Efficient Power Management using Adaptive Receiver Centric Transport Layer Protocols on Wireless Heterogeneous Networks

Kamalakshi.N
Asst Prof CSE
SCE,Bangalore
kamalnags@gmail.com

Dr. Naganna H
Professor & HOD ISE
SJBIT, Bangalore
naganna_h@gmail.com

Dr Ganesh Rao
Professor & HOD,
Dept of TC
MSRIT Bangalore

Abstract—Today's wireless networks are highly heterogeneous, with mobile devices consisting of multiple wireless network interfaces (WNICs). Since battery lifetime is limited, power management of the interfaces has become essential with flexible and open architecture, capable of supporting various types of networks, terminals and applications. However how to integrate the protocols to meet the heterogeneous network environments becomes a significant challenge in the fourth generation wireless network. Adaptive protocols are proposed to solve heterogeneity problem in future wireless networks. This paper discusses two protocols R²CP, and RCP and feasibility of RCP protocols applied to the manage power efficiently and adaptive Congestion control on heterogeneous wireless network.

Index Terms*—*adaptive transport layer protocols, Power management, AIMD, Heterogenous networks

I. INTRODUCTION

Many embedded systems in power-constrained environments such as satellite systems, hand-held devices, and solar powered systems operate using rechargeable batteries. Even though technology advances in rechargeable batteries have improved the energy storage capability, the power requirements for many mission critical systems still far exceed the storage capacity. Therefore, efficient power management techniques are critical for the operation of these systems

The TCP (Transmission Control Protocol) transport layer protocol is a sender-centric protocol with the data sender performing all important tasks including congestion control and reliability. The receiver participates in the operation of the protocol, but contributes only by sending feedback in the form of acknowledgments. It is initially designed for network with less link error without consideration more about wireless networks. TCP performance degradation is unavoidable in wireless networks due to its significant limitations. For example, TCP is unfit for real-time multimedia applications due to its burst transmission and inflexible retransmission rules. TCP cannot dynamically adjust its congestion control and rate control schemes to adapt heterogeneous wireless networks environments in the future wireless networks. For example satellite networks with wide coverage area, broadcast capability and immunity to the adverse geographic conditions, have a largely adverse impact on TCP performance, due to large propagation delay, high link errors,and link asymmetry etc. Moreover the third-generation (3G) wireless networks, with advantages of multi-megabit Internet access, omnipresent access, have significant TCP throughput degradation due to high packets losses, spurious TCP retransmission and link asymmetry etc. TCP seems more and more inflexible and inefficient in the wireless heterogeneous networks. Thus adaptive transport layer protocol is proposed to cope with heterogeneity problem and maintain high performance in the future wireless networks [1]. Adaptive congestion control is vital function addressed in adaptive transport layer protocol based on the Additive-Increase Multiplicative-Decrease (AIMD) algorithm. For example And receiver-centric transport layer protocol.

II. ADAPTIVE RECEIVER-CENTRIC TRANSPORT LAYER PROTOCOLS

2.1 R²CP (RADIAL RECP)

R²CP is a receiver-driven, multi-state transport protocol that supports multipoint-to-point connections. The R²CP destination (receiver) maintains multiple states; each of them corresponds to the single state maintained by individual sources (senders) in the connection. It is designed for multi-homed mobile hosts. *R*2*CP* is a multi-state extension of ReCP at the receiver for the higher layer application[7]. A *R*2*CP* connection has multiple independent ReCP senders with their corresponding ReCP receiver, and the *R*2*CP* is responsible for coordinating receivers when a mobile hosts handoff from on interface to another during a live connection in heterogeneous networks. *R*2*CP* can provide the

ISSN : 0975-3397

following functionalities: seamless handoffs without relying on infrastructure support, server migration for achieving continuous service and bandwidth aggregation using multiple active interfaces.

2.2 RECP (RECEPTION CONTROL PROTOCOL)

ReCP is a receiver-centric transport protocol that is a TCP clone[8]. But the receiver in ReCP has transposed the main functionalities including congestion control, loss recovery and power management form the sender. The intelligence of transport protocol at the receiver is more neighboring to the wireless link. Hence the receiver can get the first-hand information and have quicker responses to the varying network environments to achieve high performance. More importantly, mobile hosts are increasingly being equipped with multiple interfaces to adapt to the heterogeneous wireless networks in the future wireless networks. ReCP can provide powerful and comprehensive transport layer solutions to the multi-homed hosts. Firstly, more effective congestion control approaches.There are two options to solve congestion control problem, scalable solution and adaptive congestion control mechanism. In scalable solution multiple congestion control protocols are needed to perform congestion control in an interface-specific fashion. However adaptive congestion control approach is a more effective and cost-effective solution.Hence ReCP can be a more powerful adaptive transport layer protocol, if it incorporates the advantages of receiver-centric schemes and the adaptive congestion control method; Secondly, seamless server migration capacity during handoffs; Thirdly effective bandwidth aggregation when receiving data through multiple interfaces.

In RCP, the receiver performs congestion control and maintains the congestion control parameters including the congestion window `CWND` and round-trip time information.Since RCP is a TCP clone, it adopts the window based congestion control used in TCP such as slow start, congestion avoidance and fast retransmission.Note that while the same window adaptation algorithm (additive increase, multiplicative decrease) can be implemented either at the sender or at the receiver for performing congestion control, the semantics of the congestion window and the trigger for window increase or cut down are different. In TCP, the size of the congestion window limits the amount of unacknowledged *DATA* in the network, and the sender uses the return of *ACKs* to trigger the progression of the congestion window. In RCP, the size of the congestion window limits the amount of outstanding *REQs* in the network, and the receiver uses the return of *DATA* to adjust the congestion window.

2.2.1 Adaptive Congestion Control

Reception Control Protocol (ReCP) adopts an adaptive congestion control algorithm that dynamically monitors the wireless random loss rate and delay, and adjusts its congestion control adaptation parameters as offsets to the loss rate and delay components introduced by the wireless link [3]. ReCP integrates the advantages of receiver-centric mechanism and adaptive congestion control scheme

2.2.2 POWER MANAGEMENT

While a majority of work on the performance of TCP has focused on the throughput achievable, recently the energy efficiency of TCP has also gained attention [5,6,7]. It is shown that since channel errors tend to be bursty (correlated), it is energy conserving to cut down the window size (and hence reduce the number of packets in flight) when wireless losses are detected. This is because packets retransmitted immediately after wireless losses are likely to be lost again, thus wasting the energy. While TCPSACK achieves better throughput performance compared to other TCP variants, in fact it is the least energy-conserving protocol of all when the channel error rate is high [6].Therefore, an energy-efficient transport protocol should avoid persistently accessing the channel when the channel condition is hostile, as energy consumed during this period for attempting to transmit or receive packets is likely to be wasted. Instead, it should adjust the retransmission policy according to the channel dynamics. While it is possible to implement such power management in a sender-centric transport protocol like TCP, there are several limitations to this approach: (i) While the receiver is more aware of the channel condition than the sender, any power-saving decision We now show the performance of RCP in terms of facilitating power management at the mobile host., when the channel condition is severe, it is not energy efficient for a mobile host to persevere with persistent retransmissions. Since the mobile host is an end-point of the wireless lasthop,it is aware of the channel condition (via, say, measuring the signal strength in the received packets or beacons from the access point). Upon detecting a hostile channel state, the mobile host can save the battery power by reducing the amount of data in transit or refraining from transmissions. However, note that while significant energy savings can be achieved by operating the wireless interface card in the sleep mode, doing so without the sender being aware of such energy-conserving tactics may cause adverse reactions at the sender and cause performance degradation [7]. A receiver-centric protocol such as RCP does not have this problem since the mobile host has full control over *how much* data the sender should send.

 ISSN : 0975-3397

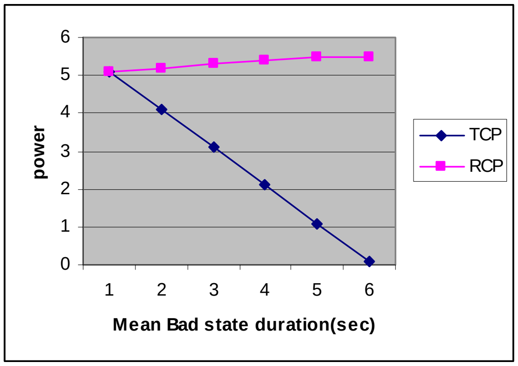

Figure 1. Performance of RCP in power management

Figure compares the performance of RCP and TCP in terms of power consumption when the mean duration of the bad state varies from 1s to 10s. We assume that the sender is unaware of the channel state, and hence when TCP is used, the mobile host receives data and transmits *ACKs* irrespective of the channel state. On the other hand, when RCP is used, the mobile host enters and leaves the sleep mode as mentioned before.The mobile host freezes the RCP timer when it enters the sleep mode. When it wakes up, RCP resumes data request based on the state (holes) of the receive buffer. As expected, the longer the mobile host stays in the sleep mode, the more energy savings it can achieve using RCP.

III. CONCLUSION

Adaptive transport layer protocol RCP are feasible schemes to cope with heterogeneity and to perform efficient power management and adaptive congestion control on wireless network. ReCP can be improved to integrate the advantages of receiver-centric mechanism .

IV. REFERENCES

[1] Ian Skyildiz and Yucel Altunbasak, “AdaptNet: An Adaptive Protocol Suite for the Next-Generation Wireless Internet,” IEEE Communication Magazine

[2] H. L. Z.Naor, “A Centralized Dynamic Access Probability Protocol for Next Generation Wireless Networks,” vol.2, 2001

[3] George Thomas, “A Rate-Adaptive Protocol For Wireless Data Channel,” IEEE, 2000

[4] A. Sanmateu, L. Morand, E. Bustos, S. Tessier, F. Paint, and A. Sollund. Using Mobile IP for provision of seamless handoff between heterogeneous access networks, or how a network can support the always-on concept. In *Proceedings of EURESCOM Summit*, Heidelberg, Germany, Nov. 2001.

[5] V. Tsaoussidis, H. Badr, X. Ge, and K.entikousis. Energy/Throughput tradeoffs of TCP error control strategies.In *Proceedings of IEEE ISCC*, Antibes, France, July 2000.

[6] M. Zorzi and R. Rao. Is TCP energy efficient? In *Proceedings of IEEE MoMuC*, San Diego, CA, USA, Nov. 1999.

[7] R. Krashinsky and H. Balakrishnan. Minimizing energy for wireless web access with bounded slowdown. In *Proceedings of ACM MOBICOM*, Atlanta, GA, USA, Sept. 2002.

[8] H. -Y.Hsiesh et al., “A receiver–centric Transport protocol for mobile Host with heterogeneous Wireless Interfaces,” Mobile Hosts with Heterogeneous Wireless Interfaces,” Proc. ACM MOBICOM, San Diego, CA, Sept 2003.

[9] H. -Y.Hsieh and R.SivaKumar,”A transport Layer Approach for Achieving Aggregate Bandwidths on Multi-Homed Mobile Hosts,” Proc ACM MOBICOM, Atlanta, GA, Sept.2002

[10] H. -Y.Hsieh and R.SivaKumar,”On transport Layer support for peer to peer networks,” Proc ACM MOBICOM, Atlanta, GA, Sept.2002

ISSN : 0975-3397