

Mobile Cellular Quality of Service (Pakistan's Case)



Introduction



Quality of service is a common term combining parameters, phenomena, effects and impressions etc. which all together, determine the degree of satisfaction of a telecommunication service to customer in a communication network.



Usually, essential Key Performance Indicators KPIs are defined to determine QoS. Terms Qos & KPI will be used interchangeably.

QoS Key Performance Indicators

The Key Performance Indicators, also known as KPI or Key Success Indicators (KSI) is a measure of performance of any organization, product or service and can be summarized into following subcategories.

Quantitative Indicators
which can be presented
in number.

Practical Indicators
that interface with
existing company
processes.

Directional indicators
specifying whether an
organization is getting
better or not.

Actionable indicators
are sufficiently in an
organization's control to
effect change.

Financial indicators
used in performance
measurement and when
looking at an operating
index

PTA's Vision to QoS

Provide reasonable service choices to consumers at affordable cost with best possible quality, within each licensing regime.

PTA has adopted a multipronged approach to realize the above.

The Multi-Pronged Approach

Build A Competitive Environment

Allow subscribers to move from one operator to another retaining their previous number with minimal obligations

Outsource Consumer Perception Surveys

Ensure Interconnect & Maintain a Reasonable MTR

Regulations

**Perform Technical QoS Surveys:
Nationwide, International Roaming**

The Multi-Pronged Approach

- **Enhanced Competition through Deregulation**
 - Warid, Telenor and CMPAK
- **Mobile Number Portability**
 - 1st in the region to introduce MNP. 2 Million+ ported.
- **Consumer Perception Surveys**
 - Gallup Survey: 2003
 - TEACH Survey: 2007
 - TEACH Survey: 2009
- **MTR & Interconnect**
 - \$0.0107; DPLC rates upto 15 percent of RIO in some areas.

The Multi-Pronged Approach (Cont....)

- **Non Technical Standards (notified)**
 - SPAM ,Unsolicited and Obnoxious Call Regulations , 2009
 - Telecom Consumers protection Regulations, 2008
 - Mobile Number Portability Regulations, 2005

The Multi-Pronged Approach (Cont....)

- **Technical Standards**
 - Developed QoS Standards inline with ACT and License Conditions
 - In consultation with the stake-holders
 - Testing based on KPIs which mimic Consumer Perception, performed through state-of-the-art drive test tools, accepted globally and designed as per PTA requirements.

QoS Testing Methodology

Applicability

**End to End
Testing**
(non-intrusive for
network under test)

**Ease of
measurement**

**Ease of
understanding
for a field testing
person**

**Push for future
improvement in
broadband
networking**

Technical Standards

[For Circuit Switched GSM Applications]

1.1 Network Accessibility

“The probability that the mobile services are available to an end customer by display of the network indicator on the mobile equipment”.

$$\text{N/w Accessibility [\%]} = \frac{\text{No. of successful network availability attempts}}{\text{Number of total attempts}} \times 100\%$$

Threshold:

Network Accessibility should be > 99 %

Technical Standards (Cont..)

[For Circuit Switched GSM Applications]

1.2 Service Accessibility

“The probability that the end customer can access the Mobile Telephony services when requested while it is offered by display of the network indicator on the Mobile Equipment”.

This test will determine blocking of the network being tested.

$$\text{Service Accessibility [\%]} = \frac{\text{Total No. of successful calls}}{\text{Total number of calls}} \times 100\%$$

Threshold:

Service Accessibility should be > 99%

Technical Standards (Cont..)

[For Circuit Switched GSM Applications]

1.3 Call Setup Time:

This is defined as “the time between sending of complete address information and receipt of call setup notification”

Threshold:

Setup Time should be < 5 Sec

Technical Standards (Cont..)

[For Circuit Switched GSM Applications]

1.4 Service Retainability

“The probability that a service, once obtained, will continue to be provided under given conditions for a given time duration”.

It can also be defined as “call drop ratio”.

$$\text{Service Retainability [\%]} = \frac{\text{Total No. of intentionally terminated calls}}{\text{Total number of successful calls}} \times 100\%$$

Threshold:

Service Retainability should be > 98%

Technical Standards (Cont..)

[For Circuit Switched GSM Applications]

1.5 End-to-End Speech Quality

This is defined as “The degree of speech quality that a listener perceives at this terminal with a talker at the other end”.

Threshold:

MOS should be > 3

MOS Values are taken in whole numbers, the numbers are quite easy to grade.

Mean Opinion Score (MOS)

MOS gives a numerical indication of the perceived Quality of the media received after being transmitted and eventually compressed using Codec's. MOS values range from 1 to 5.

- 5 - Perfect. Like face-to-face conversation or radio reception.
- 4 - Fair. Imperfections can be perceived, but sound still clear.

This is the range for cell phones.

- 3 - Annoying.
- 2 - Very annoying. Nearly impossible to communicate.
- 1 - Impossible to communicate

Sample Result Format – Voice calls

	Rawalpindi/ Islamabad		Lahore		Karachi		Quetta	
	ON-net	OFF-net	ON-net	OFF-net	ON-net	OFF-net	ON-net	OFF-net
Network Downtime < 1								
Grade of Service ≤ 2								
Call Completion Ratio > 98 %								
Call Connection Time ≤5sec								
MOS >3								

Circuit Switch GSM KPI's

2.1 Service Accessibility SMS Mobile Originated:

It is defined as “probability that the end customer can send the short message service when requested while it is offered by display of the network indicator on the mobile equipment.

$$\text{Service Accessibility SMS [\%]} = \frac{\text{Total No. of successful SMS attempts}}{\text{Total number of SMS attempts}} \times 100\%$$

Threshold:

Service Accessibility should be $\geq 99\%$

2.2 Access Delay SMS Mobile Originated

It is defined as “the time between sending a short message to a short message center and receiving the notice of successful acceptance from the Short Message Service Center”.

Threshold:

Access Delay should be < 2 seconds

Circuit Switch GSM KPI's

2.3 End-to-End Delivery Time SMS:

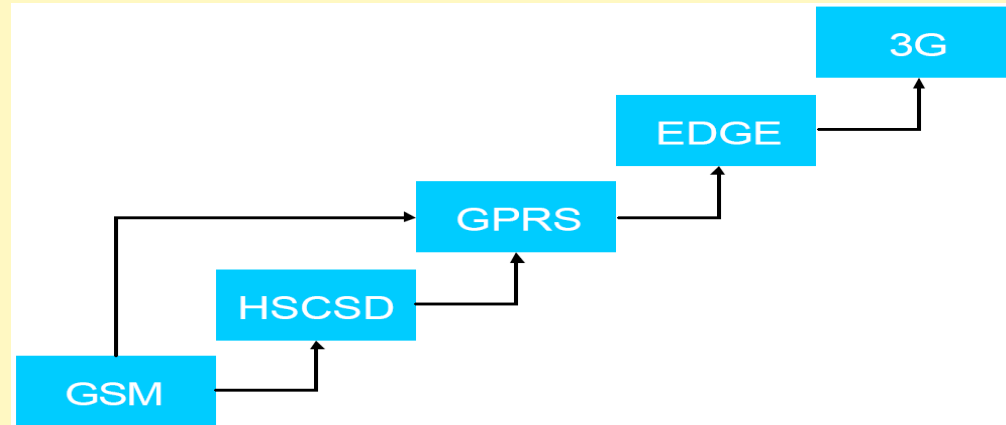
It is defined as “the time between sending a short message to a short message center and receiving the very same short message at another mobile terminal”.

Threshold:

End-to-End Delivery should be < 5 seconds

GSM Technology Evolution

GPRS and EDGE are GSM wireless packet data transfer standards commonly referred as 2.5G and 2.75G respectively. Fig 1 below elaborates the positioning of EDGE and GPRS within the technology evolution growth path from 2G (GSM) to 3G (UMTS).

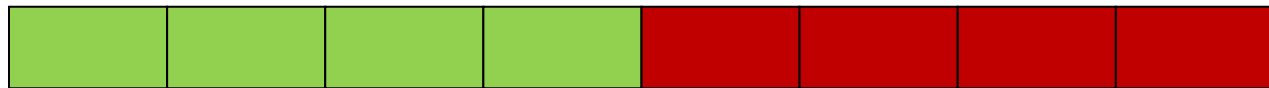


GSM Voice-Data Time slots

TS - 1	TS - 2	TS - 3	TS - 4	TS - 5	TS - 6	TS - 7	TS - 8
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GSM Transceiver



GPRS Transceiver



EDGE Transceiver



GSM / CSD Physical Channel



GPRS Physical Channel



GSM/ GPRS / EGPRS / EDGE Physical Channel

Modulation Vs Speed

EDGE			GPRS	
<i>Coding and modulation scheme (MCS)</i>	<i>Speed (kbit/s/slot)</i>	Modulation	<i>Coding scheme</i>	<i>Speed (kbit/s)</i>
MCS-1	8.80	GMSK	CS-1	8.0
MCS-2	11.2	GMSK	CS-2	12.0
MCS-3	14.8	GMSK	CS-3	14.4
MCS-4	17.6	GMSK	CS-4	20.22
MCS-5	22.4	8-PSK	-	-
MCS-6	29.6	8-PSK	-	-
MCS-7	44.8	8-PSK	-	-
MCS-8	54.4	8-PSK	-	-
MCS-9	59.2	8-PSK	-	-

Recommended GPRS/ Edge KPIs

Availability

Network
Service

Link Speed

Throughput
Download/ Upload
Rural, Urban & EDGE
during Mobility

Latency

Retainability

Rating Tables

GPRS /EDGE KPI's

Availability

Tech.	Type	Pass	Fail
GPRS & Edge	Network	Network available	Network not available
	Service	Time < 7 sec	Time > 7sec

Latency

Tech.	Good	Average	Poor	Unsatisfactory
GPRS	Delay <500ms	500ms - 800ms	800ms -1000m	Above 1sec
EDGE	Delay <100ms	100ms - 200ms	200ms – 500ms	Above 500 ms

Link Speed

Tech.	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	Over 43.2kbps	Between 43.2kbps - 36kbps	Between 36kbps - 24kbps	Between 24kbps - 12kbps	Below 12kbps
EDGE	Over 272kbps ¹	Between 272kbps ¹ - 179.2kbps	Between 179.2kbps - 88.8kbps	Between 88.8kbps - 44.8kbps	Below 44.8kbps

Throughput (fixed): DL Urban

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	Throughput	Over 6.48kbps	Between 6.48 kbps – 5.4kbps	Between 5.4kbps – 3.6kbps	Between 3.6kbps – 1.8kbps	Below 1.8kbps
	Time taken (approx)	Less than 77.2sec	Between 77.2sec – 92.6sec	Between 92.6sec – 139sec	Between 139sec – 278sec	Above 278sec
EDGE	Throughput	Over 40.8kbps ²	Between 40.8kbps ² – 26.88kbps	Between 26.88kbps – 13.32kbps	Between 13.32sec – 6.72sec	Below 6.72kbps
	Time taken (approx)	Less than 12.2sec	Between 12.2sec – 18.6sec	Between 18.6sec – 37.53sec	Between 37.53sec – 74.4sec	Above 74.4sec

Throughput (fixed): DL Rural

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	<i>Throughput</i>	Over 13kbps	Between 13kbps – 10.8kbps	Between 10.8kbps – 7.2kbps	Between 7.2kbps – 3.6kbps	Below 3.6kbps
	<i>Time taken (approx)</i>	Less than 38.5sec	Between 38.5 sec – 46.3sec	Between 46.3sec – 70sec	Between 70sec – 139sec	Above 139 sec
EDGE	<i>Throughput</i>	Over 81.6kbps ³	Between 81.6.kbps ³ – 53.8kbps	Between 53.8kbps – 26.64kbps	Between 26.64kbps – 13.44kbps	Below 13.44kbps
	<i>Time taken (approx)</i>	Less than 6.13sec	Between 6.13sec – 9.3sec	Between 9.3sec – 18.8sec	Between 18.8sec – 37.2sec	Above 37.2sec

Throughput: DL EDGE Mobility

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
EDGE	<i>Throughput</i>	Over 30.6kbps ⁴	Between 30.6kbps ⁴ - 20.17kbps	Between 20.17kbps - 10kbps	Between 10kbps - 5kbps	Below 5kbps
	<i>Time taken (approx)</i>	Less than 16.33sec	Between 16.33sec - 24.8sec	Between 24.8sec - 50sec	Between 50sec - 100sec	Above 100sec

Throughput (fixed): UL Urban

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	<i>Throughput</i>	Over 4.8kbps	Between 4.8kbps – 4.32kbps	Between 4.32kbps – 3.6kbps	Between 3.6kbps – 2.4kbps	Below 2.4kbps
	<i>Time taken (approx)</i>	Less than 20.8.8sec	Between 20.8sec – 23.1 sec	Between 23.1sec – 27.7sec	Between 27.7sec – 41.7sec	Above 41.7sec
EDGE	<i>Throughput</i>	Over 18kbps	Between 18kbps – 9kbps	Between 9kbps – 6kbps	Between 6kbps – 3.5kbps	Below 3.5kbps
	<i>Time taken (approx)</i>	Less than 5.5sec	Between 5.5sec – 11.11sec	Between 11.11sec – 16.7sec	Between 16.7sec – 28.6sec	Above 28.6sec

Throughput (fixed): UL Rural

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	<i>Throughput</i>	Over 9.6 kbps	Between 9.6kbps – 8.64kbps	Between 8.64kbps – 7.2kbps	Between 7.2kbps – 4.8kbps	Below 4.8kbps
	<i>Time taken (approx)</i>	Less than 10.41sec	Between 10.41sec – 11.6 sec	Between 11.6sec – 14 sec	Between 14sec – 21sec	Above 21sec
EDGE	<i>Throughput</i>	Over 26.9kbps	Between 26.9kbps – 13.4kbps	Between 13.44kbps – 10.56kbps	Between 10.56kbps – 5.3kbps	Below 5.3kbps
	<i>Time taken (approx)</i>	Less than 3.7sec	Between 3.7sec – 7.5sec	Between 7.5sec – 9.47sec	Between 9.47sec – 19sec	Above 19sec

Throughput: UL EDGE Mobility

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
EDGE	<i>Throughput</i>	Over 11.22kbps	Between 11.22kbps – 5.6kbps	Between 5.6kbps – 4.14kbps	Between 4.14kbps – 2.2kbps	Below 2.2kbps
	<i>Time taken (approx)</i>	Less than 8.91sec	Between 8.91sec – 18sec	Between 18sec – 24.15sec	Between 24.15sec – 45.5sec	Above 45.5sec

Retainability

Tech.	Excellent	Good	Poor	Unsatisfactory
GPRS & Edge	No disconnection	1 Disconnection out of three	2 disconnections out of three	More than 2 Disconnections

Measurement options

Option I

- **Simple Testing**
 - Crude method but requires least resources

Option II

- **Regulator Testing (Recommended)**
 - Detailed measurement method using any tool, e.g. TEMS, NEMO, Agilent, R&S, Actix etc.

Option III

- **Outsource to Experts (Not Recommended)**
 - Option involves extensive testing through experts with the possibility of third party testing.

Fair Measurement Conditions

1. During one complete test cycle, destination IP MUST remain the same for all networks under test or could be the one individually proposed by each Cellular operator.
2. KPI should ideally be tested for different traffic types e.g. BURST: for surfing; CONTINUOUS: for video streaming. Especially EDGE should support video streaming or IPTV (if announced).
3. In all cases, at-least 10 tests of each KPI must be performed with multiple configurations.
4. For every DL & UL speed test the cache should be cleared prior to its initiation.

Fair Measurement Conditions

5. For UL/DL speed testing a reasonable file size be maintained e.g. at-least 500kB (4Mb) for DL and at-least 100kB (800kb) for UL.
6. For each test complete details of the testing equipment may be noted with its make, model, software/hardware versions and class compatibilities. Moreover it is strongly recommended that same handset be used for all tests on all networks.

Fair Measurement Conditions

8. KPIs should be devised primarily for peak traffic hours, with all networks to be tested simultaneously during specified timing which will provide benchmarking

Complete Document Available at:

http://www.pta.gov.pk/index.php?option=com_content&task=view&id=1304&catid=94&Itemid=1&bold=gprs

The background of the slide features a stylized globe with a grid of latitude and longitude lines. Overlaid on the globe is a complex network of glowing green and blue lines, representing a global communication or data network. The overall color scheme is dominated by shades of green and blue, with a dark blue gradient in the upper right corner.

Thanks