

Comparative Analysis of Quality of Signal of Different Service Providers

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ABSTRACT: The various cellular networks providing services in Jodhpur area are compared to determine the network *with* a superior signal strength. The signal strength of various networks have been noted at different time intervals. The results show that the network with the highest values of signal strength has the best quality of service. From study of signal strength of different network we found Network 1 provides mean signal strength of -71 dBm, which is highest among all the service providers taken into consideration.

KEYWORDS: Signal strength, GSM, Quality of signal

I. INTRODUCTION

The field strength in telecommunication is referred as the transmitter power output received by a reference antenna at a distance from the transmitting antenna. Wireless field strength is traditionally measured in either percentile or dBm. The level of 100% is equivalent to the signal level of -35 dBm and higher, e.g. both -25 dBm and -15 dBm will be shown as 100%, because this level of signal is very high. The level of 1% is equivalent to the signal level of -95 dBm. Between -95 dBm and -35 dBm, the percentage scale is linear, i.e. 50% is equivalent to -65 dBm.

A comparative study of signal strength of various service providers like Airtel, Vodafone, Reliance, Aircel and Idea in the concerned area has been conducted. As on August 2016, India's Telecommunication network is the second largest in the world with enormous growth potential due to its high population and development potential. According to Cellular Operators Authority of India (COAI) as on November 2016, the number of GSM subscriber base increased to 801.81 million. Bharti Airtel sustained to hold on to the first position with total subscriber base of 263.35 million mobile subscribers followed by Vodafone with 202.79 million subscribers and Idea Cellular with 187.68 million. The use of cell phones has increased so rapidly that wireless networks are becoming overloaded, resulting in a growing number of customer complaints about the quality of the service provided.

Mobile phones have become an indispensable part of life by keeping constant touch with near ones and helping us aware of happenings, managing our daily utilities and providing security in emergency situations. In city areas there is generally a larger number of users and also the maximum obstructions in signal is observed. The number of base stations will be more to cover demand, and the cell sizes will have a 2-5km radius. In rural areas where there are large open spaces the base stations will be further apart and the cell radius will be around 10-32 km. The region where these observations were taken is an area Pratap Nagar in the district of Jodhpur which is moderately populated and had mild weather condition during this period.

II. RELATED WORK

Based on the study of C. Emeruwa[1], it indicates that signal strength has no effect on cellular technology used. Based on the observation the researcher suggested that factors affecting signal strength such as obstacle, environmental factors and distance from base station affect both CDMA and GSM technologies in the same manner. The study also infer that there is no distinct variation of signal strength between peak hours and off peak hours[1].

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III. FACTORS AFFECTING SIGNAL STRENGTH

1. Distance: The maximum distance that a typical cellphone can catch signals from is approximately 45 miles. However it also depends on the cellphone technology being used which determines the perfect signal strength.
2. Cell Size: The signal strength directly depends on the size of cell within a cell network and as cell sizes reduce signal strength also reduces. The carriers reduce the signal strength so that it doesn't interfere with the other cells in the vicinity using the same frequencies. This can cause a major problem in the absence of cellphone towers in several regions as one has to be within a few hundred yards of a cell tower to receive the signal[2].
3. Interference: The reason for poor signal strength of a cell tower may be interference to the signal. Cellular signals travel in a straight line and can only penetrate a limited number of obstacles. Obstructions can be of many types, manmade and natural. Trees, hills, buildings, tunnels, walls etc. are some of the major causes of signal interference. Signals can also be interfered by the neighboring cells that transmit on the same frequencies. [3]
4. Poor Capacity Planning: If a network carrier expects their customers to make more calls, the cell size is reduced and the neighboring frequencies are re-used to support a high number of calls. The number of calls that a tower can take is limited to the number of frequencies that is provided by cellphone carrier.



Fig. 1: Factors affecting signal strength

5. Lack of Towers: Cellphone carriers are supposed to reduce the distance of the cell phone towers and the Cell phones to a bare minimum to keep the cell size low. Larger cell sizes require the carriers to transmit a higher signal strength which can have several economic and health related repercussions. The cell towers are often placed in a honey comb design to provide a perfect coverage in a particular area. When you move out of a cell the signal is handed over to the neighboring cells to make mobile communication possible. This can be a problem with the lack of adequate towers placed in rural areas[4].

Apart from above mention factors there are many atmospheric condition, natural condition and the presence of human and animals also affect the signal strength because living being contain 75% of water in their body, which can absorb about 2.4 GHz radio signal causing a significant decay in the signal amplitude at particular instant of time. Hence this paper used the classic method to identify the presence of signal strength of various network providers which may be helpful for the user to select the best service providers to meet best quality of service.

Received Signal Strength Indication: The exact signal strength often called Received Signal Strength Indication (RSSI), is measured in dBm. The dBm scale is approximately between -50dBm and -120dBm. RSSI measures both the usable

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signal and the noise in a signal. The range of signal which determines the signal strength are:-50 to -75 dBm (High Signal) , -76 to -90 dBm (Medium Signal), -91 to -100 dBm (Low Signal), -101db to -120 dBm (Poor Signal).

The Quality of Signal is found as: $2 * (\text{dBm} + 100)$, where dBm: [-100 to -50]

dBm = (quality / 2) - 100 where quality: [0 to 100]

IV. MATERIALS AND METHODS

The signal strength and quality of signal of various networks were subjected to investigation using inbuilt software of GSM/CDMA phones operating in GSM (900) band. The software measures the signal strength of the networks in decibel metre (dBm). This test was done for the five available networks and measurements were taken simultaneously at 60 minute intervals for 24 hours. The graphs of the measured quantities against time has been plotted to find out the lowest and the peak values and their effect on the network.

V. RESULTS

The result obtained is tabulated with 24 hours reading of various network providers within the region.

Table 1. Signal strength of various service providers over 24 hour interval

TIME (24 HOURS)	NETWORK 1	NETWORK 2	NETWORK 3	NETWORK 4	NETWORK 5
1	-60	-87	-101	-79	-63
2	-62	-89	-98	-75	-64
3	-59	-86	-99	-74	-62
4	-65	-91	-95	-75	-65
5	-70	-99	-91	-79	-70
6	-73	-97	-87	-71	-75
7	-78	-67	-80	-74	-79
8	-55	-101	-93	-78	-72
9	-50	-51	-87	-79	-69
10	-56	-101	-83	-76	-75
11	-64	-101	-91	-75	-76
12	-76	-97	-85	-79	-77
13	-72	-91	-83	-81	-80
14	-73	-99	-85	-87	-72
15	-88	-101	-89	-83	-91

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16	-74	-99	-91	-61	-83
17	-82	-73	-90	-75	-65
18	-88	-91	-81	-81	-80
19	-89	-97	-99	-69	-79
20	-80	-95	-85	-85	-75
21	-77	-93	-84	-77	-79
22	-73	-97	-100	-75	-85
23	-75	-91	-92	-81	-75
24	-65	-92	-99	-77	-67

Table 1 shows a comparative study of signal strength of the Network 1, Network 2, Network 3, Network 4 and Network 5 during a 24 hour time period with reading measured in every one hour. Table 1 shows that signal strength varied from -50dbm to 101dbm indicating that the maximum signal strength in this area is -50dbm while the minimum signal strength is -101 dbm.

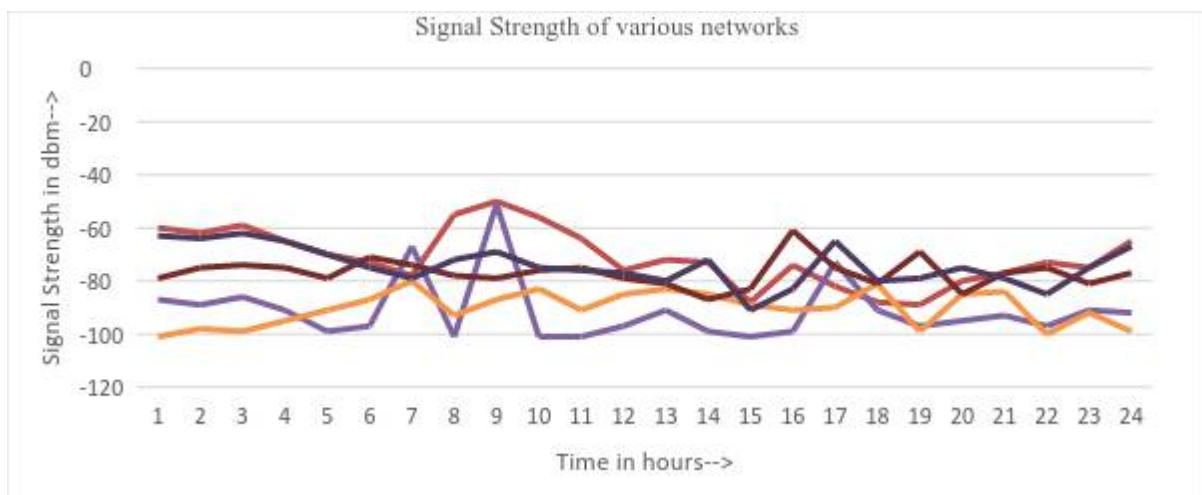


Fig. 1. Signal strength variation with time for various Networks.

Figure 1, indicates that signal strength provided by all the five networks varied in the same pattern from 06.00 hours to 24.00 hour in this region. In Fig.1, the signal strength of Network1 is represented as Series1, Network 2 as Series2 and so on. The signal strength varies from -50dbm to 89dbm. Meanwhile maximum signal strength of Network2 was recorded to be -51dbm and minimum to be -101dbm. The signal strength of Network 3 varied from -51 dbm to -89dbm. The signal strength of Network 4 showed a variation from -61 dbm to -87dbm. The maximum signal strength provided by Network 5 was -62dbm and minimum -91dbm.

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VI. CONCLUSION

It is shown from this study that signal strength of various observed network varies with time. The factors affecting signal strengths such as distance from base transmitting stations and obstacles affect signal strength. Traffic congestion does not have any direct effect on the signal strength. This is evident from the fact that there is no distinction in signal strength pattern between hours of heavy traffic (peak hours) and hours of low traffic (off peak hours). In choosing a cellular network, the signal strength should be considered seriously since the quality of signal provided by a network is a function of the signal strength of that network. Individual cells do something referred to as 'breathing' which means that their perceived signal strength goes up and down as the number of phones using that cell goes up and down. When more users are on a single cell tower, the power available for each individual connection decreases.

Table 2: Mean Signal Strength of various service providers in dbm

Service Provider	Mean Signal Strength
Network 1	-71.00
Network 2	-91.08
Network 3	-90.33
Network 4	-76.91
Network 5	-74.08

Table 2 shows that Network 1 provides mean signal strength of -71 dBm, which is highest among all the service providers taken into consideration. Hence quality of signal provided by Network 1 is the best among the networks taken into consideration.

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