

CONGESTION CONTROL IN HETEROGENEOUS WANET USING FRCC

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ABSTRACT

Congestion control is the major problem in wireless Ad hoc network especially in broadcasting the packet. In heterogeneous network data should be reliable and secure the end to end delay of data transmission. So we propose to control the congestion and error in network using Forward Error Correction (FEC) technique, which will avoid the error. Feedback and Resource based Congestion Control (FRCC) which will reduce congestion in transmission channels. In broadcasting, data communications is efficient and errors are controlled caused by channel noise. The performance of local broadcasting can be characterized by the mean number of neighbor nodes and probability distribution of the number of neighbor nodes of broadcasting node. One of the major challenges is that inter-system interference from different radio access technologies operating at the same spectrum may significantly degrade the quality of signal reception. An interesting question that can be raised is how many times a source node should broadcast a message without the aid of acknowledgement feedback. So that with a guaranteed probability the message will be successfully received by certain number of nodes. Encryption Security algorithms can be used for security which ensures that the data which is sent from the source node reaches the destination node properly.

Keyword: Congestion control, Security, Error control, Forward Error Correction, Feedback and Resource based Congestion Control, Encryption Security algorithms

INTRODUCTION

A WANET is a wireless network where the wireless nodes can be located anywhere over the globe. However, the underlying design is such that the nodes believe they are part of a single-hop or multi-hop wireless network at the PHY and MAC layers. This is accomplished by using Software Defined Access Points (SoDA) that are based on the idea of Software Defined Radio (SDR). For the uplink, each SoDA samples the down-converted channel using an ADC (analog to-digital converter). The sampled data is then multicast to the other SoDAs via the Internet. At each end-point, the received digital signals from the other SoDAs are summed and sent through the DAC (digital-to-analog converter) and transmitted on a designated channel after up conversion. Then the RF environment is mixed at geographically separate locations (albeit with a time shift). When the number of packets increases beyond the limit that can be handled by the network resources, the network performance degrades, and this situation is called congestion. Congestion simply means overcrowding or blockage due to overloading. It is similar to traffic jam caused by many cars on a narrow road. Two styles of control, proactive and reactive control, are presented. It is shown that congestion control must happen at several different time scales.

For WANETs where wireless channels are shared by several nodes using carrier sense multiple access (CSMA-like) protocols, collisions could occur when multiple active sensor nodes try to seize the channel at the same time. This can be referred to as link-level congestion. Link-level congestion increases packet service time, and decreases both link utilization and overall throughput, and wastes energy of the sensor nodes. There is another type of congestion called node-level congestion which is common in conventional networks. It is caused by buffer overflow in the node and can result in packet loss, and increase latency. Packet loss in turn can lead to retransmission and therefore wastes more energy. Both link-level and node-level congestions (illustrated in Figure 1) have direct impact on energy efficiency and QoS.

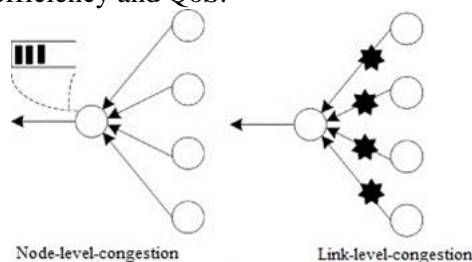


Figure 1 General WANET Congestion issues

Existing research is confined to the local broadcasting in a Stand-alone wireless ad hoc network without interference and with intra-system interference. However, coexistence of multiple heterogeneous wireless networks emerges in the next generation wireless networking, and several challenges are introduced. One of the major challenges is that inter-system interference from different radio access technologies operating at the same

spectrum may significantly degrade the quality of signal reception. Investigations of inter-system interference in coexisting heterogeneous wireless networks have focused on spectrum sharing in two-tier femtocell networks, cellular and ad hoc networks, narrowband and ultra-wideband networks, and cognitive radio networks. More details can be found in. Following this trend, in this paper we study the performance of local broadcasting in an interference-limited environment consisting of multiple heterogeneous wireless ad hoc networks. We explore the impacts of different error control techniques (including simple retransmission, Chase combining, and incremental redundancy) on the mean number of neighbors and the probability distribution of the number of neighbors in local broadcasting. With the probability distribution of the number of neighbors, QoS provisioning in local broadcasting can be facilitated. An interesting question that can be raised is how many times a source node should broadcast a message without the aid of acknowledgment feedback (e.g. ACK/NACK) so that with a guaranteed probability the message will be successfully received by more than a certain number of nodes. Via the probability distribution, we may answer as follows: "A source node should broadcast a message m times so that with probability η more than j nodes will receive the message successfully".

FRCC MECHANISM – A BACKGROUND

The proposed (Feedback and Resource based Congestion Control FRCC) method called error and congestion control protocol that has two basic functions responsible for the FEC and FRCC. The main intention of this protocol is to be used as a mechanism for reducing congestion in the network by free resources to set accurate rates and priority data needs. If two or more nodes send their packets in the shortest path to the parent node in a crowded place, a source node must prioritize the data and uses data that have lower priorities of a suitable detour nodes consisting of low or non-active consciously. Due to the limited energy of sensor node, existing trails will be used instead of creating new routes. The proposed protocols are tried to increase network lifetime and the rate of successful packet transfer by reduction of possibility of packet loss as much as possible.

The protocol is described in Figure 2. As we know there are two types of traffic at each node, local traffic and transmitted traffic. In fact, each node can act as a source and as routers in the network. Source traffic is created locally and by the node itself if the transmitted traffic is created through other nodes and is sent to the upstream node to be sent to the scrap. As can be inferred, the tree structure has a kind of injustice in terms of bandwidth allocation for sensor network nodes located at different levels so that nodes near the sink are given a higher priority but farther nodes have to send data through intermediate nodes, passing several steps with great delay.

To solve this problem, Forward Error Correction (FEC) technique, which will avoid the error, control the congestion using Feedback and Resource based Congestion Control (FRCC) which will reduce congestion in transmission channels.

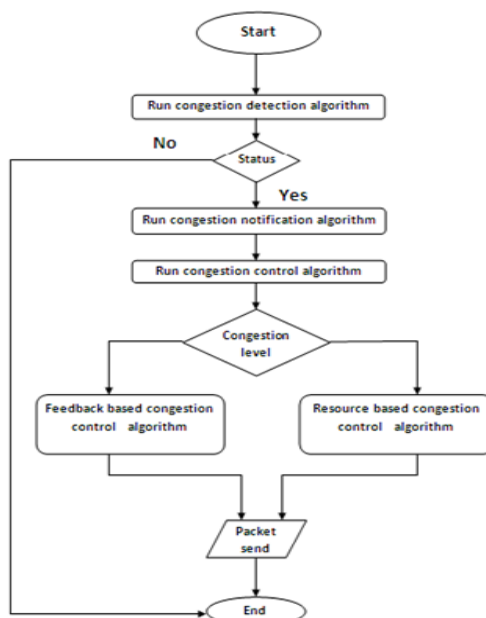


Figure 2 Scheme of FRCC congestion control protocols

First: Queuing delay is the primary congestion index.

Second: Packet loss is the next congestion index. Congestion control strategies based on packet loss to keep high bandwidth is employed when delay based strategy act inefficiently.

Proposed algorithm is applied to the network when these two indexes have been settled. In general case, proposed algorithm is not applied in normal case since computation is a time consumer manner. Proposed algorithm is

applied to the nodes near the base station (which convey more traffic) after the congestion detection mechanism detected the congestion and resolved it.

FRCC DESCRIPTION

Problem Statement:

Objective function to be maximized: $\sum_s U_s(X_s)$ (total source utility)

Constraint 1: $X_i^k \leq \sum_{j:(i,j) \in L} f_{ij}^k - \sum_{j:(j,i) \in L} f_{ji}^k$ (flow conservation per node-destination pair)

Constraint 2: $f \in \pi$ (rate in the rate region)

Direct variables: $X_s \geq 0$ (source rate) $f_{k,i,j} \geq 0$ (capacity allocation per link per destination)

Dual relaxation of coupled constraints, with resultant partial dual $D(p) = \max_{x_s \geq 0, f_{k,i,j} \geq 0} \sum_s U_s(X_s)$

$$\sum_{i \in N, k \in D, i \neq k} p_i^k (X_i^k - \sum_{j:(i,j) \in L} f_{ij}^k + \sum_{j:(j,i) \in L} f_{ji}^k)$$

At slower time scale, update dual variables p_i^k for all i and k At faster time scale, solve the following scheduling problem $\max \sum_{i,j} f_{i,j} \max (p_i^k - p_j^k)$

$$f_{i,j} \geq 0 \quad i,j \quad k$$

Sub gradient update of dual variables

$$p_i^k(t+1) = [p_i^k(t) + \lambda_t (x_i^k(p(t)) - (\sum_{j:(i,j) \in L} f_{ij}^k(p(t)) - \sum_{j:(j,i) \in L} f_{ji}^k(p(t))))]^+,$$

where λ_t is the stepsize.

Distributed Approximate Weighted Maximum Matching to solve the scheduling problem.

PERFORMANCE METRICS AND RESULT ANALYSIS

In this paper we have considered Packet Delivery Fraction and throughput in Kilo bits per second (Kbps) for evaluation of RCC, FCC and FRCC Congestion Control Protocol. The simulation results obtained with the above mentioned simulation parameters are appended in Table-1. The graph showing comparison between RCC, FCC and FRCC is shown in Figure.3. Packet Delivery Fraction. It is the ratio of the data packets delivered to the destinations to those generated by the sources. Packet Delivery Fraction = Total Packets Delivered to destination / Total Packets Generated.

Table.1. Packet Delivery Fraction with varying number of Nodes

| Congestion Control Protocol | Total Packets sent | Total packets Received | Packet Delivery Ratio |
|-----------------------------|--------------------|------------------------|-----------------------|
| RCC | 9812 | 9073 | 0.9248 |
| FCC | 9838 | 9176 | 0.9327 |
| FRCC | 9895 | 9874 | 0.9979 |

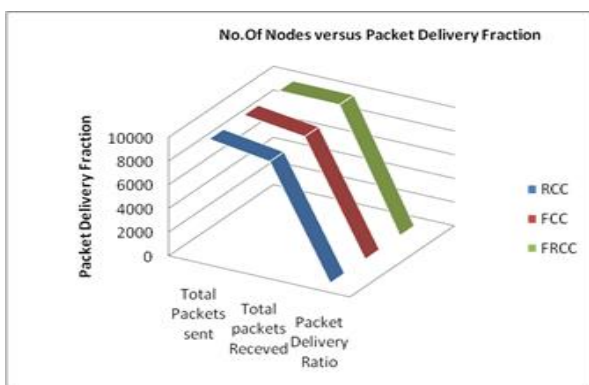


Figure.3 Packet Delivery Fraction

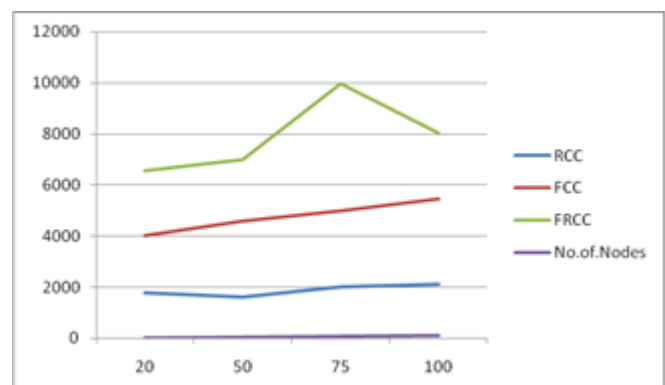


Figure.4. No of Nodes Versus Throughput

Throughput: Throughput of the congestion control protocols means that in certain time the total size of useful packets that received at all the destination nodes. The unit of throughput is MB/s, however we have taken Kilo bits per second (Kb/s). The throughput values obtained for the simulation parameters of table-1 is tabulated in table-2. The graph shown in figure- 4 indicates the throughput comparison of congestion control protocols, RCC, FCC and FRCC.

Table.2 Throughput in speed with varying number of Nodes

| Throughput in speed with varying number of Nodes | | | | |
|--|---------|---------|---------|---------|
| No. of .Nodes | 20 | 50 | 75 | 100 |
| RCC | 1770.41 | 1600.34 | 1999.18 | 2102.4 |
| FCC | 4034.64 | 4600.76 | 5002.64 | 5454.36 |
| FRCC | 6554.53 | 7002.67 | 9979.99 | 8044.33 |

CONCLUSION

In this paper we have evaluated the performance of FRCC congestion control protocol for ad hoc networks. FRCC uses the proactive table-driven congestion control strategy whereas FEC uses the reactive on demand error control strategy with different control mechanisms. Experimental results showed that FRCC perform better for Packet Delivery Fraction as well as Throughput.

Due to the importance of Congestion Control for Wireless Ad hoc network, we presented a model for congestion control in WANETs. The main intention of this protocol is to be used as a mechanism for reducing congestion in the network by free resources to set accurate rates and priority data needs. If two or more nodes send their packets in the shortest path to the parent node in a crowded place, a source node must prioritize the data and uses data that have lower priorities of a suitable detour nodes consisting of low or non-active consciously. Proposed algorithm (FRCC) is not applied in normal case since computation is a time consumer manner. Proposed algorithm (FRCC) is applied to the nodes near the base station (which convey more traffic) after the error and congestion detection; control the error in network using Forward Error Correction (FEC) technique, which will avoid the error, control the congestion using Feedback and Resource based Congestion Control (FRCC) which will reduce congestion in transmission channels.

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