETS, reducing energy consumption and packet loss involves congestion control and load balancing technique. MLBCC (Multipath Load Balancing Congestion Control) introduces a congestion control and load balancing mechanism during the data transmission process. The congestion control mechanism detects the congestion by using an arrival rate and an outgoing rate at a particular time interval. The load balancing mechanism detects congestion by selecting a gateway node by using a link and path cost to efficiently distribute the load by selecting the most desirable path [1].

III. Outcome

1. Problem Definition

Mobile ad hoc network's traits like dynamic topology and decentralized connectivity make routing a challenging task. When the nodes receive more data than it can send, the excessive data has to be buffered, then congestion occurs because the limited buffer space becomes full and as a result the extra data have to be dropped. This tends to waste of resources like bandwidth of the nodes.

2. Proposed Technique

In this paper, a **bandwidth aware routing scheme** that caches the information in queue to adjust data rates is examined. **Contributions are:**

1) The scheme permits the source to adjust its sending rate whenever network is nearer to congestion.

2) The proposed routing mechanism alters the RREQ and RREP messages of AODV by inserting path bandwidth and queue size in it.

Following new attributes are worked in the AODV:

1. Capability to estimate the remaining bandwidth.

2. Updates the source node about ongoing network conditions in terms of remaining bandwidth.

3. The route recovery process instantly carries out route recovery.

The vital difference between the proposed methodology and other mechanisms based on AODV is the implementation of adaptive feedback method. Because of this, the source node easily determines the ongoing network state, links capacity and regulates its data rate accordingly.

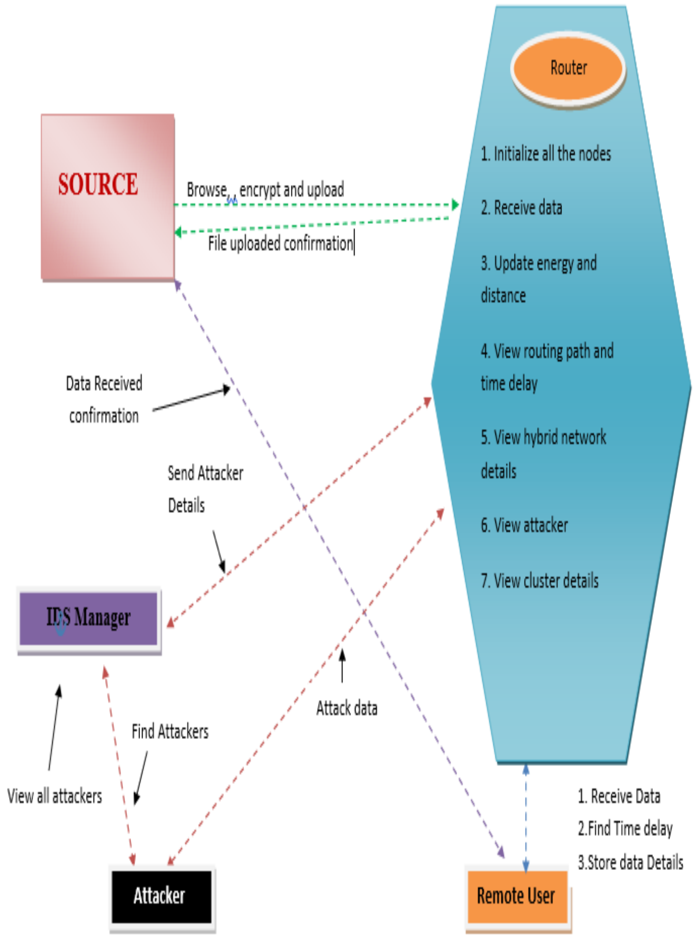

Fig 1: System Architecture

IV. Conclusion

The designed scheme presents the bandwidth aware routing where the prevailing network condition is estimated in terms of residual bandwidth and residual size of queue to cache the information. As a result of residual bandwidth, the source node transmits data packets respectively. Eventually, we intend to combine quality of service factors like energy aware route selection in sequence with bandwidth estimation.

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