

# Performance Enhancement & Optimization of GSM System through the Analysis of Key Performance Indicator for QoS

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**Abstract**— In this modern era of technology the field of telecommunication has advanced tremendously worldwide, enhancing it an ever-expanding process which not only revolutionized the arena of telecommunication but also accelerated the process of making the world a step closer of being a single “Global Village”. In addition different technical advancement has made the existing mobile companies to upgrade their various services continuously in order to sustain in this competitive world. Quality of service (QoS) is an important key performance indicator (KPI) that is used in determining the efficiency of an industry in terms of services rendered. In telecommunication system, accessibility, retainability and connection (voice) quality are three major factors used in evaluating quality of service of an operator. And for consumers in the industry, it is expected that maximum satisfaction be derived from any services paid for. This (maximum satisfaction) has now become a difficult task to achieve especially in GSM industry. One of the major reasons attributable to this is as a result of mismatch between expansion in customer base and infrastructural (Network) expansion. In this report we standardize the benchmark of different performance parameters involved in a calling process for the mobile operators to ensure a quality service in Bangladesh. The resultant values are taken from a set of test driven real-time data, performed by Swiss Qual, which is attached with the report.

**Index Terms**— HOSR (Handover Success Rate), KPI (Key Performance Indicator), QoS (Quality of Service), GOS (Grade of Service), T.A (Timing Advance), CSSR (Call Setup Success Rate), CDR (Call Drop Rate)

## 1 INTRODUCTION

Bangladesh is a rapidly growth country in terms of Mobile Subscribers. Till December 2015, the number of mobile subscribers were 133.720 million <sup>[1]</sup> and the number is rapidly increasing.

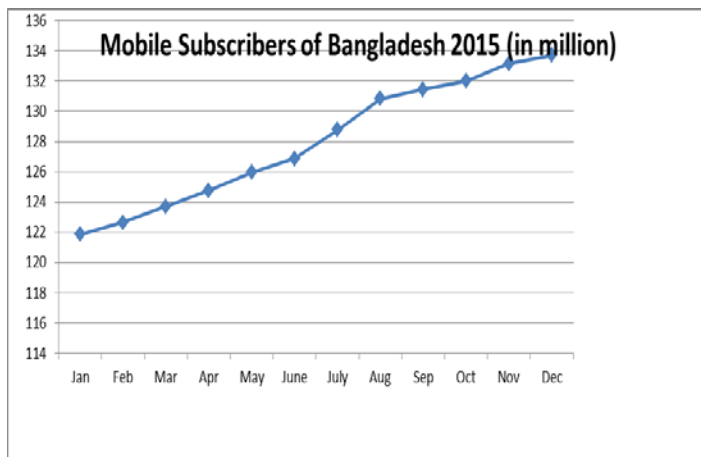


Fig 1: Mobile Subscribers Growth in Bangladesh

To increase the subscribers in Bangladesh, Mobile Network Operators are improving their network infrastructure. Quality of Service or QoS in an important factor that enhances the mechanisms which include the performance control, stability, reliability, scalability, usability and customer satisfaction. Therefore not only it has to be standardized but also needs to be monitored whether necessary changes in the specifications are required. These specifications include the followings:

- Proper network planning with the provision of an effective further expansion.
- Stability and reliability of the network.
- Periodic monitoring and proper optimization of different network performance parameters
- Addition of different value added services without hindering the network performance.

Network Performance is the most important QoS parameter for the measurement of quality of a Telecom Operator. In order to ensure customer satisfaction different performance parameters needed to be maintained with highest quality. The Network Performance parameter can be categorized into the followings:

- Call Success rate.
- Call set-up time
- Call drop rate.
- Handover Success Rate.
- GoS
- Signal receive Level and it's Quality
- Speech Quality.

In this paper we have investigated the present condition of Key Performance Indicators for top 3 Mobile Operators in

Bangladesh and lastly we have tried to give a solution to improve the QoS condition so that mobile operators can use this to give better services to the subscribers.

## 2 NETWORK PERFORMANCE PARAMETERS

Call Success Rate (CSSR) is defined as *“The ratio of successfully established calls to the total number of calls that are attempted.”* In other words CSSR is *“The Number of the unblocked call attempts divided by the total number of call attempts”* [2].

Call set-up time is defined as, *“The time taken to set up a desired call successfully”* [3]. This term is very important because this parameter indicates how well the network is designed and the amount of network congestion is there in a particular network.

Call Drop Rate is defined as *“The ratio of calls lost or prematurely terminated after establishment to all established calls”*. This includes calls dropped due to failure of handover, radio loss and network congestion [4].

Handover success rate is *“The ratio of the number of successfully completed handovers to the total number of initiated handovers.”*[5]

Grade of Service (GoS) is one of the most important performance parameter for ensuring a standard Quality of Service. The term Grade of Service (GoS) is defined as, *“The ratio of lost traffic to offered traffic”*. The offered traffic is the product of the average number of calls generated by a subscriber and the average holding time per call. Whereas, the lost traffic is difference between the offered traffic and the actual traffic that is carried by the network. Usually GoS is measured is percentage and the lower its value the more prominent the network provider is.

## 3 MAJOR QVOICE STANDARDS & KPI ANALYSIS

### 3.1 Major QVoice Standards

The proper received level of the signal and ensuring its highest quality is an integral part of quality of service. Received Signal Level (RxLev) is measured in dBm and the received signal power is within a range of -110dBm to -47dBm. Received Signal Quality (RxQual) is measured in percent of received samples allocated on quality levels.

TABLE 1: MAJOR QVOICE STANDARDS [6]

Rx Level (dBm)	Excellent	Good	Fair	Poor	Bad
	-47 to -61	-62 to -71	-72 to -81	-82 to -91	-92 to -110
RxQual	Excellent	Fair	Bad		
	0 to 3	3 to 5	5 to 7		

### 3.2 KPI Analysis

The following charts will give a broaden information of the results obtained from a test drive ,operated by Swiss Qual, that mainly emphasizes on the aforesaid performance parameters.

TABLE 2: RX QUALITY DISTRIBUTION

Rx Quality (%)	Operator “A”	Operator “B”	Operator “C”
Excellent (%)	91.73	94.16	91.80
Fair (%)	5.05	2.88	4.54
Bad (%)	3.22	2.96	3.65

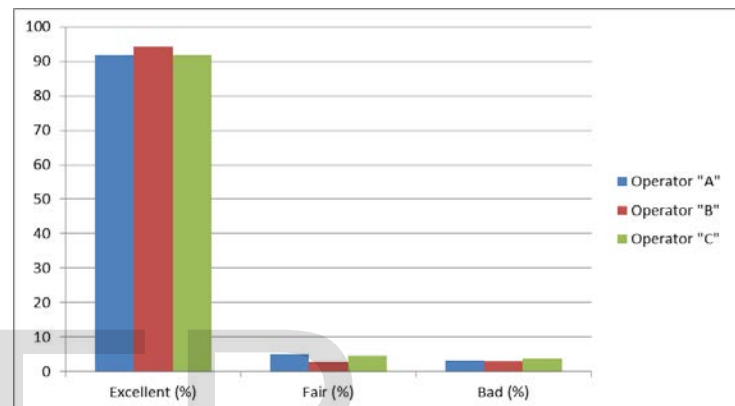


Fig 2: Rx Quality Distribution

TABLE 3: RX NOISE LEVEL DISTRIBUTION

Operator	Remarks	Value (dBm)
Operator “A” (900 MHz)	Range	-80 to -77.9
	Average	-78.95
Operator “A” (1800 MHz)	Range	-80 to -76.7
	Average	-78.35
Operator “B” (900 MHz)	Range	-79.9 to -75.7
	Average	-77.8
Operator “B” (1800 MHz)	Range	-80 to -76.1
	Average	-78.05
Operator “C” (900 MHz)	Range	-80 to -78.6
	Average	-79.3
Operator “C” (1800 MHz)	Range	-80 to -78.5
	Average	-79.25

Fig 4: CALL SETUP SUCCESS RATE

TABLE 4 : BENCHMARKING KPIS

KPIs	Uplink			Downlink		
	Operator "A"	Operator "B"	Operator "C"	Operator "A"	Operator "B"	Operator "C"
Gap (%)	6.76	3.67	3.87	2.99	6.39	6.41
Silence (%)	0.06	0.09	0.06	0	0	0
Echo (%)	0	0	0	0	0	0

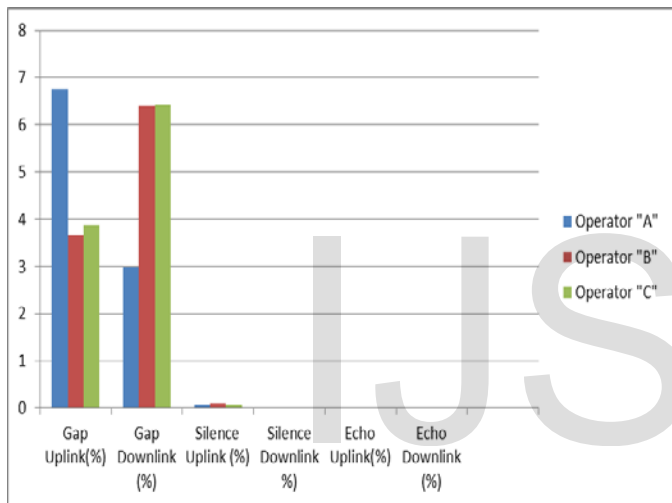


Fig 3: Benchmarking KPIS

TABLE 5: CALL SETUP SUCCESS RATE

Operator	Attempts Completed	Attempts Dropped	Total Counts	Success Rate (%)
Operator "A"	82	4	86	95.34
Operator "B"	115	2	117	98.29
Operator "C"	114	5	119	95.80
AVG	103.66	3.66	107.33	96.47

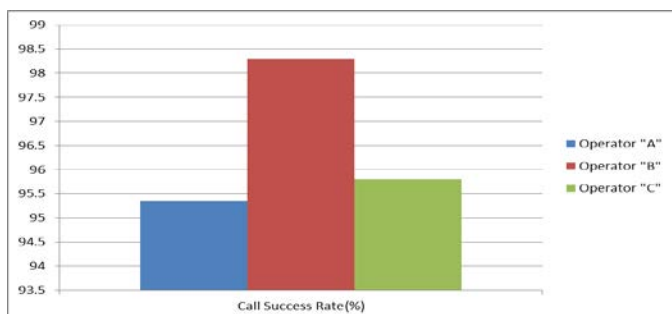


TABLE 6 : HANDOVER SUCCESS RATE

Handover	Data	Operator "A"	Operator "B"	Operator "C"
Assignment Completed	Avg	212	274	227
	Max	330	330	966
	Min	170	170	140
HO Completed	Avg	313	343	287
	Max	516	626	423
	Min	220	233	186
HO Failed	Avg			599
	Max			640
	Min			566
TCH Assignment Completed	Avg	216	215	195
	Max	266	266	486
	Min	170	170	153
HO not Completed	Avg			
	Max			
	Min			
Assignment Failed	Avg			1280
	Max			1280
	Min			1280
TCH Assignment Failed	Avg			227
	Max			966
	Min			140

TABLE 7: TIMING ADVANCE (T.A)

Average of T.A	Operator A	Operator B	Operator C
Total	0.92	1.07	0.21

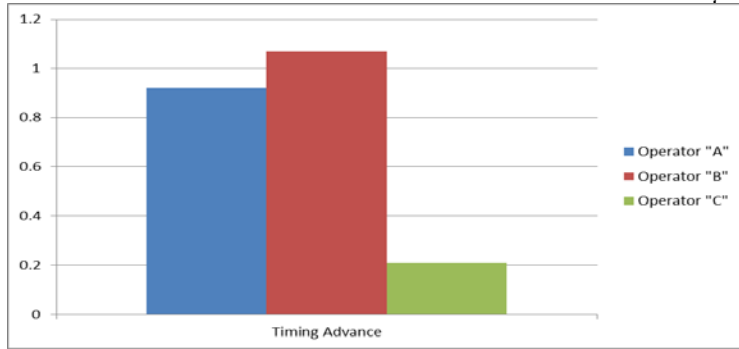


Fig 5: Timing Advance (T.A)

#### 4 ANALYSIS

The results show that some of the operators don't meet the desired level of the performance in different aspects. Thus to ensure that these operators have upgraded their performance, the implementation of the newer technologies is necessary here. These include Transmit Diversity, MIMO etc.

Multiple Input Multiple Output (MIMO) in wireless communications is an efficient technology that offers significant improvements to data rate in a non-line-of-sight environment [7]. The MIMO system utilizes multiple element antennas (MEAs) both on transmit and receive sides of the communication link and thus increases the capacity in a multi-path propagation environment by using Alamouti Codes.[7].

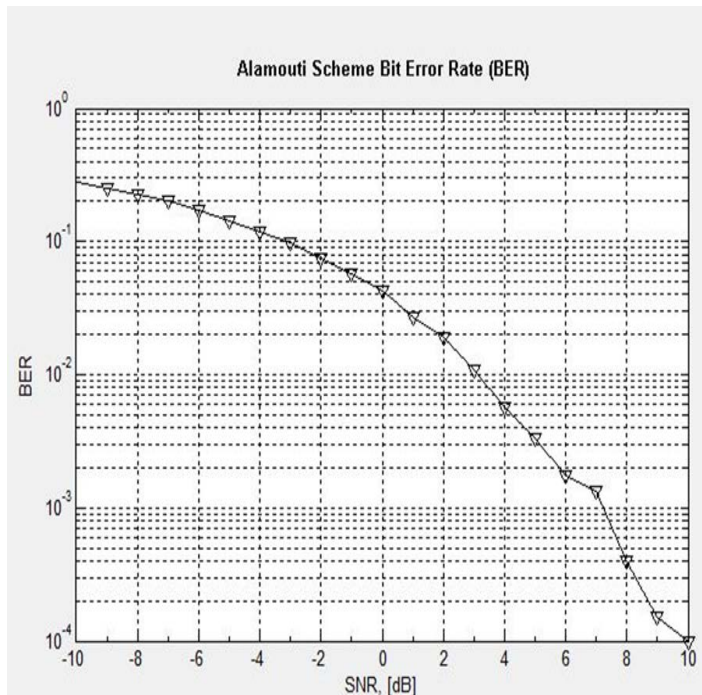


Fig 6: MIMO transmission using Alamouti Schemes [7].

Transmit Diversity diminish the effects of fading by transmitting the same information from two different antennas. The data from the second antenna (Open Loop Antenna 2) is encoded differently to distinguish it from the primary antenna (Open Loop Antenna 1). The user equipment (UE) must be able to recognize that the information is coming from two different locations and properly decode the data [8].

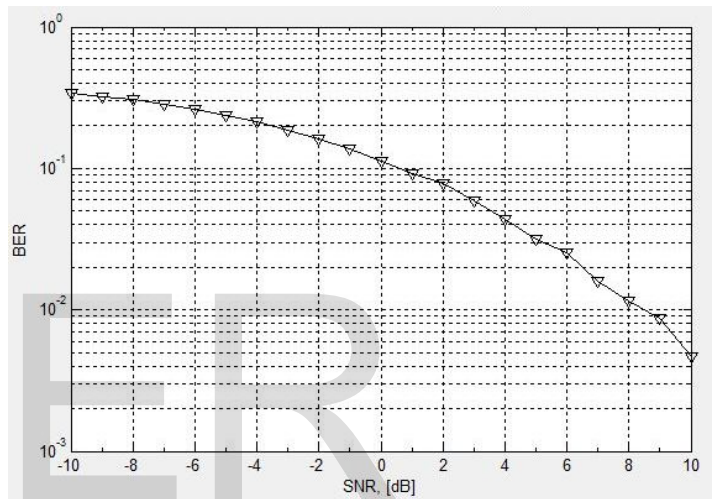


Fig 7: BER vs SNR Curve using Transmit Diversity

#### 5 CONCLUSION

In this paper we have used Swiss Qual drive test data to create an analysis of present GSM QoS condition of Bangladesh. As the numbers of subscribers are increasing here day by day, so the Mobile Network Operators have to improve KPIs to cope up with the extended subscriber's pressure. That's why we have analyzed all the major QVoice Parameters. And we have observed the necessity of MIMO and Transmit Diversity to keep the Network Condition sound and smooth. Besides fading effect is a major part in MIMO which is on process for our future analysis.

#### ACKNOWLEDGMENT

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