

Service Quality and Subscriber Satisfaction of Cellular Network

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Abstract: Cellular networks are the backbone of technology for mobile phones, personal communication systems, wireless networking, and other devices. This cellular network technology is essential to the daily lives of humans. So People prefer high-quality service at a low cost. Quality of service analyzes each user's satisfaction level individually at each user terminal. So service providers need to maintain the proper monitoring system for subscriber satisfaction. To provide high-quality service, consider the call setup success rate (CSSR), dropped call rate (DCR), received signal code power, and handover success rate. Based on the high quality service factors apply the various call charging methods for customer satisfaction

Keywords: Quality of Service, Call Setup Success Rate (CSSR), Dropped Call Rate (DCR)

1. Introduction

The cellular networks play the essential role in day to day life of human because they are very helpful to communicate better and easy way to each other. This cellular network sectors are highly competitive market due to many service providers. In the subscriber site, the mobile communication is widely used for distance communication, entertainments, mobile bank transactions, business meetings, e-learning, etc. So the service provider needs to provide the high quality of service with subscriber's satisfaction.

The quality of service is defined as the end to end user satisfaction of cellular network which includes high quality of voice, few call blocking and dropping and high data transmission rate. These factors are directly related to rating of subscriber satisfaction. In order to address those issues quickly and cost-effectively, service providers need to maintain a high quality network monitoring system.

High quality network monitoring system monitors via key performance indicators (KPI).through this monitoring system service provider upgrade the service quality and further continues their service so that service provider full fill the subscriber requirements.

In this research we analyze the call setup success rate (CSSR), dropped call rate (DCR), received signal code power and handover success rate. According the measured value these parameters of the quality of service are categorized quality and apply various call charging methods based on the quality of service. This system satisfies the high priority customer to low-level customer and helps to the service provider to increase the number of user.

Objectives

In order to find out the solution for the research of the research, the following objectives are formulated by the researcher.

- To evaluate the quality of service of a cellular network
- To find out the various charging methods to subscriber satisfaction based on the quality of service of a cellular network.

2. Literature Review

Existing System

Vandana Khare and M.Sudhakar, "Quality of service parameters evaluation for real time traffic in cellular network" in IJRTE in June 2019 [13].

Quality of service (QoS) represent the quality measure in cellular service in a subscriber to provide an error free service defined high quality of voice, few call blocking and dropping probability even at high data transmission rates. This research drive test tools are used to measuring Quality of Service (QoS) of a mobile radio network. Using drive test tool measured and analyze Call Set up Success Rate (CSSR), Blocked and Drop Calls. In this analysis of the drive test result has helped to identify problem like low throughputs, drop calls, handover failure in a service test area for different service provider.

Proposed System

In this proposed system will analyze the call setup success rate (CSSR), dropped call rate (DCR), Block Call Rate (BCR), received signal code power and handover success rate of the cellular network sector. This quality of service parameter analyze helps the service provider to provide high quality of service to the subscriber. Furthermore, apply various call charging method based on the quality of service will full fill the subscriber satisfaction.

Quality of Service Parameters Variable Description

1) CSSR (Call Setup Success Rate)

The call setup success rate is an importance KPI for evaluating the network performance for the customer satisfaction in a cellular network. CSSR is a term in a mobile communication denoting the fraction of the attempts to make a call which result in a connection to the dialed number. This fraction is usually measured as a percentage of all call attempt made and this call setup success rate equation given by

$$CSSR(\%) = \frac{N_{SCS}}{T_{CA}} \times 100$$

Where

N_{SCS} = Number of successful call setup

T_{CA} = Total Number of call attempt

The sum of successful call setups and blocked calls is the total number of attempted calls.

Successfully call setup defined as the connected to the dial number. If a call is connected successfully but the dial number is busy, the call is counted as successfully.

The main reasons for unsuccessful call setups are low signal strength, radio interference between different subscribers, hardware problem, etc.

2) Block Call Rate

The block call rate is measured as a percentage of call block due to the non-availability of the network resources. This block call rate equation are given by

$$N_{BCR}(\%) = \frac{N_{BC}}{T_{CA}} \times 100$$

Where

N_{BCR} = Total number of Block Call Rate

N_{BC} = Number of call block

T_{CA} = Total Number of call attempt

3) Call Drop Rate

Call drop is one of the major issue which affect the quality of service of the mobile communication network. There are many reasons that may contribute to the drop calls in mobile communication.

Call dropping is caused by lack of radio coverage, radio interference between different Subscribers, hardware fault etc. The call drop rate is measured as a percentage of call drops during the call process.

$$CDR(\%) = \frac{N_{DR}}{N_{CA}} \times 100$$

Where

N_{DR} = number of call drop

N_{CA} = Number of successful call setup

4) Hand over Success Rate (HOSR)

Handover is an important function in mobile communication systems. As a means of radio link control, handover enables users to communicate continuously when they traverse different cells.

The major purpose of handover is to guarantee call continuity, reduce cross interference in the network, improve speech quality, and thus provide better services for mobile station (MS) subscribers.

According to the relations between involved network elements (NEs), this KPI can be divided into three types: Success Rate of Intra-BSC Handover, Success Rate of Incoming BSC Handover, and Success Rate of Outgoing BSC Handover. The HOSR is an important KPI assessed by operators because the value of the HOSR directly affects the

user experience. The HOSR is the ratio of the number of successful handovers to the number of handover requests.

$$HOSR(\%) = \frac{N_{HA}}{N_{HR}} \times 100$$

Where

N_{HA} = Number of Handover attempt

N_{HR} = Number of Handover request

5) RSCP (Received Signal Code Power)

RSCP denotes the power measured by a receiver on a particular physical communication channel.

It is used as an indication of signal strength, as a handover criterion, in downlink power control, and to calculate the path loss.

Path Loss: The path loss is the difference (dB) between the transmitted power and the received power.

6) RSSI (Received Signal Strength Indicator)

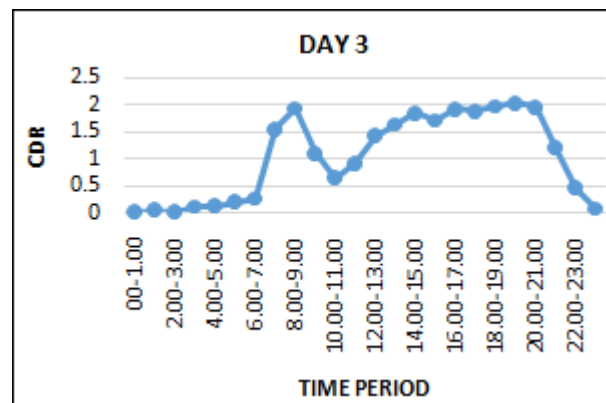
It indicates the power level that is being received after any possible loss at the antenna and cable level and is measured in dBm. It's a value that is useful for determining if you have enough signal to get a good wireless connection.

7) E_c/I_0 (Carrier to Interference Ratio)

The E_c/I_0 is a measure of the quality of the signal from the tower to the mobile equipment and indicates the signal-to-noise ratio. It is the ratio of the received signal level (RSCP) to the sum of all levels of signals on the same frequency (RSSI). It is measured in decibels (dB).

The above Quality of service variable parameters equation analysis of the call setup success rate and call block rate if the call setup success rate reduce the call block rate also reduce. Here call setup success rate is used to initiate the call process and the call drop rate is number of call drop during the call process. Hand over success rate is the important parameter for call continuity. Based on the above parameters analysis the call drop rate is the important parameter for call charging

Quality of Service Parameters Mathematical Calculations



Events Name					QOS Parameters				
call attempt	call setup	block call	call drop	Handover request	Handover attempt	CSSR (%)	BCR (%)	CDR(%)	HOSR (%)
100	100	0	0	100	100	100	0	0	100
110	105	1	1	110	108	95.45	0.952	0.952	98.18
120	110	2	2	120	110	91.66	1.66	1.81	91.66
130	115	3	3	130	120	88.46	2.3	2.6	92.3
140	120	4	4	140	130	85.71	2.85	3.33	92.85
150	125	5	5	150	142	83.33	3.33	4	94.66

Data Collection Methods

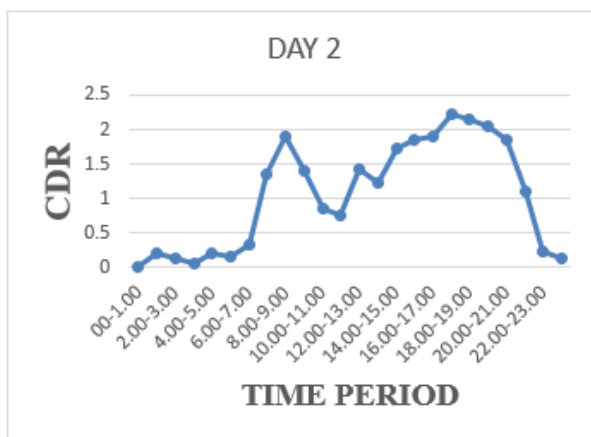
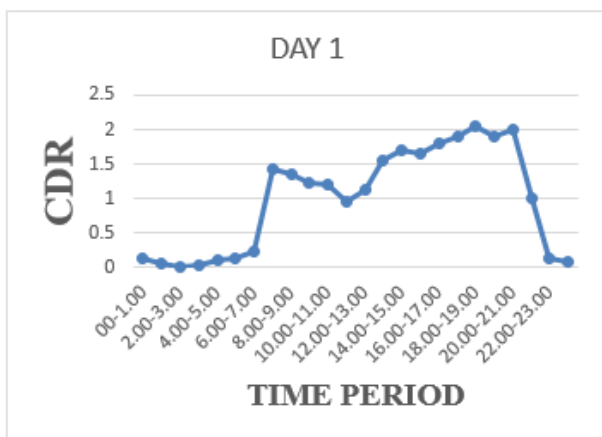
Data collection is an important factor of the researches. The parameters of the quality of service data are collected in the following methods.

- 1) Primary methods:- Drive testing is a primary method use to collect the data. Drive testing is a hardware based technique. The equipment steadily measures the parameters of the quality of service.
- 2) Secondary methods: -This method the parameters of Quality of Service data are collected from ITU telecommunication standardization sector of ITU

(International Telecommunication Sector) reports in addition with this, the researcher going to use previous research paper for collecting data.

On the above two methods, researcher has plan to use the secondary method for collecting the data.

The data of the call drop rate are collect the secondary methods of the KPI reports. These report are shown below Ms Excel sheet



These data's are converted to the graph form using excel shown below figure.

Data Presentation and Analysis

This research use secondary method to identify and analyze the values of call drop rate. Further find out the target values of the parameters of the call drop rate. In this call drop rate analysis. The target value of the call drop rate is 2 %.Based on the graph divide the parameters rage of the quality of service parameter call drop rate is shown below.

Apply the various call charges based on the above classification is shown below Table (ii)

Grade	Charges
Very good	X
Good	X*0.75
Average	X*0.5
poor	X*0.25

Call drop rate range	Grade
0 to 0.5	Very good
0.5 to 1	Good
1.5 to 2	Average
Above 2	poor

Using the Python programming language for finding the various call charging based on the quality of service for the subscriber satisfaction of the postpaid cellular network.

Day1	00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	5:00-6:00	6:00-7:00	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00	22:00-23:00	23:00-00:00
CDR	0.12	0.05	0	0.04	0.11	0.14	0.73	1.42	1.35	1.73	1.2	0.95	1.12	1.55	1.7	1.65	1.8	1.9	2.05	1.85	2	1	0.12	0.07
Day2	00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	5:00-6:00	6:00-7:00	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00	22:00-23:00	23:00-00:00
CDR	0	0.21	0.12	0.05	0.21	0.15	0.73	1.34	1.89	1.39	0.85	0.76	1.42	1.22	1.72	1.86	1.89	2.73	2.15	2.05	1.85	1.11	0.24	0.12
Day3	00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	5:00-6:00	6:00-7:00	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00	22:00-23:00	23:00-00:00
CDR	0	0.04	0	0.1	0.12	0.19	0.75	1.55	1.95	1.11	0.65	0.92	1.43	1.65	1.86	1.72	1.93	1.86	1.98	2.05	1.96	1.21	0.45	0.06

```

print("Call Charge Calculation")
x=float(input("Enter x value: "))
y=float(input("Enter call drop rate: "))
z=0
if y >= 0 and y <= 0.5:
    print("Range: Very Good")
    z = x

    print("Call Charge: ", z)
elif y > 0.5 and y <= 1:
    print("Range: Good")
    z = x * 0.75
    print("Call Charge: ", z)
elif y > 1 and y <= 2:
    print("Range: Average")
    print("Call Charge: ", z)
    z = x * 0.5
elif y > 2:
    print("Range: Poor")
    z = x * 0.25
    print("Call Charge: ", z)
else:
    print("Invalid Drop Rate")

```

3. Conclusion

The telecommunications sector serves as the backbone of the economy since it facilitates networking, and it also has a positive impact on consumer satisfaction through its high standard of service. Because of that this research paper identifies the quality of service factors call setup success rate (CSSR), dropped call rate (DCR), received signal code power, and handover success rate. The call drop rate is a crucial indicator of the quality of service based on these factors. As a result, A applies a variety of call billing mechanisms based on the call drop rate. So this method satisfies the subscribers in the cellular network technology. So this method satisfies subscribers in cellular network technology.

References

- [1] V. S. Pavankumar, Dr. B. Anuradha, Vivek and Naresh "Improvement of key performance indicator and QoS Evaluation in operational GSM network in IJERA
- [2] Richa Budhiraja Jitendra Singh Jadon "Study and Implementation of Drive Test for Development of GSM network in IJETT in Oct 2013
- [3] Akram Aburas and Khalidc AI-Mashouq "Call Quality and Its Parameter measurement in Telecommunication network" in JSAT in April 2011
- [4] Dushyanth Balasubramanian. Washington, "QoS in Cellular network" university in Saint louis.
- [5] Pedro Casas' Michael Seufert, Florian Wamser, Bruno Gardlo, Andreas Sackl, Raimund Schatz "Monitoring Quality of Experience in Cellular Networks from the End-devices" in June 2016 IEEE Transactions on Network and Service Management 13(2):1-1
- [6] Aninyie, P. 2012. Performance Evaluation of A GSM/GPRS Cellular Network Usi The CSSR with Direct TCH Assignment Feature. Ghana: Kwame

- Nkrumah University of Science and Technology, College of Engineering
- [7] Chatzimilioudis, G., Konstantinidis, A., Laoudias, C., And Zeinalipour-Yazti, D.2011. Crowd sourcing with Smartphones. IEEE Journal of Internet Computing, 16(5), 36-44.
- [8] Ciprian-Mihai, B. 2011. Indoor Localization of Mobile Devices for Wireless Monitoring System Based on Crowd sourcing. Edinburgh: Master's thesis, School of Informatics, University of Edinburgh.
- [9] P. Vijay, Dr. V. Krishnaveni, "customer preferences towards the mobile network service provider-a study with the special reference to Coimbatore city" IJMRR/Oct. 2016.
- [10] Patrick O. Olabisi (2014), "Trend Analysis of Key Cellular Network Quality Performance Metrics" in IJESRT (July 2014)
- [11] Paula Aninyie and K. Diawuo, "Evaluation of CSSR with Direct TCH Assignment in Cellular Networks" in IJERA (Aug 2014).
- [12] Ugbomhe O. Ugbomhe (Ph. D), Osagie N.G (Ph.D) , UduAma Aka (Ph.D) , "Service Quality and Customer Satisfaction in Cellular Telephony in Nigeria" in IOSR-JBM (Aug 2018)
- [13] Vandana Khare and M. Sudhakar, "Quality of service parameters evaluation for real time traffic in cellular network" in IJRTE in June 2019.