Design of Energy Efficient Congestion Control Protocol for Ad-hoc Networks

Wireless communications is fast becoming the most popular mode of communication in today's era. This is evident from the fact that most of us posses mobile phones, laptops, other portable devices which we use for exchanging information for various purposes. Data exchanges in such portable devices are possible using wireless networks which are of two types, cellular network and ad hoc networks. Ad hoc networks are characterised by distributed routing where all nodes coordinates to enable communication among themselves. These types of networks are independent of a fixed or centralised infrastructure makes them suitable for military applications, collaborative and distributed computing and emergency operations pertaining to crowd control. Transport layer protocols of ad-hoc network offer services such as congestion control, end to end service, reliability, packet-loss recovery, energy efficiency, and fair –allocation of bandwidth with heterogeneous application support. Proven protocols, TCP and UDP provide services in transport layer for wired network, which are not suitable for wireless technology, as we know that nodes in wireless sensor network, which is a kind of ad hoc network has inbuilt features for sensing, processing, and storing some amount of data in a limited buffer and each device occupies a very less amount of energy to survive in the network. Hence the main challenges of wireless ad-hoc networking are reliability, congestion, and energy efficiency. There are several reasons that increase the power consumption of sensor nodes. One of the main reasons is packet retransmission. Packet retransmission occurs when the network or nodes get congested. In ad-hoc networks, congestion occurs whenever the incoming traffic volume exceeds available resources. Compared to wired network, however we observe a much higher packet drop rate, which is caused by not only queue overflow, but also collisions at the receiving node(s). In addition, this packet drops have more adverse impact on ad hoc network because the energy consumed to forward this packet from its source to current location will be wasted. Energy in each node is the scarcest resource in ad hoc networks, and sometimes it may not be replenished. Congestion increases the packet drop rate, delay and decreases throughput and the lifetime of the node. Packet drops have a serious impact on energy efficiency. In order for this we should limit effectively packet and energy losses caused by congestion. Packet collision and channel interference are some more reasons for packet retransmission. When more number of nodes are present in the path for packet transmission, then the battery power of all nodes get wasted. Hence the transport layer protocol should sustain congestion detection and avoidance mechanism so as to conserve energy by reducing packet retransmission.

Considering the above challenges, researchers have designed some protocols such as CODA [2], FUSION [3], CCF [4], SIPHON [5], PCCP [6] and PHTCCP [7] control congestion only, basically by reducing transmission rate. These protocols are not energy efficient. Protocols such as RBC [8], ERTP [9], GARUDA [10], PSFQ [11] and RMST [12] provide reliability only but suggest for enhancement to overcome the limitations of high power consumption. Others such as ESRT [13], TRICKLE [14], DTC [15], PORT [16], ATP [17], STCP [18], DST [19], ART [20], FLUSH [21], RCRT [22], DSTN [23], CTCP [24], CRRT [25], SenTCP [26], TRCCIT [27], RT2 [28] and [29] are meant for both reliability and congestion control which work in transport layer, have the same limitations of heavy power

consumption. Some of them fulfils reliability, some energy efficiency, some handle congestion by different mechanisms (ACK, NACK, both ACK and NACK based). Also some has developed features those works for both congestion control and reliability. Mitigating the issues like congestion and reliability, there is a need of protocol which enhances energy efficiency and meets other challenges with proper bandwidth utilization. From the above information, it is assumed that, several protocols are available in literature with certain limitations such as congestion, reliability and energy efficiency with respect to different parameters such as coverage area, number of sensors, simulation time etc. Hence the objective of present research work is to energy efficient congestion control to achieve the same throughput as the traditional congestion control while consuming less energy.

Objective:

- Accepting the above challenges, objectives of our research work can be summarized as follows:
- To study the various protocols available in literature for reliability, energy efficiency and congestion control for Ad-hoc networks.
- To design some new energy efficient congestion control protocols that is useful for generic type of applications.
- The performance testing through simulation of proposed protocol with different parameters using network simulator NS2.
- The performance comparison of proposed protocol with other existing protocols.

Plan of action:

The work plan can be summarized as follows.

Step 1: Extensive survey on energy efficient protocols for ad-hoc networks will be carried out.

Step 2: The limitations of the existing protocols will be identified.

Step 3: The enhanced protocol for same will be designed.

Step 4: The performance of enhanced protocol will be tested through simulation using network simulator NS2 with different parameters such as number of nodes, coverage area, packet size, data-transfer rate and topology will be carried out.

Step 5: The performance of proposed protocol will be compared with other existing protocols.