

# Performance Testing of 4G (LTE) Networks in SRM University Kattankulathur New Campus

T. Manoranjitham, Aniketh Mohanty, Samarth Misra

**Abstract:** This paper is aimed at testing the performance of various 4G (Long Term Evolution) network carriers in the SRM University, Kattankulathur campus. Increasingly most telecommunication companies today are encouraging users to move towards 4G connections. Handset devices are also 4G compatible now, and 4G enabled SIMcards are widely available in the Indian market. Due to this transition, the performance of various carriers is vital to understand which carrier provides the best quality of service in SRM campus. The tests are carried on the three prevalent network carriers, namely, Airtel, Reliance Jio, and Idea. The comparison between the three carriers has been illustrated by means of various graphs and tables.

**Keywords:** 4G, LTE (Long Term Evolution), throughput, jitter, latencies, Airtel, Jio, Idea, mobile application module, QoS

## I. INTRODUCTION

After the third generation of wireless mobile telecommunications technology (3G), 4G was developed to service growing consumer needs. LTE (Long Term Evolution) is a 4G-candidate system, which was first deployed in Sweden and Norway. For true 4G speeds in accordance with the International Mobile Telecommunications Advanced (IMT-Advanced) specification, a data rate of 100 Mega bits per second must be provided. [1]. In practice, this speed is unattainable by most network carriers. Hence, as a compromise, carriers provide 4G LTE speeds, which are typically faster than the 3G speeds, but much slower than true 4G [2]. Some of the requirements for true 4G as per the IMT-Advanced standard are given below

- Use an all IP switched packet network
- High mobility peak data rate 100 mbps and low mobility peak data rate 1 gbps
- Share resources to support more users simultaneously
- Bandwidth must be scalable between 5-20 MHz

The difference between 3G and 4G is provided in the table below [3].

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Comparison chart

| Improve this chart  | 3G            | 4G   |
|---------------------|---------------|--|
| Data Throughput:    | Up to 3.1mbps | Practically speaking, 3 to 5 mbps but potential estimated at a range of 100 to 300 mbps. |
| Peak Upload Rate:   | 50 Mbit/s     | 500 Mbit/s   |
| Peak Download Rate: | 100 Mbit/s    | 1 Gbit/s   |

Airtel was the first provider to launch 4G services in Tamil Nadu. Their services were launched in June 2015 [4]. On September 1st 2016, Mukesh Ambani announced his Reliance Jio services which are free till March 31st 2017 [5]. Idea 4G services have been in existence since December 2015 [6]. The purpose of this paper is to determine which network carrier is providing the best 4G services within the SRM University community. Due to the large body of faculty and students, and the constant research and innovation going on at SRM, the results of this paper can be used by any current or future member of the SRM family to see the difference between the promised and delivered quality of service of the carriers, make informed decisions, and select network carriers in accordance with their internet requirements.

## II. RELATED WORK

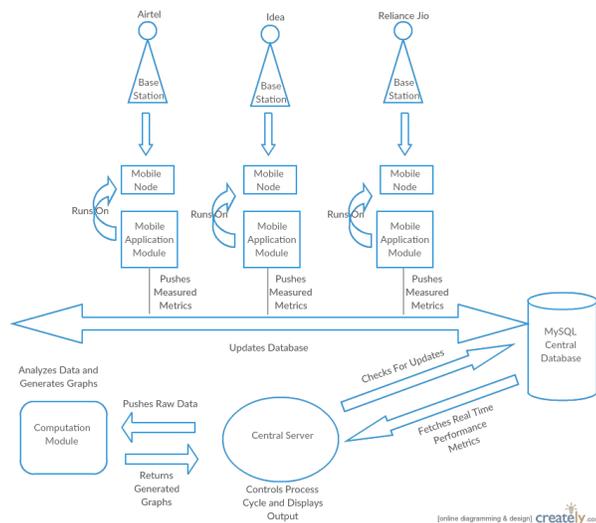
For conducting research, the Performance Testing of 4G LTE Networks in Saudi Arabia paper by Mahdi H. A. Ahmed was taken as a reference. The tests conducted were on Saudi Arabian network carriers Zain, STC, and Mobily. The tools used were open source tools available such as the speed test.net website. The tests carried out measured throughput, upload speed, latency, jitter, packet loss and RSSI (received signal strength indication). Readings were taken in different areas in the city of Abhain Saudi Arabia. The aim of the author was to gauge which new carrier provided the best service for an upcoming technology in the mobile domain. [7]

Another paper studied was The Gap Between Expectation and Reality: Long Term Evolution (LTE) and Third Generation (3G) Network Performance Testing in Campus with Test Mobile System (TEMS) by Syahiran Ahmad, Sameh Musleh, Rosdiadee Nordin.

Here, two network carriers in Malaysia, Maxis and Celcom, are tested in the Universiti Kebangsaan Malaysia campus.

Drive tests as well as LTE enabled user equipment is used to test RSSI, average user throughput, and round-trip delay time. The aim of the paper was to compare 3G and 4G speeds and determine whether coverage of both carriers was adequate within the campus [8].

### III. PROPOSED SYSTEM



#### Modules

- Base Station:** The base stations being used will be the commonly available tower of each network provider.
- Mobile Nodes:** In our information system, mobile nodes are Android devices connected to the networks that are to be tested. Once the mobile application has been installed, network tests will be carried out automatically on receipt of a notification on these nodes.
- Mobile application:** This module is an Android application that performs the network measurement tests. It can be run on any number of mobile nodes simultaneously. It executes the logic that measures the latency, throughput, jitter and packet loss on the mobile node's network. The application then sends the measured metrics to the central database.
- Database:** The database being used is my SQL database. Once the values have been pushed from the mobile application to the database, the database forwards the new results to the computation module.
- Computation Module:** The job of the computation module is to use statistical representation tools and generate real time graphs based on the metrics calculated.
- Notification Agent:** Firebase is being used to generate notifications and send them to multiple mobile nodes.
- Central Server:** It runs the main application and periodically checks the database for updates. When the values are updated on the database, the central server pushes those values to the computation module.

#### Methodology

The system is designed to test each network remotely and in real time. The base stations used are the ones that are geographically closest to SRM for the three carriers. The process for testing and generating results is as follows

- The central application will send a notification to each mobile node (running Android OS) which wants to test its own network performance.
- On receiving the notification, an application installed on the smart phone will run, and execute all tests in the background.
- On completion of testing, each device will send the information to the central database.
- After the database entries have been added by all testing nodes, the computation module will pull this data from the central database for analysis.

•The computation module will draw real time graphs based on the data and display the output to the central application.

#### Performance metrics

The metrics that we tested for indicating performance are

- Throughput:** It is the measure of how much data is passing through the network within a given amount of time. It is measured in Mbps(Megabits per second).
- Latency:** It is a measure of the delay that occurs when a network is responding to requests. It is measured in  $\mu$ s(microseconds).
- Jitter:** Jitter is the measure of the change in latency of the network. It is measured in  $\mu$ s(microseconds).
- Packet loss percentage:** It measures the fraction of packets lost for the total number of packets sent.
- RSSI:** It is a measure of the power of the signal within the wireless network. It is measured in dBm (decibel milliwatt) on algorithmic scale. This means, the closer the value to 0, the stronger the radio signal.

The information system designed will be able to test the performance of different network carriers in real time and will store these values on a database. Using the values generated, comparative graphs will be generated, to show the performance of the 3carriers in different areas within the campus.

#### Areas Covered

To test the networks, 5 different areas within the new campus of SRM University, Kattankulathur were chosen. These areas were

- University Block
- Java Food Court
- Tech Park
- Valiammai Engineering College Gate
- SRM General Hospital

These spots were chosen as they covered the maximum area across the campus. A true understanding of each networks performance could only be obtained after obtaining results in different zones.

## Software and Hardware Requirements

The software requirements for the information system are

- NetBeans IDE latest version
- Android Studio
- LAMP server
- Android OS Marshmallow or above
- Fire Base

The hardware requirements for the information system are

- Windows/LINUX/MAC OS X operating system
- Processor i5 or above
- RAM requirements 1GB or more
- Memory minimum 256MB to store and run
- 3 different 4G SIM cards
- Android smartphones with 4G capability

## F. Tests

To perform the network tests, some code from open source platforms [need to find link] has been modified to suit the project needs. The application has been created using Java as the programming language. Java has been chosen due to its robustness and easy cross-platform integration. Each metric is tested in the following manner

•Latency: 50 ping requests are made to a website such as Google or Facebook. The time taken to calculate the response to each request is calculated, and then the average of the response time is taken to give average latency.

•Throughput: A 19MB image file is downloaded from the Internet and the time taken to download is calculated. Once the image has been downloaded, the total image size is divided by the time taken to provide down load speed or throughput rate.

•Jitter: The difference between the individual response rate is calculated, and the average of the difference is taken. This provides the average jitter.

•RSSI: An inbuilt handset sensor is used to check for RSSI (measured in dBm, on a logarithmic scale). Multiple values are taken within a walking radius for each area, and the average is calculated.

•Packet loss percentage: Assuming any packets are lost, the (number of lost packets/total packets sent) \*100 gives the packet loss percentage.

## IV. EXPERIMENTAL RESULTS

The tests were conducted over two days, the 14th of February 2018 and the 21<sup>st</sup> of February 2017. The tests were conducted between 12.30PM and 2PM, as this was a time where the networks would be operating under maximum load in the campus. From the tests, the following basic results were evident-

•Airtel average latency is the lowest, while Jio has the highest latency on an average.

•Idea has the highest average throughput, while Jio again has the lowest average throughput.

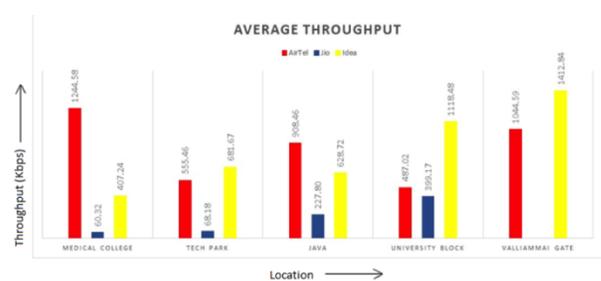
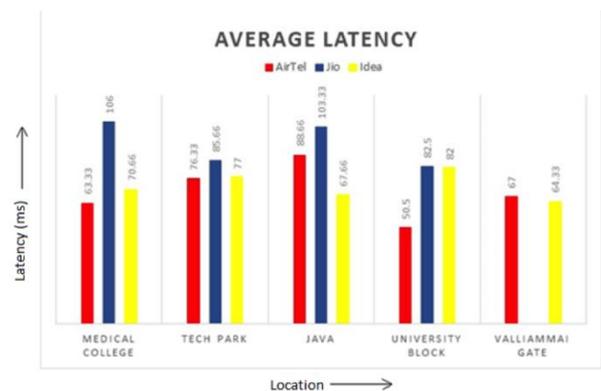
•Idea has a marginally lower jitter than Airtel, and Jio has the highest jitter.

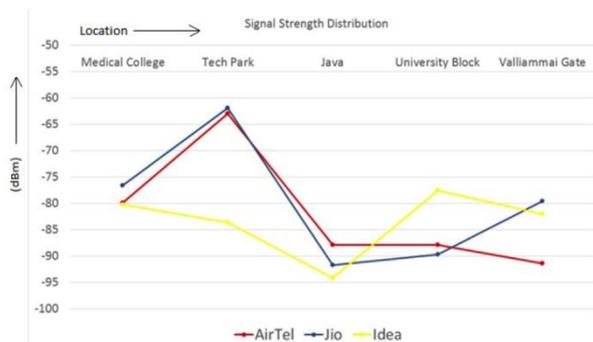
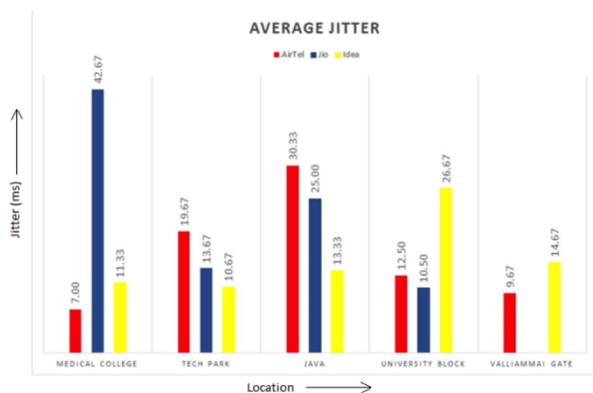
• The packet loss for each network is negligible in the SRM campus.

However, on closer inspection of the data, it is evident that Airtel is by far the most consistent network available in the campus. Jio, due to being a new service, and still in the process of setting up its network, is currently the weakest. Finally, Idea is also a strong network, but as can be seen on the table, it has certain spots (e.g. Valliammai College Gate) where it is much stronger, and certain spots where it is comparatively weaker. In a nutshell, if one wants a network which will perform to a fairly high level of consistency, Airtel would be their best bet.

Our results can be corroborated with recent studies which show that Airtel has the best down load speeds for streaming services across India[9].

The tables and graphs from our tests are shown below (no data has been shown for Reliance Jio at Valiammai Gate as Jio offers no coverage in that area).





V. CONCLUSION

As shown through our data, 4G LTE networks are increasingly becoming popular in India. Going forward, their use can only increase. The basic conclusions we can draw are-

- The throughput on the SRM campus varies between 188 for Jio and 850(Airtel and Idea).
- The jitter varies between 16(Airtel and Idea) and 27 for Jio.
- The latency varies between 69(Airtel) to 94(Jio).
- The RSSI varies between - 94dBm (Idea) to-61dbM (Jio).
- Packetloss for all three networks is negligible, but an occasional packet might be lost during peak hours of usage. This will have no serious effects on the performance.

VI. FUTURESCOPE

We believe our project can be used as an ideal network measurement tool in any part of the world. All one needs is a connection to test and an Android smartphone with our application running on it. Once the testing is done, to see comparative graphs with other networks that have also been simultaneously tested, a server application will be required. Within the campus, we hope to allow current and future members of the SRM community to make informed decisions about the SIM cards they choose to purchase. Often times, important work is hard to complete due to sudden slowness or latency in networks. With our results, both students and faculty can find zones where the irrespective networks will work and hope to increase their productivity by utilizing this to their advantage.

Furthermore, with potential talks of an Idea and Vodafone merger, the need for this kind of performance testing will only increase in the near future [10]. Once the merger is complete, it is possible that the combined resources of the two telecom giants leads to better network performance, or alternatively, it is also possible that regulatory hurdle slow them down. During this transitional period, a network performance test will help the public in determining whether investing in a Vodafone/Idea SIM card is a good idea or not.

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