Poster: Reliable TCP for Popular Data in Socially-aware Ad-hoc Networks

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ABSTRACT

Reliable social connectivity and transmission of data for popular nodes are vital in multihop Ad-hoc Social Networks (ASNETs). However, congestion may occur and hence popular nodes might not achieve required bandwidth when multiple senders share data with a single receiver. The traditional Transport Control Protocol (TCP) might not be able to perform efficiently in ASNETs. Therefore, we propose a Reliable TCP for Popular Data in Socially-aware Ad-hoc Networks called RTPS. RTPS employs a popularity level approach for every single node which partitions the bandwidth among users. The reliability of popular data is ensured since bandwidth will firstly assigned to the popular sender. Preliminary results show that by delaying the acknowledgment and improving the performance of TCP, RTPS reduces collision loss in multihop ASNETs.

Categories and Subject Descriptors

C.2.1 [**Computer-Communication Networks**]: Network Architecture and Design - *Wireless Communication*

Keywords

Congestion, TCP, ad-hoc social networks

1. INTRODUCTION

TCP suffers in multihop ASNET due to the reliability issues and face congestion related losses due to scarce bandwidth. The reliability of popular sender data packets is affected by two aspects: 1) when multiple senders are sending data on multihop ad-hoc networks and only a single receiver is receiving data. Due to less bandwidth of the end node, it drops packets and reduces the reliability of popular sender data packets, and 2) the dropping of acknowledgment packets from the networks affects the reliability of already sent or popular node data packets. Dropping packets from multi-hop ad-hoc network is due to collision loss that happens because data and acknowledgment packets use the same path [1].

Some recent developments in ASNET are available to solve reliability and congestion issues. The reliability of data packet in ASNET can be achieved by leveraging the concept of multiple copies but this can create congestion. Therefore, Xia *et al.* [2] present efficient replication scheme to maximize availability of data in ASNETs. To solve congestion issue in ASNETs, TIBIAS [3] uses an assignment procedure of data packets based on next node social property (similarity) and provides sender side solution. The congestion issue can also be solved after reduction in acknowledgment overhead. Therefore, TCP-DAAp [1] uses packet loss rate to set the delay acknowledgment window.

To solve the above mentioned problems, we propose RTPS. It provides maximum reliable transmission to popular nodes (high degree centrality) with a congestion control scheme. The degree centrality gives high advantage in terms of maximum utilization of resources. Reliability of data packet to popular node follows two aspects. First, it shares bandwidth between sender nodes using popularity level and secondly, it acknowledges earlier to popular node packet as compared to other. To reduce collision loss, RTPS sets the delay window based on the network condition.

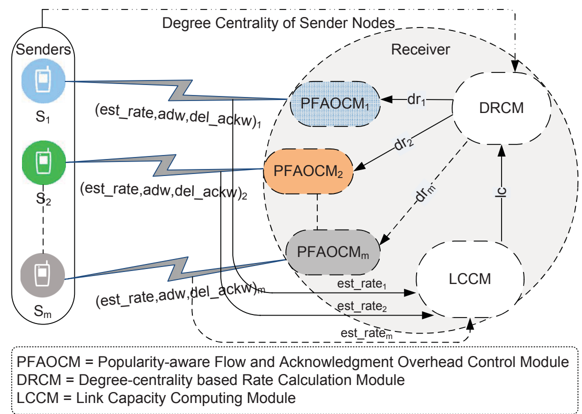

Figure 1: Structure of RTPS.

2. DESIGN OF RTPS

RTPS is composed of Link Capacity Computing Module (LCCM), Degree-centrality based Rate Calculation Module (DRCM) and Popularity-aware Flow and Acknowledgment

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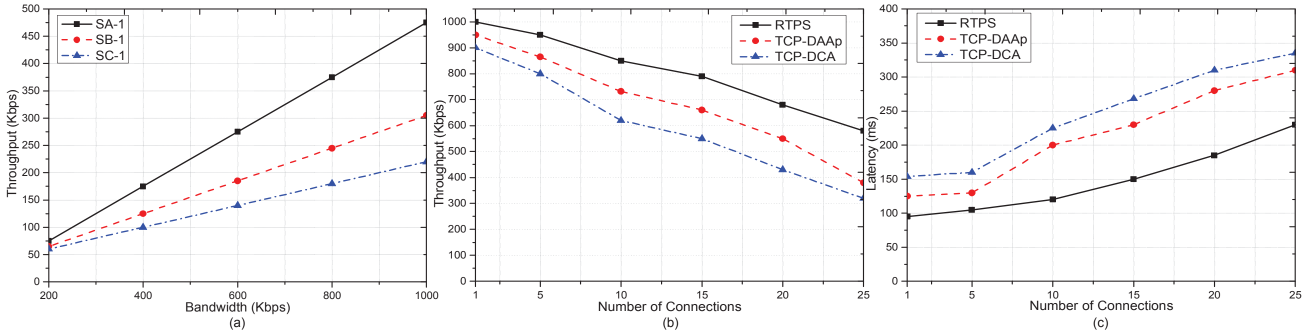

Figure 2: Performance comparison.

Overhead Control Module (PFAOCM). Fig. 1 shows the model in which multiple Senders (S) connect with single Receiver (R). RTPS provides full utilization of available bandwidth without wastage of resources. In first step, LCCM receives the estimated rates $c = \sum_{0}^{m-1} est\_rate_k$ from all S and then calculates the optimum value for full link utilization. After calculation of favorable link capacity (lc), it transfers to DRCM. DRCM first assigns minimum rate to all flows then calculates the desired rates (dr) based on the lc and computes *degree centrality* of sender nodes. The following equation provides the calculation of dr:

$$dr_k = \frac{dec_{k'}}{\sum_{k=0}^{m-1} dec_{k'}} * (lc - \sum_{k=0}^{m-1} lr_k) + lr_k \qquad (1)$$

DRCM assigns dr values to multiple PFAOCMs. PFAOCM sets the advertised window (adw) and delays acknowledgment window (del_ackw) based on the value of dr and exponential weighted moving average rate (avg_rate). In (2), est_rate_k defines the available rate for kth flow; $prvavg\_rate_k$ explains the previous exponential weighted moving average and α denotes the average parameter of exponential (i.e. 0.3).

$$avg\_rate_k = \alpha * (prvavg\_rate_k) + (1 - \alpha) * est\_rate_k \qquad (2)$$

To achieve the setting of adw based on popularity level, PFAOCM aims to set avg_rate_k of the flow with in a desired rate dr_k of the fraction σ. To solve the overhead issue, RTPS uses delay acknowledgment methodology. In PFAOCM, when any data packet arrives at the receiver end, it counts the unacknowledged data packet through ac variable. After receiving an in order data packet RTPS generates single acknowledgment. The ac is reset to 0 when ac reaches to del_ackw. To adjust the dynamic del_ackw, estimated network situation with popularity level provides high advantage. If any node has a higher popularity level than all other nodes, then earlier acknowledgment is also required. Early acknowledgment is useful in achieving e.g. reliable data transfer and desired rate.

3. EVALUATION AND DISCUSSION

The performance of RTPS is evaluated via simulation and compared with existing approaches: TCP-DAAp [1] and TCP-DCA [4]. Our main objective is to investigate whether RTPS can perform better in terms of link utilization, latency and throughput. The transmission range of our simulation is 250 m. We used 1 to 25 TCP connections and each node buffer capacity is 50 packets. The transmission power of each node is 0.007 watts with 11 Mbps channel bandwidth. Ad-hoc On Demand Distance Vector (AODV) was selected as a routing protocol and the type of traffic is FTP. The size of packet is 1,460 bytes with simulation time of 1000 seconds.

Figure 2 depicts the bandwidth assignment within different flows. Figure 2(a) illustrates that it first assigns 50 Kbps to each flow and the remaining bandwidth assigns using *degree centrality* calculation. The result shows the throughput of SA-1 is greater than all other sender nodes. Figure 2(b) explains the throughput of RTPS is 34.5% and 44.8% higher than TCP-DAAp and TCP-DCA. The throughput of RTPS also increases when we assign maximum bandwidth to the user who has a high popularity level. TCP-DAAp and TCP-DCA use equal bandwidth sharing with a fixed number of window sizes which cause lower throughput when the number of connections increases in the network. Figure 2(c) shows that the latency of RTPS is 25.8% and 31.3% lesser than TCP-DAAp and TCP-DCA. RTPS reduces delay in transmission since it assigns bandwidth based on popularity level of node and sets del_ackw based on social property. In addition, RTPS considers network bandwidth to adjust the receiver windows.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

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