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PERFORMANCE EVALUATION IN STANDARD TCP AND UDP USING NS3 SIMULATOR

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ABSTRACT

User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) are a transportation layer routing protocols which are considered of the main protocols of the internet protocol suite. The attribute of these routing protocols with different network metrics and scenarios is still not very clear. Therefore, this research discusses a comparison of the performance of both TCP and UDP to determine which of these protocols is better in terms of latency and throughput. Network Simulator (NS3) is utilized to analyze and evaluate the performance for both TCP and UDP protocols varying in the packet size and the bandwidth. In this paper, we use two situations, in the first situation the bandwidth has been adjusted with fixed packet size and in the second situation the packet size has been adjusted with fixed bandwidth to actually validate the performance of these protocols. These protocols were examined in terms latency and throughput. The results have referred that TCP outperformed UDP in terms of the latency while UDP outperformed TCP in terms of throughput.

Keywords: Internet Protocol, Network Simulator 3, Transmission Control Protocol, User Datagram Protocol.

INTRODUCTION

The connectivity between two or more systems to shares resources such as video, audio, graphics etc., using electronic devices connected to the network. The transport layer is the center of all protocol hierarchy. Its major goal is to provide reliable and effective data transport from the source device to the destination device, independently of the networks currently in use. The desired result is achieved when the transport layer makes use of the services provided by the network layer.

Transport layer components like TCP and UDP provide the link through which applications access network services. TCP and UDP use Internet Protocol (IP), which is a lower-layer best

effort delivery service. IP encapsulates TCP packets and UDP datagrams and delivers this information across router-connected internet works.

TCP and UDP procedures are appropriate to work on middle layer of a network. Each layer takes data differently (Awasthi, P. and A. Kosta, 2013). Goswami et al (2014) opines that TCP uses a connection-oriented way to means of taking data by providing a consistent way of treating messages to ensures the transfer of the information. If error occurs in the process of sending the message, the data will be re-sent automatically over a network. UDP makes uses a transport prototype with minimum procedural method. Different software packages with the UDP can sent information, thus designated as datagram, it will also send sounds and videos (Kumar, S. and S. Rai, 2012). Researchers used NS3 software to assess the performance procedures built on the several measures like throughput and latency.

Thus, this research provides the performance evaluation in standard TCP and UDP to examine the functionality of the procedures with different packet size and bandwidth.

EVALUATION PERFORMANCE BETWEEN TCP AND UDP

TCP and UDP procedures are simulated and their performance is compared (Wechta et al, 1999). This comparison is mainly based on their congestion control and queue management mechanisms. TCP is a transport layer protocol used by applications that require guaranteed delivery. It is joined together by byte stream protocol. UDP is the connectionless transport layer protocol. The User Datagram Protocol offers only a minimal transport service nonguaranteed datagram. An application program running over UDP must deal directly with end-to-end communication problems that a connection-oriented protocol would handle. TCP is more reliable since it manages message acknowledgment and orders retransmissions in case of lost packets. UDP is a lightweight transport layer designed at top of IP. UDP uses a simple transmission model without implicit hand-shaking dialogues. TCP reads data as a byte stream and message is transmitted to segment boundaries. UDP messages are packets which are sent individually and on arrival are checked for their integrity.

TCP is used to control segment size, rate of data exchange, flow control and network congestion. Web browsing, email and file transfer are common applications that make use of TCP. TCP is preferred where error correction facilities are required at network interface level. UDP is largely used by time sensitive applications as well as by servers that answer small queries from huge number of clients. UDP is compatible with packet broadcast sending to all on a network and multicasting sending to all subscribers. UDP is commonly used in Domain Name System, Voice over IP, Trivial File Transfer Protocol and online games etc.

Table 1: TCP and UDP Comparison

TRANSMISSION CONTROL PROTOCOL (TCP)	USER DATAGRAM PROTOCOL (UDP)
TCP is a connection-oriented protocol. Connection-orientation means that the communicating devices should establish a connection before transmitting data and should close the connection after transmitting the data.	UDP is the Datagram oriented protocol. This is because there is no overhead for opening a connection, maintaining a connection, and terminating a connection. UDP is efficient for broadcast and multicast type of network transmission.

TRANSMISSION CONTROL PROTOCOL (TCP)	USER DATAGRAM PROTOCOL (UDP)
TCP is reliable as it guarantees delivery of data to the destination router.	The delivery of data to the destination cannot be guaranteed in UDP.
TCP provides extensive error checking mechanisms. It is because it provides flow control and acknowledgment of data.	UDP has only the basic error checking mechanism using checksums.
Sequencing of data is a feature of Transmission Control Protocol (TCP). this means that packets arrive in-order at the receiver.	There is no sequencing of data in UDP. If ordering is required, it has to be managed by the application layer.
TCP is comparatively slower than UDP.	UDP is faster, simpler and more efficient than TCP.
Retransmission of lost packets is possible in TCP, but not in UDP.	There is no retransmission of lost packets in User Datagram Protocol (UDP).
TCP has a (20-80) bytes variable length header.	UDP has a 8 bytes fixed length header.
TCP is heavy-weight.	UDP is lightweight.
TCP doesn't supports Broadcasting.	UDP supports Broadcasting.

Source: geeksforgeeks.org

SIMULATION SCENARIOS

To evaluate the performance of both the TCP and UDP protocols, we used the NS3 program. Two wired situations have been shown in this simulation to thoroughly examine how these protocols behave. Whereas in the first example, the packet size is fixed at 64 bytes and the bandwidth varies from 0.1 Mb/ms to 0.5 Mb/ms. While the bandwidth in the second scenario is fixed at 0.3 Mb/ms, the packet size varies from 800 to 1000 bytes. In table 1, simulation parameters are displayed. In this work, there are 8 nodes, and both simulations last for 60 seconds (Awasthi et al. 2013). The setting for wired simulation is shown in Figure 3.

PERFORMANCE METRICS

While comparing these protocols, we have taken the below two performance metrics:

1. Latency is the time it takes for data to pass from one point on a network to another
1. Latency is the time it takes for data to pass from one point on a network to another
2. Throughput is the average amount of data that actually passes through over a given period of time the average amount of data that actually passes through over a given period of time

Table 2. Simulation Parameters

Parameters	Values
Simulator	NS 3
Number of Nodes	5 Nodes
Simulation Time	60 Sec
Protocols	TCP and UDP
Bandwidth	2Mbps

SIMULATION RESULTS AND DISCUSSION

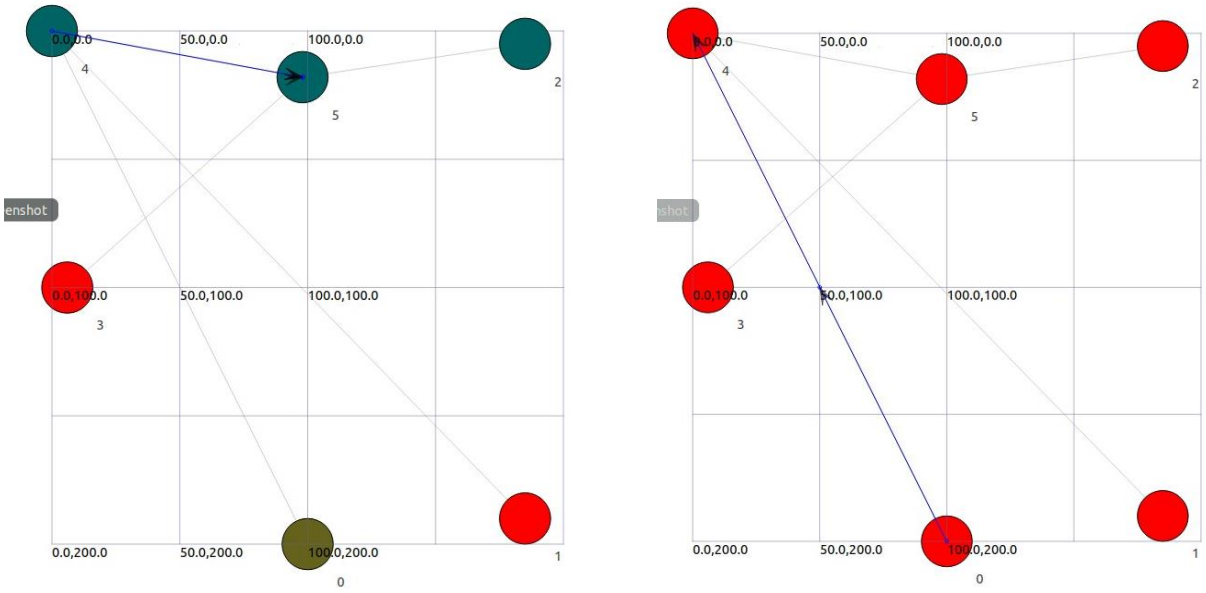

Figure 1: Simulation scenario showing package direction from different nodes

The time when using TCP to complete the task is greater than the one using UDP. When using TCP, source and destination need to perform a three-way handshake before starting sending data and all amount of data need to be acknowledge by the destination when it is received, so is taking more time than UDP, which doesn't perform these tasks.

We have examined and contrasted the TCP and UDP protocols using NS3 in two scenarios in this simulation. 500kb packet size and 2Mbps bandwidth were used to mimic the scenario. According to the outcomes in the delay scenario, TCP protocols performed significantly better than UDP, however in the second scenario, throughput, UDP performed better than TCP, as seen in the figures below.

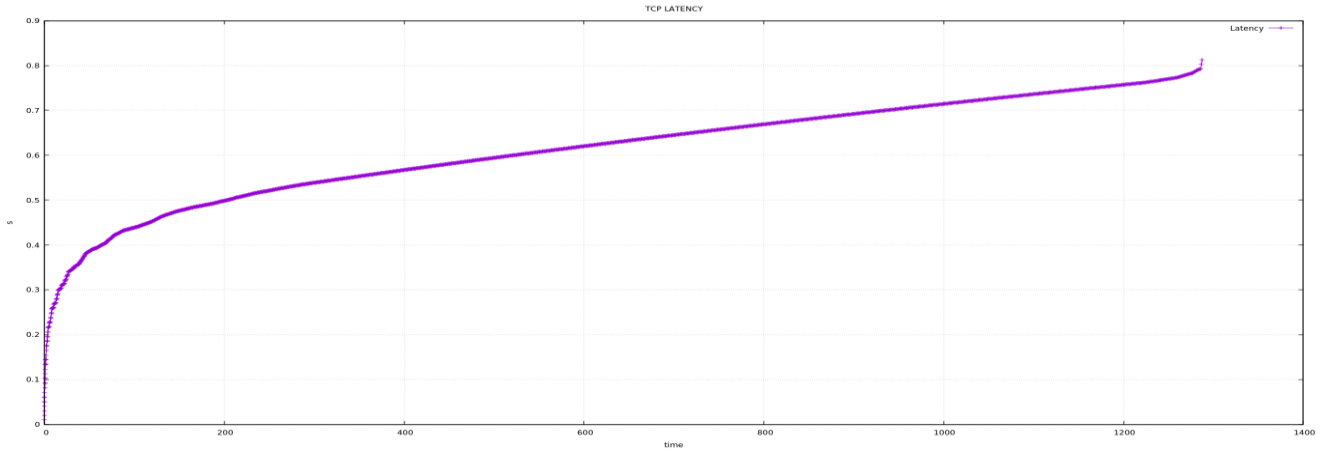

Figure 1: Graph showing TCP Latency

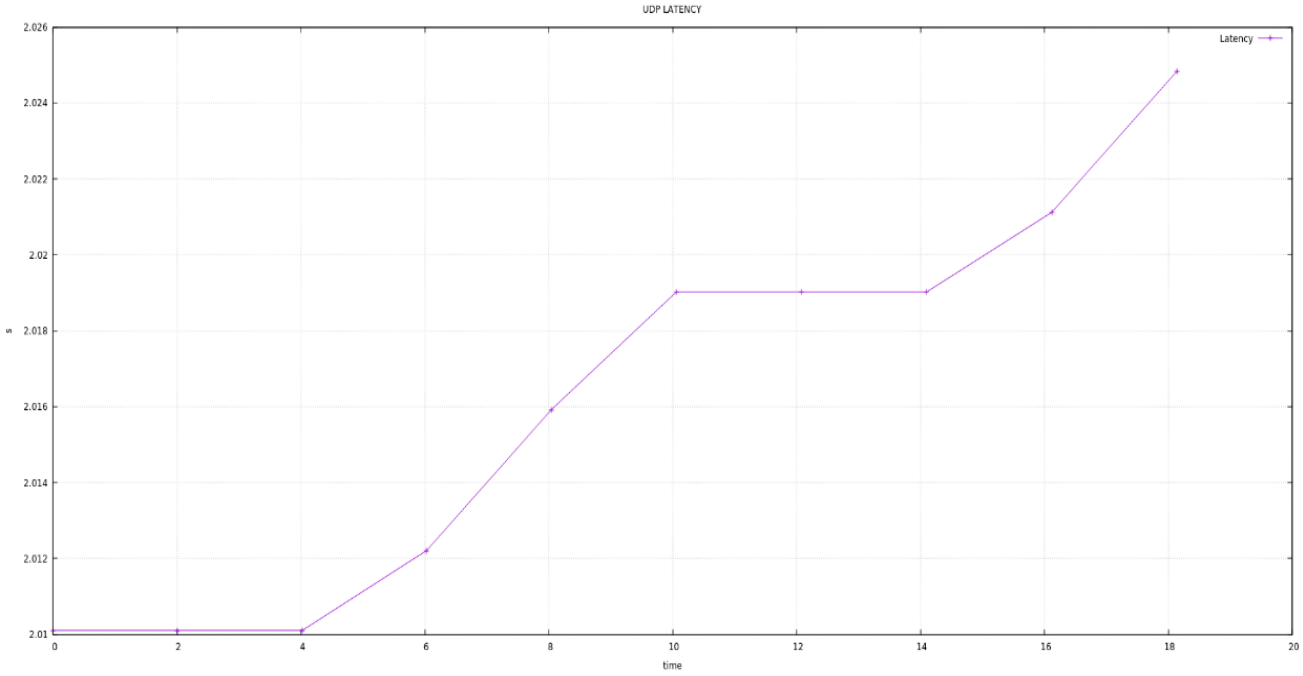

Figure 2: Graph showing UDP Latency

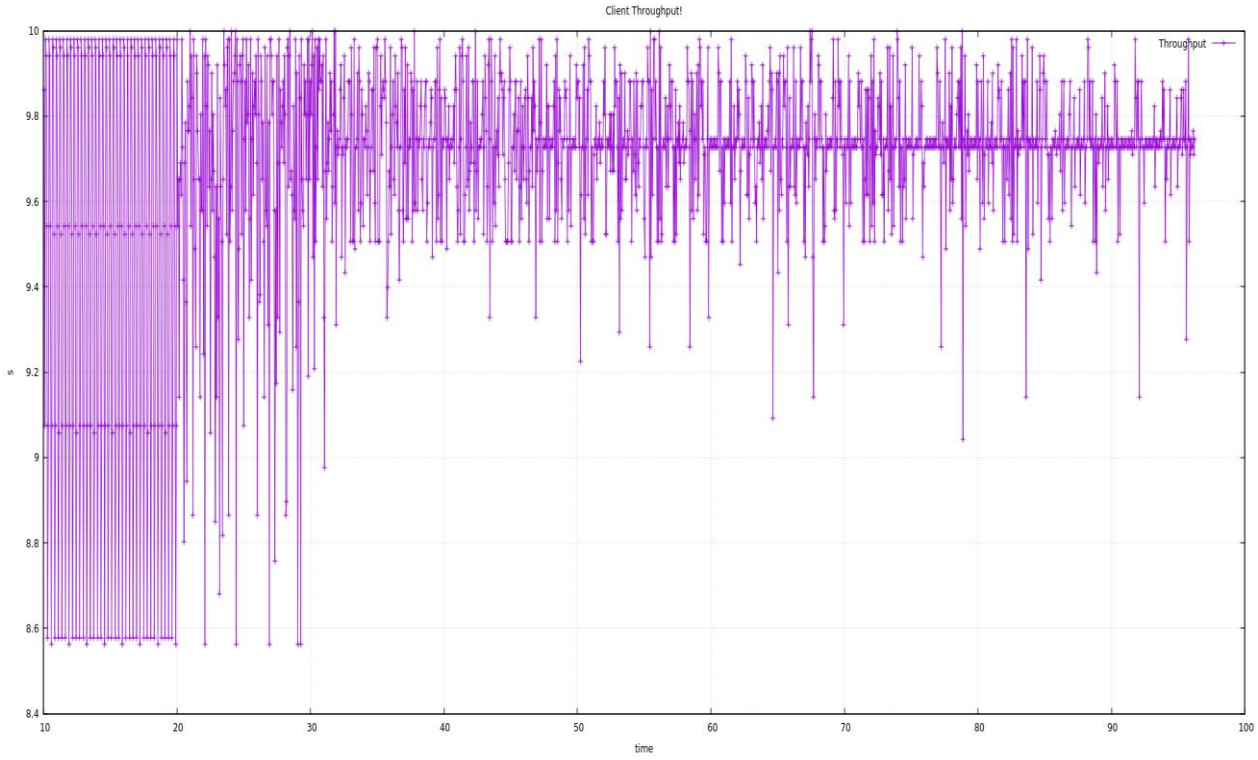

Figure 3: Graph showing TCP Throughput

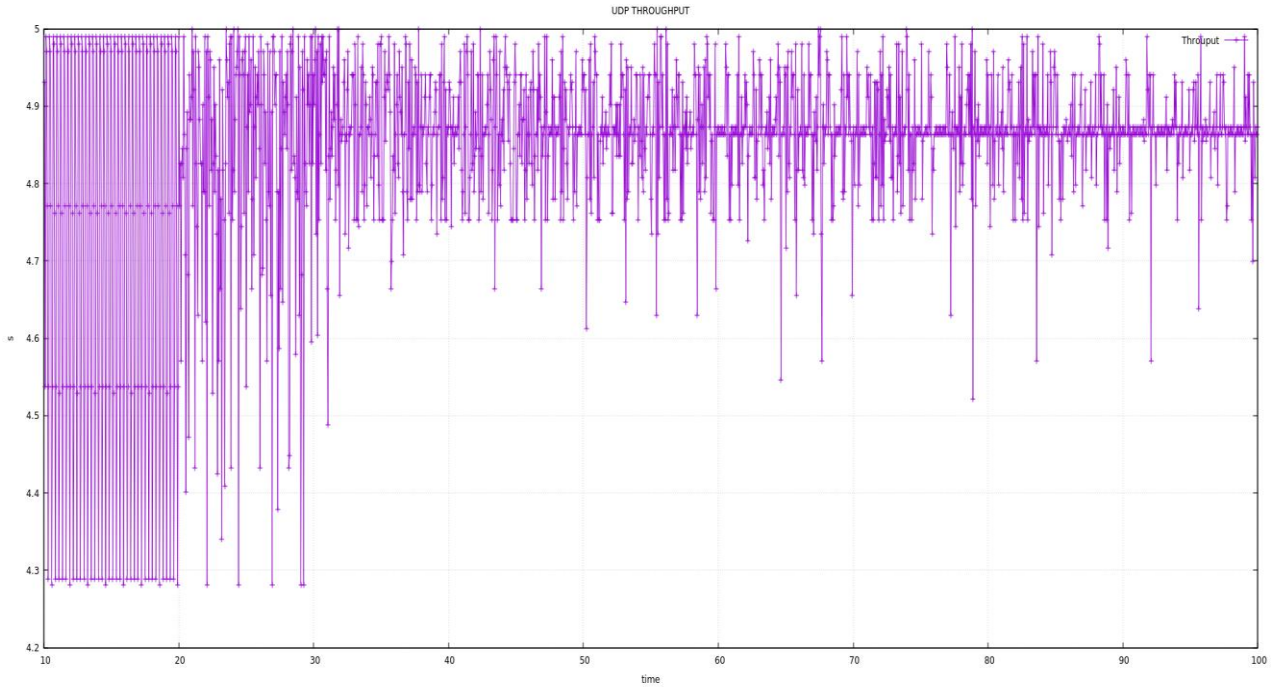

Figure 4: Graph showing UDP Throughput

Figures 1 through 4 above show the scenarios' findings, which indicate that UDP performs better than TCP in terms of throughput, TCP is superior in terms of latency.

CONCLUSIONS

The transportation layer protocols (TCP and UDP) are regarded as the fundamental internet protocols. These protocols behave differently depending on the network characteristics and contexts they are used in. We precisely identify which of these protocols is superior, we have therefore examined and contrasted the behavior of both TCP and UDP in two separate circumstances. To evaluate TCP and UDP behavior with variable packet size and bandwidth, we used the NS3 simulator. Throughput and latency were evaluated for these two protocols. The results showed that while UDP outperformed TCP in the throughput case, TCP outperformed UDP in the delay situation.

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