Evaluation of Transport Layer Protocols for Wireless Multi-hop Networks

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Abstract—Transport Layer protocols (TLP), protocols responsible for connection establishment and ensuring that all data are transmitted from source to target destination safely. TLPs provide QoS in various ways, but we are unable to identify the optimal protocol, since TLPs have not been compared in a consistent manner in previous works. We have designed the framework based on the literature, which we followed to analyse, categories and select the representatives TLPs samples to be compare and in order recommend the design features for and ideal TLPs that should be followed when designing the TLP for WMNs.

Index Terms— Design features, QoS, TLPs, WMNs

I. INTRODUCTION

Multiple mechanisms for QoS provision have been proposed for Wireless multi-hop networks(WMNs) such as routing protocols, load balancing, Medium Access Control (MAC), topology control and transport layer protocols (TLP) [2], [3].

In recent years the research activities on WMNs have pointed out that the traditional TLP (TCP) behavior in WMNs is far from ideal [8]. The reason for this is that WMNs such as (wireless ad hoc networks) behave in a significantly different way with respect to traditional wired networks, like the Internet, for which TCP protocol was originally designed for [1]. It assumes that all packets losses are due to network congestion which is not the case in WMNs [1], [6].

Packet losses are due to many reasons such as mobility, high bit error rate, medium contention, route breakage, and radio channel errors [6]. Multiple TLPs have been proposed to improve the performance of TCP (solving the above mentioned issues) in WMNs. Some are the extensions of TCP and other are designed from to avoid fundamental problems exist in TCP [3].This is to tailor the characteristics of WMNs. In despite of the multiple different existing TLPs, almost all of them are not implemented in real world. These protocols provide QoS in various ways, but we are unable to identify the optimal protocol, since TLPs have not been compared in a consistent manner in previous works.

II. RELATED WORK

Wang et al [8] proposed an end-to-end approach to interpret out-of-order (OOO) deliveries as an indication of route failures in wireless networks. Because of random packets losses, OOO event happen more often in wireless networks. Similarly, TCP with Adaptive Pacing [7] retains the end-to-end semantic of TCP. It identifies high contention on the network path of the TCP connection and proactively throttles the transmission rate before losses occur. Although they both using end-to-end mechanism, but they are not being compare in certain manner.

TLP in [5] provides a systemic way of controlling end-to-end rate for multimedia streaming applications, based on the degree of medium contention information received from the network. Protocol [2] also designed for multimedia streaming application, but over high-speed and long-distances networks not in the degree of medium contention as in [5]. It improves TCP by replacing the TCP response function with high speed response function. It provides bandwidth scalability for wireless ad hoc networks.

In [4], proposed a cross-layer aware protocol for TCP performance enhancement over the large variety of networks. It provides QoS through reduction of medium busy time, sensibility link error and round trip time. Each TLP designed to solve a particular problem, but no standard requirements in place that should used to compare them if they real solve the problems in an expected manner.

III. PROPOSED RESEARCH

The goal of this study is to compare the existing transport layer protocols (TLPs) and make recommendations for real world implementations. In order to achieve this goal we have developed a framework which we use to analyse related work. This framework is used to categorise the existing work on TLPs in WMNs. The resultant categorization will help us in selecting representative samples of each identified category of TLP. Our framework has helped us identify four categories of TLPs and two representatives of each TLP category have been selected for the performance comparison. Table1 below depicts the attributes of our Framework. The lack of simulation code has forced us to develop pseudo code (which will be translated into code) and flowcharts relying on the details of the schemes exposed in the publications.

Table 1 (Framework for analyzing TLPs of WMNs)

Framework Attribute	Description
Year	In which year the transport layer protocol was developed.
Problem	What is the main problem being solved by the transport layer protocol in the MWNETs.
Approach	How did they go about providing the proof of concept so as to prove that their solution is the optimal among the existing ones?
Type	Transport layer protocols classified into four types.
Does it works in conjunction with other protocols	Some protocols can employ certain features of other protocols to solve different problems or same problem and some protocols cannot work hand in hand other protocols.
Real-time or non real-time	There are protocols designed for real-time, non-real-time and some for both real and non-time applications.
QoS aware	What is the performance level of a service offered by the TLP to the user?
Cross-layer aware	Does it allow the knowledge sharing between all OSI model layers to obtain the highest possible adaptively
Implemented in real- world scenario	Identify whether the protocol has been implemented in a real-world scenario or not.

as well as correspondence with various components of the schemes. The design of the selected has been completed and has been distributed to the original authors for verification. Out of eight authors only one verified the correctness of our design, although the code was offered. We currently busy implementing what we have designed in ns-2.

The ns-2 simulator will be used to evaluate the performance of the various schemes with respect to identifying the optimal protocol for WMNs among the existing ones and recommend the design feature of an ideal TLP for real world implementations, so that any researcher intends to design the TLP should consider those features. If the time permits we hope to translate our ns-2 implementations into tested located at our CoE. The intended purpose of this effort would be to test the performance of the various TLPs in the real-world as well as evaluate interoperability with the standard TCP.

V. CONCLUSION

TLPs provide QoS in various ways, but we are unable to identify the optimal protocol, since TLPs have not been compared in a consistent manner in previous works. We have designed the framework based on the literature, which we followed to analyse, categories and select the representatives TLPs samples to be compare and in order recommend the design features for and ideal TLPs that should be followed when designing the TLP for WMNs.

REFERENCE

[1] D. Klizovich, F. Graneli and M. Gerla, "Performance Improvement in Wireless Networks using Cross-Layer ARQ", Computer Networks, Jun. 2007.

[2] K. Sundaresan, V. Anantharaman, H. Hsieh and R. Sivakumar, "ATP: Reliable Transport Protocol for Ad-hoc Networks", Proceeding of MobiHoc'03, Jun. 2003.

[3] I. F. Akyildiz, X. Wang and W. Wang, "Wireless Mesh Neteorks: a survey", Computer Networks, 2005.

[4] A. A. Franklin , C. S. R. Murthy, A Link Layer Adaptive Pacind Scheme for Improving Throughput of Transport Protocols in Wtireless Mesh Neworks, Computer Networks (2008), doi:10.1016/j.comnet.2008.02.001

[5] P. Navaratnam, H. Cruickshank, R. Tafazolli, A Lank Adaptive Transport Protocol for Multimedia Streaming Applicatins in Mult-hop Wireless Networks, Mobimedia'07, Month 8, 2007, Nafpaktos, Aitolokarnania, Greece.

[6] Y. Su and T. Gross. WXCP: Explicit Congestion Control for Wireless Multi-hop Networks. In IWQoS '05: Proceedings of the 12th International Workshop on Quality of Service, June 2005.

[7] S. M. EIRakbawy, A. Klemm, and C. Lindemann, TCP with Adaptive Pacing for Multihop Wireless Networks. In MobiHoc '05: Proceedings of the 6th ACM International Symposium on Mobile Ad Hoc Networks and Computing, page 288-299 May 2005. DOI:http://doi.acm.org/10.1145/106289.1062726.

[8] F. Wang and Y. Zhang, "Improving TCP performance over mobile ad-hoc networks with pout-of –order detection and response," in proceedings of MOBIHOC'02, pp.217-225, June 2002.

BIOGRAPHY

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