Evaluation of Network Performance by measuring one-way latency through precisely synchronizing time over a network connection

Measurement of one-way latency (time) taken by request and response interactions over a network connection.

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***Abstract*—Bandwidth, Latency, Throughput, Error Rate are the various parameters to evaluate network performance. Latency is the time expended by propagation through the network medium and the adapter hardware as well as the execution times of the software. It is an expression of time it takes for a packet of data to reach from server to client, the Round-trip time is considered the latency, if it is one-way, it will be time taken by the server to send the file or the time taken by the client to receive the file. This paper as the title points, focuses primarily on the evaluation of network performance by measuring one way latency through precisely synchronizing clocks at server and client side. The experiment is carried out primarily by synchronizing clocks at both client and server. Then, using the offset calculated on a symmetric link, time taken by the server to send the file and time taken by client to receive the file are noted down. The main observation was that the time taken for sending the packet data is less at server side than the time taken by the client to receive the file.**

I. Introduction

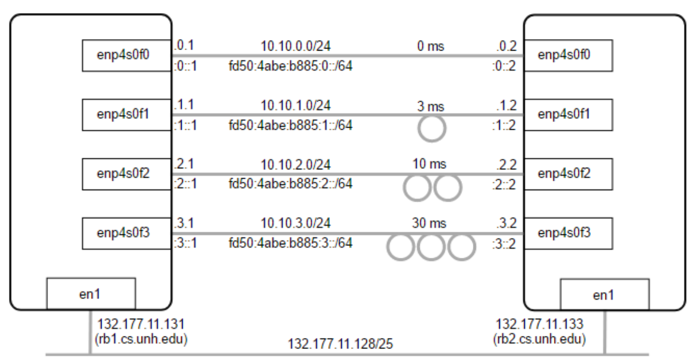
As the quality of Network service is expected to be always high across the globe, one of the best methods to evaluate the performance is by measuring the one-way latency. One-way latency can be measured by dividing the round-trip time into half, when the test systems' configurations are perfectly symmetrical. This means that the systems must be configured identically with the same OS, memory architecture and they should be having the clocks synchronized.

While Round Trip Time (RTT) provides limited insight with respect to one-way latency, the experiment is mainly performed to measure one-way latency by observing the time taken by the server to send a file and time taken by the client to receive it.

II. Detailed Description of the Experiment

For the experiment, to measure one-way latency, two Linux servers RB1 and RB2 with 4 interfaces each named enp5s0f0, enp5s0f1, enp5s0f2, enp5sof3 were used.

Figure 1.1: Design and IP address assignment of the Linux servers, RB1 and RB2

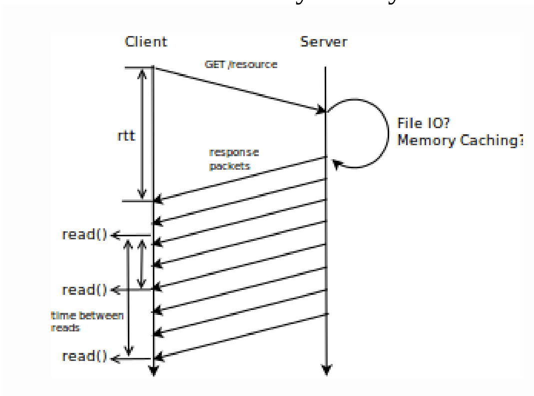


The algorithm is tested on all the four interfaces to observe the optimization in time (milliseconds). Primarily, offset between system clocks on rb1 and rb2 is found by taking advantage of a low latency symmetric link enp4s0. The type of data that is sent and received among the client and the server is same on all the four interfaces. For the experiment performed, 'RB1' served as the server and 'RB2' served as the client.

III. ONE-WAY LATENCY MEASUREMENT

One of the best methods to calculate network performance is to find Round Trip Time (RTT) and measuring one-way latency. RTT is the time it takes for an outgoing client packet to be answered by the server. It doesn't necessarily mean that there is any payload in the reply packet.

Figure 3.1: RTT and one-way latency outline



To perform the experiment, the client program is run on 'RB1' and server part of the code is run on the 'RB2'. The time taken for the server to send the file and time taken for the client to receive it is noted. The method is carried out at all the four interfaces and accurate transaction time (in milliseconds, ms) are noted down. RTT can theoretically calculated by using the formula,

$RTT = (\alpha.Old\_RTT) + ((1-\alpha).New\_RTT)$ where α is constant weighting factor ($0 \leq \alpha < 1$). RTT can also be determined by pinging from 1 server to the other but only if forward and return latencies are the same, it will yield the accurate RTT. Hence, RTT has limited scope with respect to one-way latency. In order to get accurate one-way latency value, offset between the clocks present in servers needs to be resolved. In case of geographically distributed nodes, GPS should be used as the source of precise time. In this experiment, offset is found using the symmetric link enp4s0. Then using the algorithm and file, one-way latency, i.e Time taken by server to send the file and time taken by the client to receive it were noted down.

The following table and diagram illustrate the patterns that were observed.

Figure 3.2: Network performance evaluation using one-way latency

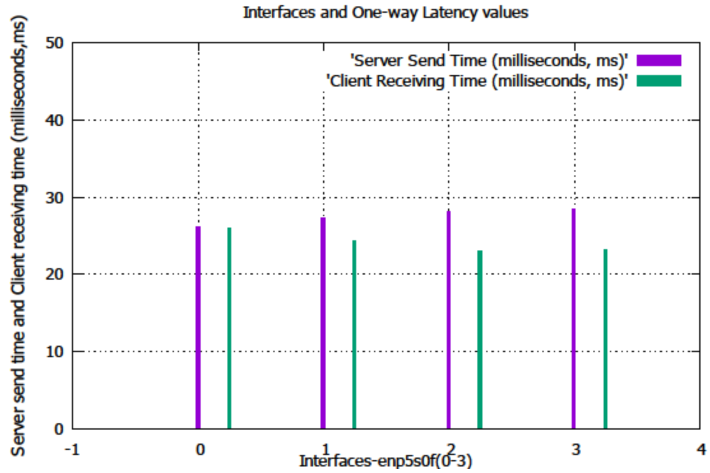


Table 3.1: Interfaces and One-way Latency values

Interface	Server Send Time (milliseconds, ms)	Client Receiving Time (milliseconds, ms)
enp5s0f0	26.1143	25.8218
enp5s0f1	27.2275	24.3171
enp5s0f2	28.1156	23.0181
enp5sof3	28.3771	23.1032

From figure 2.1, it can be observed that the time taken by the Server to send the file is less than the time taken by the TCP client to receive the same file.

Using the observations, it can be concluded that to evaluate network performance, one-way latency can be the best factor when it is observed separately apart from observing RTT. It can be read from the values obtained by resolving offset of the clocks in servers that time taken by the server is negligibly higher than the time taken by the client to receive the file due to various parameters. It can be further decreased depending upon network traffic, load, packet distribution mechanism which in turn increases the overall performance of the network.

References

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