

# Analysis of Cellular Signal Strength with the GPS-based location for Mapping Signal Strength and Dead Zones of Cellular Networks

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**ABSTRACT:** A mobile phone signal (also known as reception and service) is the signal strength (measured in dBm) received by a mobile phone from a cellular network. Depending on various factors, such as proximity to a tower, any obstructions such as buildings or trees, etc., this signal strength will vary. Generally, a strong mobile phone signal is more likely in an urban area, though these areas can also have some "dead zones" where no reception can be obtained. In this paper technique presented is for detecting and storing cellular signal strength with location coordinates (using mobile phones) for showing the signal strength and dead zones of the different cellular operator over the map in order to give an insight to mobile phone users for selecting a cellular network according to their traveling route.

## I. INTRODUCTION

Cell phones are the most used communication tool today. They are also becoming increasingly connected to the Internet, which allows people to do various works but there are some limitations for its use as a communication tool. A major limitation of Mobile phones is Cellular network coverage. All types of Cellular networks suffer from problems of network coverage and dead zones.

This system will help end users of a cellular network by having an insight about network coverage in any area they are about to travel in. It will also help them in planning any cellular network dependent work in advance during traveling.

System depicted in this paper is divided into 2 parts 1.) Storing Cellular network strength along with GPS location coordinates and Timestamp 2.) Analyzing generated data with Map-reduce (Hadoop) for displaying end results, the reason for selecting Hadoop as an analytic tool is because amount data will be large.

Cellular network strength with GPS location is to find out with help of lightweight android application specially developed for this system. The application will generate data only if there is a change in network strength then this application generates a text consisting information about current network strength, location coordinates along with a timestamp of that event this text then get append in a file located in internal memory. After 24 hours this file is transferred to the cloud storage and same cycle of data generation and storing will be executed repeatedly. This application is installed in several mobiles having different cellular operators for gathering data related to their cell strength. Generated data files from all these mobiles are transferred to the cloud storage.

Files on Cloud contains information about Network strength, GPS location, and Timestamp. These files are then analyzed with Map-Reduce (Hadoop). Where data from all the files is analyzed. The end result of this analysis shows the variations of signal strength of any cellular network operator according to change in location, the same result is depicted in visual form over a map, Data related to timestamp will work as a 3 dimension showing variation in signal

# International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 5, Issue 9, September 2016

strength over the same area with change in time during a day. Along with it, this analysis is also giving the location of dead zones for different cellular networks.

This paper is organized as follows. Section II represents the flow diagram of the system. Section III presents experimental results. Finally, Section IV presents the conclusion.

## II. RELATED WORK

Android Application developed for this system is lightweight with minimal UI overhead so that it do not consume much battery of cell phone. The application consists of one text field and one button. Text Field is for entering file name and button is for saving file that will contain all the generated data.

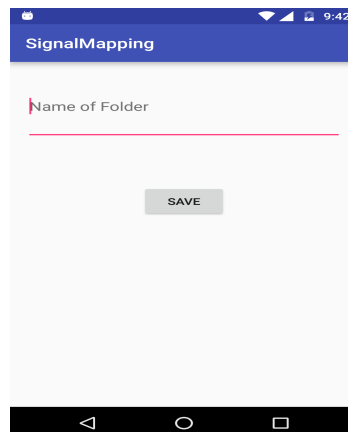


Fig. Screenshot of Android Application

Data generated by Application is in consistent .txt format. So that there is no data loss during data analysis.

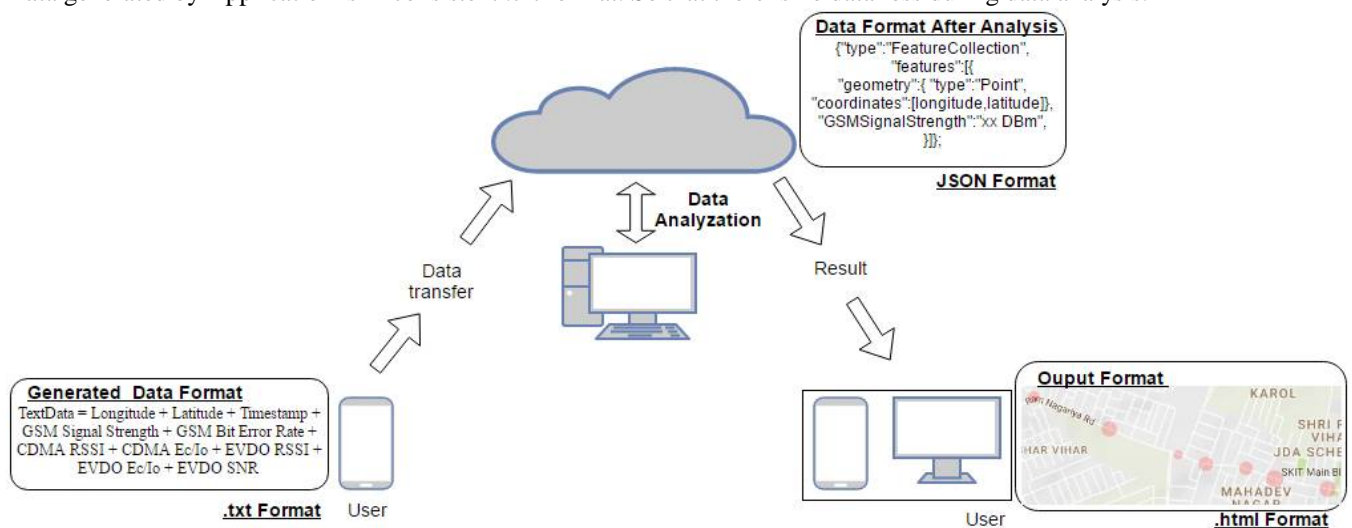


Fig. Flow Diagram of System

Transferred Files over the cloud storage is analyzed with the help of Map Reduce (Hadoop). The result is generated in JSON format so that it is compatible with Google Map API. The end result is shown to the user with help of Google Map.

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Vol. 5, Issue 9, September 2016

### III. PROPOSED METHOD

This system works on a simple method of generating and storing data, followed by analyzing stored data and at last giving result backed with visualization so that end users can understand it.

Data is generated and stored through the android application developed for this system. This application is installed on mobile then it is started and kept in the background so that any other application can also run if required. Once the application starts running, mobile is moved through different locations whenever it detects a change in cellular signal strength during this movement it generates data consisting information about signal strength, location, bit error rate and signal to noise ratio. This data is then stored in the internal storage of the phone.

After a fix period of time this file is transferred on cloud storage where it is analysed. This analyses includes aggregation of data on basis of location followed by finding out signal strength on that location. With these locations, continuous variations of signal strength is obtained. After processing all location coordinates JSON file is generated in which all the data is stored. This JSON file is then uploaded on webserver.

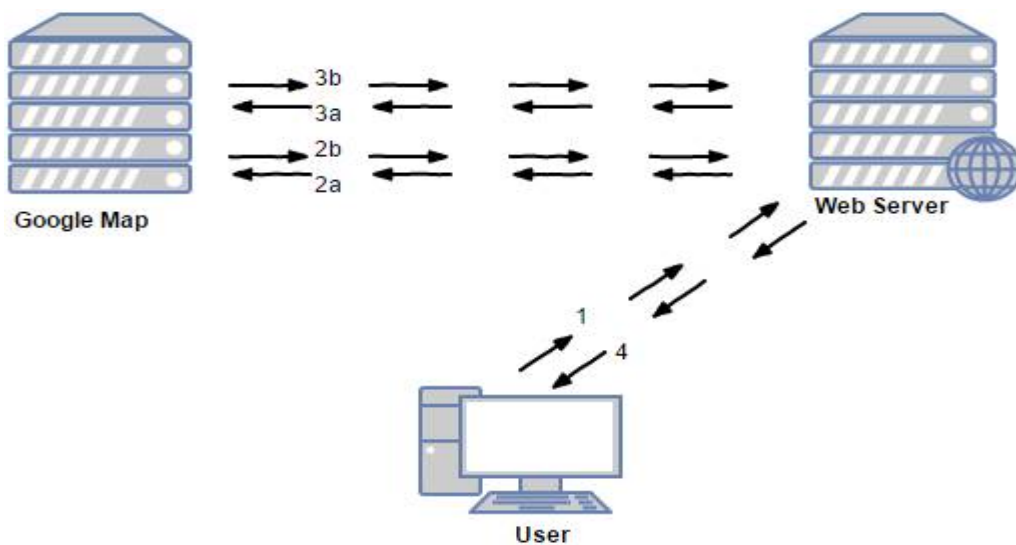


Fig. Visualization of Data

For visualization of result URL of webpage is entered in web browser. This webpage is specifically developed for this system, in Fig.,(1) shows request sent to webserver by webpage,(2a) In its response webserver sent request to Google Map API this request consist of unique API key and URI address of Google Map Server, (2b) After verifying unique API key google sent response to webserver,(3a) Once connection is established webserver sent required information like location of JSON file, map style, zoom level and other relevant information to Google Map Server(3b)After processing received request Google Map Server sent response to webserver in form of google map, (4) Webserver then forward this response to user with locations and signal strengths mapped over google map.Result is then displayed to user.

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## IV. EXPERIMENTAL RESULTS

Images show the result of Signal Strength Mapping performed inside SKIT M&G campus.

In this experiment, 2 Cellular operator's signal strength was measured over the same area.

In the Images:

- Red Circles represent points where there is a change in signal strength and radius of the red circle is directly proportional to signal strength.
- Readings along lines (VIEW1. Road wise Strength), represents Signal strength over that road, this reading is average of signal strength over that road
- Area inside rectangle (VIEW2. Overall Signal Strength), represents area over which total signal strength is measured,  
Total signal strength = Average of allRoads Signal Strength laying in given area and Average of Variation in Signal Strength off road

Following figure show signal strength mapping results for cellular operator 1  
Cellular Operator → 1

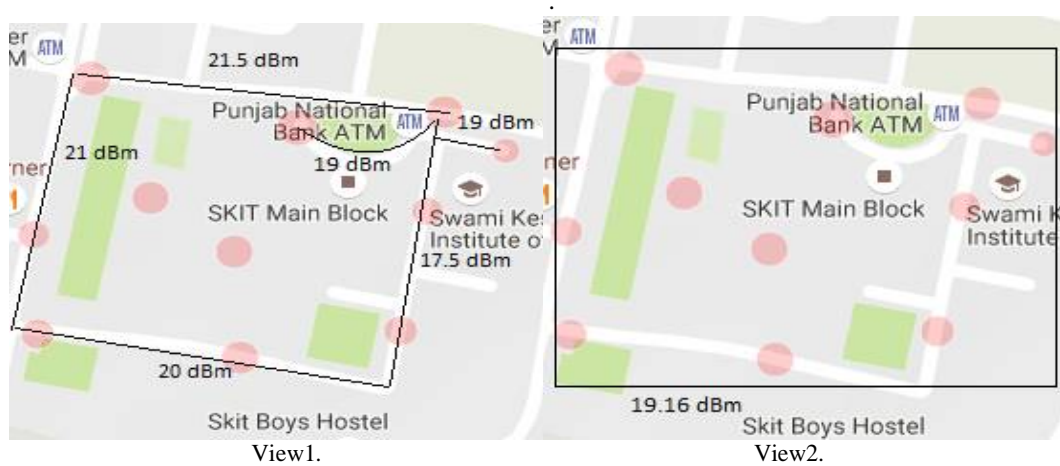


Fig1.

Fig.1 Signal strength mapping over experimental area with GPS based location(View 1) Road wise signal strength mapping for cellular operator 1. (View 2) Total signal strength mapping for cellular operator 1 over same area as in View1.

Following figure show signal strength mapping result for cellular operator 2.  
Cellular Operator → 2

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Vol. 5, Issue 9, September 2016

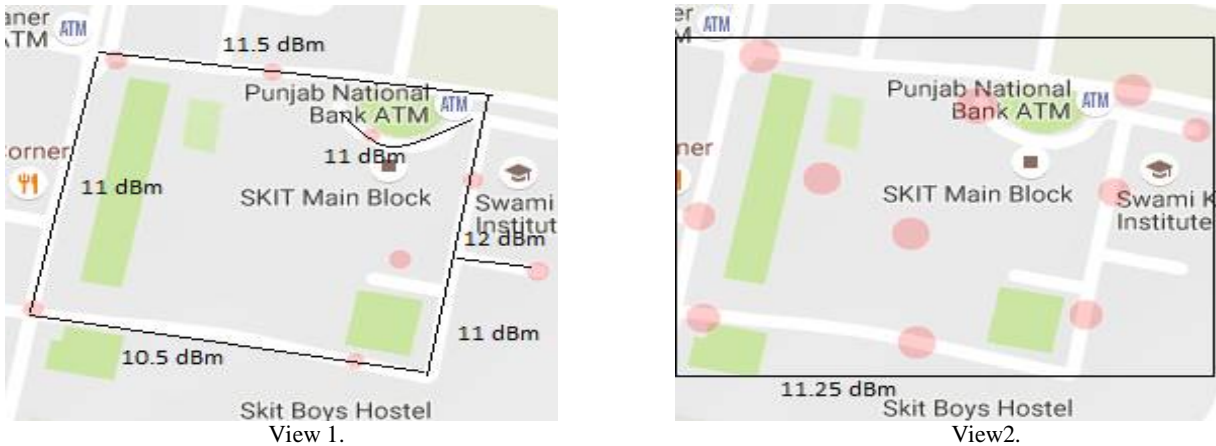
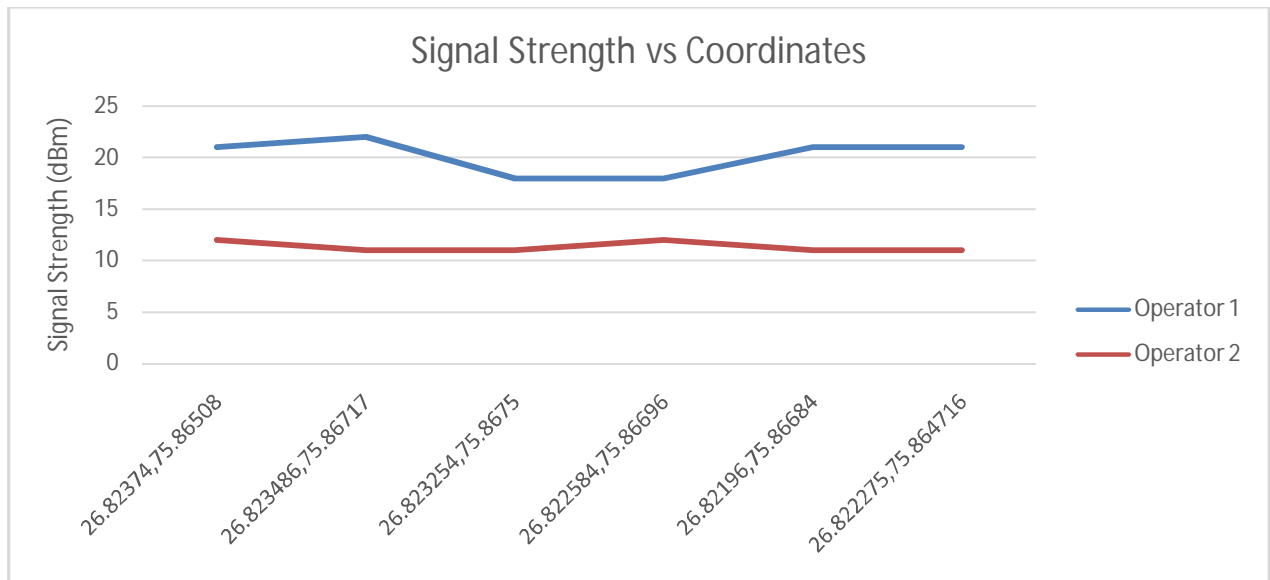


Fig2.

Fig.2 Signal strength mapping over experimental area with GPS based location (View 1) Road wise signal strength mapping for cellular operator 2. (View 2) Total signal strength mapping for cellular operator 2 over same area as in View1.

From these experimental results, it can be inferred that Cellular operator 1 is having better network coverage as compared to cellular network 2 in the given area and none of the 2 operators had any dead zone in given area.



Graph above represents variation in signal strength of Operator 1 and Operator 2 with respect to common coordinates. Coordinates selected are uniformly selected common coordinates for both cellular operators. Coordinates are represented in format of (longitude, latitude) while altitude for all coordinates are same.

Similarly, signal strength for different cellular operators can be found out over the region of any size.

# International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 5, Issue 9, September 2016

## V. CONCLUSION

We have implemented a system for Analysing Cellular Signal Strength with GPS-based location for Mapping Signal Strength and Dead Zones. Our system successfully maps the signal strength for any cellular network over any given area. Which help in giving the end user an insight about signal strength for a cellular network operator over any area they are traveling to.

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