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TCP Variants under WSN and MANET Environment & Their Analysis using NS-2

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Abstract
TCP provides reliability to data transferring in all end-to-end data stream services on the internet. This protocol is utilized by major internet applications. TCP was originally created to handle the problem of network congestion collapse. This paper is prepared on the performance of different TCP variants to identify the best protocol variant for network expansion. In such context, a full comprehensive simulation environment is created for evaluating the comparative performance of TCP variants like TCP Tahoe, Reno, NewReno and TCP Vegas. From the results, TCP Reno is the most aggressive (least fair one), and highest amount of throughput. In the TCP NewReno it follows Reno's step by becoming the second most aggressive (second least fair), and second highest throughput. SACK is fair to Reno and NewReno, but it is competing with Vegas, Finally TCP Vegas shows the highest degree of fairness, TCP Vegas can adapt the changing bandwidth very well and it is robust against the fluctuation
Keywords—TCP Tahoe, Reno, NewReno, SCAK, TCP Vegas.

I. Introduction

TCP was originally made for wired links. On wired links there are very less chances of high delay [1] and corruption of data due to external parameters. Congestion is the main cause of packet loss on wired links. So, TCP was designed by keeping in mind the above parameters. As wireless and heterogeneous networks came into the existence, due to the requirement of reliable protocol in TCP/IP model in internet, TCP was adopted as it was on wired links. Wireless links have severe problem of variable and high delay with high Bit Error Rate (BER). So initially, unmodified old TCP started to perform badly on wireless links. To deal with the problems of wireless links, a research started in the field of TCP and modifications were done according to the requirements to improve the performance. Variants named Tahoe, Reno, NewReno and SACK and many more came into existence. TCP Tahoe is the first TCP variant which includes the first congestion control algorithm. This algorithm is developed by Jacobson and Karels in 1986. Based on the same concept presented by Jacobson and Karels, many more algorithms are then introduced. Following that, many enhancements and modifications are conducted on Tahoe, and leads to design and development of new TCP variants with different congestion window algorithms (Mo et al., 1999). The performance of TCP variants are directly affected by its own congestion control mechanisms, where the packet amount transferred over network connections is based on the work and the behaviour of the congestion control and its role in exploiting the capacity of the network path (Sarolahti, 2002). RFC 793 standardized the first TCP version with its basic configuration based on a scheme of windowbased flow control. TCP Tahoe represents the second generation of TCP versions, which includes two new techniques, congestion avoidance and fast transmission. Reno is the third version of the first developed series, and it is standardized in RFC 2011, where the congestion control mechanism is further extended by fast recovery algorithm. However, versions of TCP Tahoe and Reno (and their variants) are not perfect in terms of throughput and impartiality among connections. Therefore, active research on TCP has been done, and many improvement mechanisms have been proposed [1]-[4]. Among them, a TCP Vegas version [5],[6] is one of the promising mechanisms because of its high performance. One important point is the underlying network assumed by TCP Vegas. When the original TCP Vegas was proposed [5], The RED (Random Early Detection) mechanism [8], was not consider in the operating network. TCP Vegas may or may not be effective when the router is equipped with the RED mechanism [8]. We therefore consider two packet scheduling mechanisms, the RED router as well as the conventional drop-tail router. One of the contributions in this paper is to International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 8–August 2013 ISSN: 2231-2803 http://www.ijcttjournal.org Page 2963 derive analysis results of the throughput of TCP Tahoe, Reno, NewReno and Vegas in such a situation where they share the link with TCP variants. The accuracy of our analysis is validated by comparing the simulation results.

II. Litrature Review

L. S. Brakmo et. al [3] had proposed a new technique of congestion control detection and avoidance called TCP Vegas. They investigate the performance of TCP Vegas in the wired network by comparing to the performance of TCP Reno. The implementation of BSD Unix in the x-kernel based simulator tool is used to analyze the performance of TCP Vegas. From their study, they conclude that TCP Vegas achieves better throughput. TCP Vegas involves modification to the earlier TCP congestion control algorithm (TCP Tahoe and TCP Reno [8]) that detects congestion based on packet delay rather than packet loss. The delay estimation scheme is used as a mechanism to detect the congestion in terms of packet delay. TCP Vegas as the congestion control algorithm optimizes the performance of TCP due to the implementation of this delay estimation scheme. However, this is only true when TCP Vegas is implements in homogeneous wired network. When TCP Vegas is implemented in heterogeneous wired network, TCP Vegas performances become worst.

A. D. Vendictis et. al [6] evaluate the performance of TCP Vegas and TCP Reno behaviors in a heterogeneous wired network. From their study, they conclude that the fairness of TCP Vegas and TCP Reno cannot be achieved. They had proposed a new TCP congestion control algorithm called TCP NewVegas. TCP NewVegas preserves the excellent features of TCP Vegas in homogeneous wired network and improves the bandwidth fairness of bottleneck link when competing with TCP Reno.

R. Dunaytsev et. al [9] evaluate the performance of TCP in wired and wired-cum-wireless networks. They proposed enhanced-TCP variants that allow evaluating the combined effect of parameters on TCP performance over both correlated and uncorrelated wireless network. These enhanced-TCP models include TCP Tahoe, TCP Reno, TCP NewReno and TCP SACK. The parameters include the bit error rate (BER). The developed models are able to optimize startup performance, minimize correlated losses, enable performance evaluation over wide range of operating conditions and allow quantifying the joint effect of parameters of automatic repeat request (ARQ)/ forward error connection (FEC).

K. Pentikousis et. al [10] conduct a survey study on the performance of the TCP in wired-cum-wireless environments From their survey, the present TCP performance-related issues in wired-cum-wireless environments. They conclude that TCP perform poorly in wireless environments in terms of achieved throughput due to the factors of limited bandwidth, Long RTT, random losses, short flows, user mobility and power consumption.

H. Balakrishnan et. al [11] compare the mechanisms for improving TCP performance over wireless links. They classified these mechanisms into three categories. The first category is the end-to-end protocol, where loss recovery is performed by the sender. The second category is the link-layer protocols that provide local reliability; and the third category is the split-connection protocols that break the end-to-end connection into two parts at the base station. These protocols shield the wireless transmission losses from the congestion losses.

III. Simulation environment & Result:

Simulation Tool	NS-2
No.Of Nodes	100
IEEE Standard	802.15.4,802.11
MobilityModel	Random Way Point
Anteena Model	Omni Directional
Mobility Speed	20m/sec,250m/sec
Routing Protocol	AODV,DSDV
Simulation Area	2 K.m
Simulation Time	200 sec.

We have performed our simulation using both manet and wsn environment along with different routing protocols.

IV. Results & Analysis:

TCP variants with AODV routing protocol over MANET.

AODV	FACK	NEWRENO	RTCP	SACK	VEGAS
ENERGY (JOULE)	79.3	78.7	99	79.04	79
E2E DELAY (MS)	120.7	116.1	225.3	125.5	34.5
JITTER (MS)	0.19	0.16	0.22	0.166	0.30
TPUT (KBPS)	1997.26	1975.14	337.16	2000.98	916.31
PDR	90.4	91.7	88	91.5	86.5

TCP variants with DSDV routing protocol over MANET.

DSDV	FACK	NEWRENO	RTCP	SACK	VEGAS
ENERGY (JOULE)	79.1	79.4	99.2	79.4	80.5
E2E DELAY (MS)	129.7	129.0	148.52	131.84	30.12
JITTER (MS)	0.11	0.11	3.2	0.112	0.118
TPUT (KBPS)	1970.28	1977.20	76.92	1957.02	917.01
PDR	94.1	94.2	36.6	94.1	94

Analysis for MANET Scenario:tcp variants when implemented on manet scenario on following parameters:
Energy Consumption:energy consumption in dsdv protocol in all the variants is less as compare to aodv except tcpfack.
E2E Delay: When we look across end to end delay than DSDV having More delay with all the tcp variants except one i.e. TCPVEGAS.
JITTER: Jitter for all the tcp variants for DSDV under MANET environment is less as compared with AODV under MANET scenario.
Throghput: For RTCP throghuput is less under DSDV as compared with AODV but except this all the variants having almost same throughput.
Packet Delivery Ration:Packet Delivery ratio in all the cases under DSDV except RTCP is better than that of AODV thus we can conclude that DSDV gives better PDR with most of the tcp variants.

TCP variants with AODV routing protocol over WSN.

AODV	FACK	NEWRENO	RTCP	SACK	VEGAS
ENERGY (JOULE)	98.9	88.7	99.5	99.04	99.7
E2E DELAY (MS)	50.16	46.01	116.2	43.4	124.32
JITTER (MS)	0.35	0.16	2.85	0.58	2.7
TPUT (KBPS)	83	128.4	8.45	65.36	67.5
PDR	83.4	90.8	39.7	75.0	84.7

TCP variants with DSDV routing protocol over WSN.

DSDV	FACK	NEWRENO	RTCP	SACK	VEGAS
ENERGY (JOULE)	87.18	87.1	99.7	87.57	98.15
E2E DELAY (MS)	56.36	56.34	31.97	51.95	10.03
JITTER (MS)	0.07	0.07	2.98	0.7	0.40
TPUT (KBPS)	107	108.58	12.49	107.6	82.7
PDR	96	96	38.2	96	81.12

Analysis of TCP Variants for WSN Scenario:tcp variants when implemented on wsn scenario on following parameters:
Energy Consumption:energy consumption in aodv protocol in all the variants is less as compare to aodv except rtcp.
E2E Delay: When we look across end to end delay than for dsdv rtcp and vegas shows less e2e delay but all other variants shows more e2e delay as compared with aodv under wsn scenario.
JITTER: Jitter for all the tcp variants for DSDV as well as AODV under WSN environment is almost same means in wsn scenario the distortion in frequency for both the cases will be the same..
Throghput: From above results it is clear that for a WSN environment DSDV is always showing a better throughpurt as compared with AODV routing protocol.
Packet Delivery Ration:Packet Delivery ratio in all the cases except RTCP and TCP Vegas is better in case of DSDV than that of AODV thus we can conclude that DSDV gives better PDR with most of the tcp variants.

V. Conclusion:

We have implemented two scenarios i.e. MANET & WSN for comparing various tcp variants and from results and analysis we have conclude that DSDV for protocols and new reno for tcp variant is better when compared in both MANET and WSN environment.

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