Impact of Network Conditions on Video Streaming Performance In LTE: A Simulation Study With Riverbed Modeler

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Abstract- *With the increase in user requirements for internet browsing and streaming videos online, various technologies have come forward to provide best services and solutions according to the needs. In this era of using advanced cell phone technology, most internet browsing and video streaming is done over Wi-Fi or LTE. These days, users prefer watching videos on their cell phones while at work or while traveling, and thus, use technologies mentioned above to stay connected and to stream videos while being mobile or stationary. Due to this, the telecommunication industry has improved services provided to users at a level where they can enjoy fast streaming for any YouTube video while on the go. The main idea behind our project is to analyze the performance of Long Term Evolution (LTE), a wireless network technology used by network operators around the world meant for high-speed communication between data terminals and observe the packet transfer, drop rate and delays for using the technology. We will be using Riverbed Modeler to simulate various scenarios where data would be transferred to stationary or mobile terminals and observe how LTE performs.*

I. INTRODUCTION

We will be analyzing one of the most commonly used video streaming applications: YouTube. YouTube has become one of the most widely used applications due to its best video streaming system. In order to analyze the packets while streaming a single 720p music video over YouTube, Wireshark was used to analyze the packets. "port 80" filter was used to see the data traffic. This was done to have a more realistic setting for the video streaming application that will be used for the simulation. Since YouTube buffers the packets for streaming, we found that it used TCP for on the transport layer.

The simulation is to be performed using Riverbed 18.0 where different scenarios will be created to simulate a server such as a YouTube server that has the video database and various types of clients trying to access videos from the server for streaming. There will be stationary terminals as well as mobile nodes to have a more realistic simulation for the project, and the server will be placed at a place far away from the users in our case. We will collect different statistics to have a reliable analysis of the LTE network simulation.

II. LTE Technology

LTE Technology

Long Term Evolution is one of the most commonly used and fast growing wireless telecommunication technology used these days. It is used by network operators around the globe for high-speed communication for smartphones or data terminals [1]. Initially, it was created to enhance the speed of wireless data networks and allow the usage of DSP. It provides a relatively fast downloading rate of 5-12 Mbps which is an enough for streaming videos online [2].

Wireshark Data Collection

We used Wireshark to collect information about streaming video using YouTube. Wireshark is an open- source packet analyzer. We used it to view the packets for YouTube streaming. The following screenshot shows the packets when we opened up the browser, went to YouTube, and loaded a 720p video.

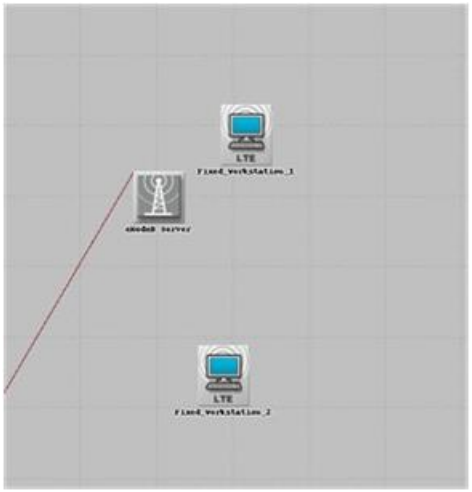
accuracy, specificity, precision, and recall over existing methods[13].A deep ensemble model using improved Inception-v4

For the application as mentioned earlier, the aim of the project was to analyze the performance of LTE networks while streaming videos. The first approach was to use the default video streaming model for the application and change the setting so that it mimics the behavior we observed for YouTube. The video streaming application model was tried as

the main application but we were unable to receive and send any traffic to the nodes created using Modeler. Eventually, we moved to creating application and set it up as an HTTP application tha replicates the video streaming for a YouTube video. Since YouTube uses HTTP and TCP protocols for the streaming videos, HTTP Application named YouTube was created and used for simulating different scenarios for this project. Under the Application definition, a new application was created that uses HTTP as the base application and it was named YouTube1080p.

Validation LTE Simulation

The first step required to analyze LTE technology in detail was to create a basic topology with a very simple network and try and run the application and observe the packet throughput and the delay for each node and see whether there was any communication between different nodes of the network. The Validation Scenario was created with the server, base station and the workstations all in the vicinity near the Vancouver area.

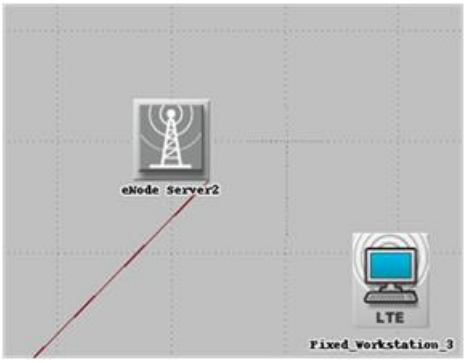


Validation Scenario

The following figure shows the basic topology for sanity checking. The network was created to check whether the user (Fixed_Workstation) was able to receive any data from the server. The basic scenario can be seen in the figure below. A server runs the Application, which was defined as a first step. The server is connected to a Cisco router which is then connected to the Ethernet router (EPC) for the LTE network. The EPC can be connected to various base stations that can transfer the information further to either fixed or mobile nodes.

The only wireless communication in the scenario shown above is between the LTE Base Station and the workstation nodes, rest of the nodes are all connected to each other sung the 100 BaseT links for traffic transfer. If we zoom into the section where we have the base station and the fixed node, it will look as shown in the figure below.

It can be seen from the figure above that Workstation1 is closer to the base station as compared to the Workstation2. The next figure shows the second base station that is connected to the same router and is sending same packets as the first base station. In the following figure, the Workstation3 is at the farthest distance from the base station as compared to the other Workstation as shown in the previous figure.

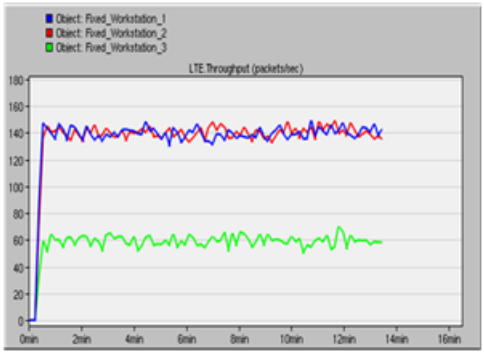


The simulation was running for the above-mentioned scenario for 15 minutes, and the node statistics were collected and the graphs can be seen in the simulation results section of the project report where the detailed discussion is provided on the results and how do they relate to the scenario settings.

Simulation Result

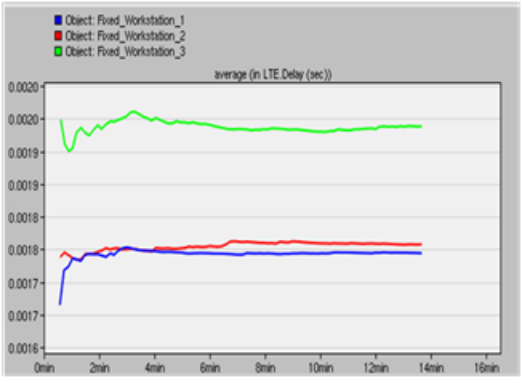
Throughput

As shown in Figure 11, we see that the throughput for all workstations is constant, as expected since they are stationary nodes, and thus the distance between the nodes and the base stations does not change. However, workstation 3 is further from the base station than workstations 1 and 2, and as a result has a lower throughput, which is as expected.



Delay

From the graph below, we collected the delay of the LTE network at three fixed workstations. In this scenario, workstation 1 (blue) and workstation 2 (red) are close to the base station whereas workstation 3 (green) is far away from the base station. The result shows clearly that workstation 3 has a higher delay than the other two in average per second. Analysis of the delay on a mobile workstation in the results analysis of Scenario 1.



III. CONCLUSION

The entire project was a great learning experience as we got to know more about the LTE technology. It is something we use quite often in our daily lives without knowing anything about it. Our understanding from the course material and some self-learning helped a great deal to complete the project successfully. The main understanding was the change in throughput and the delay as the users go away from the base stations, even though in real life a user would not care where the base stations are and how the data is being transferred it was one of the things we wanted to investigate and get a better understanding. As mentioned in the results for the scenarios and various simulation the results obtained met our expectations. We also learned that it is a good practice to start off by creating a validation scenario and perform a simple simulation to get a better picture of how to use the tool properly.

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