

TCP Versus UDP Performance In Term Of Bandwidth Usage

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By
Mostfa M. Kaytan

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ABSTRACT

This project is mainly about how to establish User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) connection in the same network simulation. For that, we will be using four types of TCP which are TCP Tahoe, TCP Reno, TCP NewReno and TCP Vegas. From there, we are going to differentiate them in term bandwidth usage and define how it works and describes several effect that occurred when its work together. In order to create the topology and run the protocols, we use Network Simulator 2 (NS2) to create and run the coding. To run the codes, we use command which use a few code in running the coding. Then we will get a topology, which is the flow of the packet within the source and destination, base on the coding. A graph also appears after the command.

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In the name of Allah, Allah says:

((Work; so Allah will see your work and (so will) His Messenger and the believers ;))

(Al-Quran: Tawba-105)

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ABBREVIATIONS

TCP	Transport Control Protocol
UDP	User Datagram Protocol
FTP	File Transfer Protocol
CBR	Constant Bit Rate
NS	Network Simulation
NAM	Network Animator
TCL	Tool Command Language
OTCL	Object extension of TCL
HTTP	Hypertext Transfer Protocol
POP	Post Office Protocol
SMTP	Simple Mail Transfer Protocol
ATM	Asynchronous Transfer Mode
DSSS	Direct-Sequence Spread Spectrum.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Transmission Control Protocol/Internet Protocol (TCP/IP), the most common of all network protocol suites, used for communication on the Internet. TCP/IP is a hierarchical protocol made up of interactive layers (as shown in Figure I) each layer has a specific functionality. (Ross, 2008)

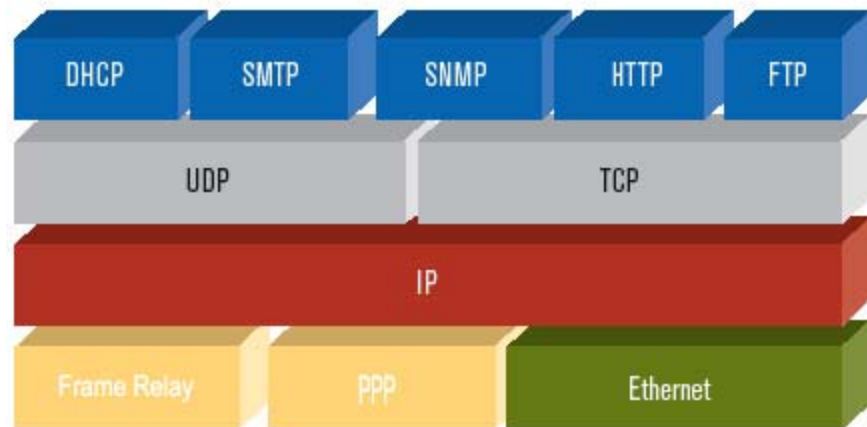


Figure 1.1 TCPIIP Protocol Suite

According to (Ross,2008) application layer are placed at the top of TCP / IP stack, it defines protocols such as (FTP, HTTP, Telnet and so on) for application communication. These protocols are acting as interface for the actual application program. The transport layer follows the application layer. TCP/IP makes available two distinct transport layer protocols to the application layer: Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). The transport layer follows the application

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References

REFERENCES

A study of the behavior of TCP in variable-bandwidth environments. from

<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.59.8428> 2/8

A Comparative Analysis of TCP Tahoe, Reno, New-Reno, SACK and Vegas. (1998).

from

<http://inst.eecs.berkeley.edu/~ee122/fa05/projects/Project2/SACKRENEVEGAS.pdf>

A.K.Aggarwal, A. (2003). ACC – ABCD Compliant NS-2.

Allman, M., and Falk, A. (1999). On the Effective Evaluation of TCP. *ACM Computer Communication Review*.

Allman, M., Paxson, V., and Stevens, W. (1999). TCP Congestion Control. *RFC 2581, IETF*

Bajaj, s., Breslau, L., Estrin, D., Fall, K., Floyd, S., Haldar, P., et al. (1999). Improving Simulation for Network Research. *IEEE*.

Barbeau, J. G. M. (2000). "Comparison of Bandwidth Usage: Service Location Protocol and Jini."

Chohan, N. (2006). An Analysis of TCP through Simulation.

Eddy, W. M. (2004). *Improving Transmission Control Protocol Performance With Path Error Rate Information*. College of Engineering and Technology of Ohio

References

- University.
- Fall, K. and Floyd, S. 1996. Simulation-based Comparison of Tahoe, Reno and SACK TCP.
- Fang, Q., Jia, W., and Wu, J. (2005). Available Bandwidth Detection with Improved Transport Control Algorithm for Heterogeneous Networks. *ACM*, 656 - 659.
- Floyd, S., and Fall, K. (1999). Promoting the use of end-to-end congestion control in the Internet. *IEEE/ACM Transactions on Networking*, 7(4).
- Floyd, S., and Fall, K. 2001. Why we don't know how to simulate the Internet.
- Floyd, S., and Fall, K. 1997. Difficulties in Simulating the Internet.
- Forouzan, B. (2000). *TCP/IP Protocol Suite*. Boston: McGrawHill.
- Giannoulis, S., Antonopoulos, C., Topalis, E., Athanasopoulos, A., Prayati, A., and Koubias, S. TCP vs. UDP Performance Evaluation for CBR Traffic On Wireless Multihop Networks. from <http://www.wcl.ee.upatras.gr/csndsp/CD/contents/Sessions/Presentations/A7%20-%20Wireless%20LAN/A7.4.pdf>
- Gill, M. and Zafar, M. S. (2008). Evaluation of UDP and SCTP for SIP-T and TCP, UDP and SCTP with constant traffic.
- Govea, J., and Barbeau, M. (2000). Comparison of Bandwidth Usage: Service Location Protocol and Jini. from www.scs.carleton.ca/~barbeau/Publications/2000/TR_00_06.pdf
- Hassan, M., and Jain, R. (2004). *High Performance TCP/IP Networking Concepts*,

References

- Issues, and solutions*. London: Prentice Hall.
- Hossain, T. I. E. (2009). Introduction to Network Simulator NS2.
- Huston, G., and Telstra. (2009). TCP Performance. *The Internet Protocol Journal*, 3(2).
- Issariyakul, T., and Hossain, E. (2009). *Introduction to Network Simulator NS2*. New York, USA: Springer Science+Business Media.
- Jacobson, V. (1988). *Congestion avoidance and control*. Paper presented at the ACM SIGCOMM Special Interest Group on Data Communications.
- Jeonghoon Mo, R. J. L., Venkat Anantharam, and Jean Walrand. (2004). Analysis and Comparison of TCP Reno and Vegas [Electronic Version].
- Jin, C., X.Wei, D., and Low, S. H. (2004). FAST TCP: Motivation, Architecture, Algorithms, Performance. *IEEE Infocom*
- Kazantzidis, M. (2001). How to measure available bandwidth on the Internet. from <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.25.2565>
- Khorashadi, B., Chen, A., Ghosal, D., Chuah, C.-N., and Zhang, M. (2007). Impact of Transmission Power on the Performance of UDP in Vehicular Ad Hoc Networks. *IEEE*, 3698-3703.
- Kurose, J., and Ross, K. (2005). *Networking: A Top-Down Approach Featuring the Internet* (3 ed.). Boston: Addison-Wesley.
- Lai, Y. and Yao, C. (2000). The Performance Comparison between TCP Reno and TCP Vegas. *IEEE*, 61 – 66.

References

- Lee, H., Lee, S.-h., and Choi, Y. (2001). The Influence of the Large Bandwidth-Delay Product on TCP Reno, NewReno, and SACK. *IEEE*, 327-334.
- Mattsson, N.-E. (2004). *A DCCP module for NS-2*. Lulea Tekniska University.
- Mehra, P., and Zakhor, A. (2003). Receiver-Driven Bandwidth Sharing for TCP. *IEEE*, 7(4), 740- 752.
- Mo, J., La, R. J., Anantharam, V., and Walrand, J. (1999). Analysis and Comparison of TCP Reno and Vegas. *IEEE*, 3, 1556-1563
- Peterson, L. L., and Davide, B. S. (2003). *Network Simulation Experiments Manual*. San Francisco, USA: Morgan Kaufmann Publishers.
- Polyzos, G. X. a. G. C. (2003). "Wireless link layer enhancements for TCP and UDP applications."
- Postel, J. (1981). Transmission Control Protocol. *RFC 793*.
- Ren Wang, G. P., Kenshin Yamada, M.Y. Sanadidi, and Mario Gerla. (2004). TCP Startup Performance in Large Bandwidth Delay Networks [Electronic Version].
- Rohner, C., Nordstrm, E., Gunningberg, P., & Tschudinn, C. (1998). Interactions between TCP, UDP and routing protocols in wireless multi-hop ad hoc networks.ROSS, J. F. K. K. W. (2008). Computer network.
- Ross, J. F. K. K. W. (2008). Computer network.
- S.Floyd, and T.Henderson. (1999). The NewReno Modification to TCP's Fast Recovery Algorithm. *RFC 2582*.

References

- S. Giannoulis, C. A., E. Topalis, A. Athanasopoulos, A. Prayati, S. Koubias. TCP vs. UDP Performance Evaluation for CBR Traffic On Wireless Multihop Networks [Electronic Version] from <http://www.google.com.my/search?hl=en&ei=aGKoSvPFBIme6gPN3uWYBga&nds=1>.
- S.Sudha, Maddipati, S., and Ammasaigounden, N. (2008). A new adaptive marker for bandwidth fairness between TCP and UDP traffic in DiffServ. *IEEE*, 1-5.
- Singh, H., and Singh, S. (2002). Energy Consumption of TCP Reno, Newreno, and SACK in Multi-Hop Wireless Networks. *ACM*, 206 - 216.
- Singh, M., Guha, S., and Francis, P. (2005). Utilizing spare network bandwidth to improve TCP performance. *ACM*.
- Stevens, W. (1997). TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms. *RFC 2001, IEEE*.
- Stevens ,W.(1994).TCP/IP illustrated.
- Todorovic, M. (2005). *Comparative Study Of The End-To-End Compliant Tcp Protocols For Wireless Networks*. Texas Tech University, USA.
- Wang, R., Pau, G., Yamada, K., Sanadidi, M. Y., and Gerla, M. (2002). TCP Startup Performance in Large Bandwidth Delay Networks. from www.ieee-infocom.org/2004/Papers/16_5.PDF
- Xu, S., and Saadawi, T. (2001). Does the ieee 802.11 mac protocol work well in multihop wireless ad hoc networks? . *IEEE Communications Magazine*, 39(4).

References

- Xylomenos, G., and Polyzos, G. C. (1999). TCP and UDP Performance over a Wireless LAN. *IEEE*, 439–446.
- Yaacob, N. A. (2003). Utilizing Snort in the analysis of intrusion Detection System. University Utara Malaysia.
- Zafar, M. S., and Gill, M. S. (2008). *Evaluation of UDP and SCTP for SIP-T and TCP, UDP and SCTP with constant traffic*. Blekinge Institute of Technology.
- Zakhor, P.M. (2003). Receiver-Driven Bandwidth Sharing for TCP [Electronic Version] from <http://www.google.com.my/search?hl=en&q=Receiver-Driven+Bandwidth+Sharing+for+TCP.6/8>