

2009

Key Performance Indicators for Fixed Broadband Services in Pakistan

This document defines the Key Performance Indicators (KPIs) for Broadband Services for Pakistan as defined in the Fixedline Deregulation Policy of 2004. Key Performance Indicators are expressed in terms of critical quantifiable thresholds which translate into optimal acceptable limits for the relevant consumers. The defined parameters reflect the above and can be considered as key to the success of the service providers, consumers and broadband growth in the country. They differ from other countries based on indigenous essentials. Although these KPIs are planned for long-term benchmarking but it is recommended that they may be reviewed after one year.



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Key Performance Indicators (KPI) for Fixed Broadband Services in Pakistan

The Broadband Policy for Pakistan was issued by the Government in December 2004, which aimed at proliferation of broadband services in Pakistan. Starting with only a handful of broadband connections back in 2004 the broadband subscribers have leapfrogged to a mark of 0.5M; thereby implying a momentous growth. Along with the growing number of subscribers the quality of broadband services is also of concern to the regulator.

Encompassing the afore mentioned fact together with PTA's vision of "Protecting Consumer Interest and ensuring high quality ICT services" Pakistan Telecom Authority (PTA) has delineated Broadband Key Performance Indicators (KPI) for Pakistan. These KPI's shall act as benchmarks in determining Quality of Service (QoS) for Broadband in Pakistan from end user's perspective. The objective of laying down these indicators is to create transparently establish quantifiable and measurable standard parameters; which the service provider is entailed to provide and the user has a right to expect thus invariably enhancing consumer satisfaction. KPI's have been defined keeping in consideration the **Broadband Policy of Pakistan 2004**. Broadband in Pakistan is referred to as "always on" services with a data rate greater than **128Kbps**. The Broadband Delivery Technologies in Pakistan as per clause 5.2 of Broadband Policy refer to following technologies (1):

<i>Common Terminology</i>	<i>Technical Terminology</i>
1 Copper Telephone lines	Digital Subscriber Line (DSL)
2 Hybrid of Coaxial and Fiber cable	HFC Network
3 Wireless	Broadband Wireless Access
4 Satellite	VSAT and DTH

Table 1: Broadband Technologies in Pakistan

Broadband shall be taken to refer to always-on services with a data rate greater than 128Kbps including technologies referred at table 1.

1. Hypothesis

Following was considered while defining the Key Performance Indicators (KPI's) for Broadband in Pakistan, wherever pertinent and possible:

- 1.1. Should be easily understood by the public, useful and important.
- 1.2. All network related parameters be applicable at the Network Termination Point (NTP).
- 1.3. Use of realistic, real time traffic instead of using test lines for measurements.
- 1.4. Maintain consistency across all operators.
- 1.5. All tests to be carried out at a designated place defined by PTA, without mobility.
- 1.6. The parameters are designed for the statistical and individual applications. The statistical values are derived by the application of a simple statistical function to the individual values. The statistical function is specified in the standard. The standard also contain guidelines on how statistically significant samples should be selected.
- 1.7. The statistical functions are designed to make consumers choice easy.
- 1.8. Test Timings are appended at Para 4. Three test slots have been suggested explicitly: Peak, Off Peak and Medium Traffic Hours. While testing, daylight time saving clock shifts should be considered.

- 1.9. Test areas shall be identified by PTA after obtaining coverage information from operators.
- 1.10. Duration of the tests are intentionally left open for flexibility.
- 1.11. The document excludes tests for satellite transmissions.
- 1.12. Customer Premises Equipment power backup arrangements should be ensured before commencement of the test.

2. Key Performance Indicators

Following metrics are suggested to measure broadband metrics from subscribers' perspective:

2.1 Network Availability: The parameter shall check the availability of the Network or Service, as is claimed or "advertized" by the Broadband Service Providers. This shall verify operator coverage claims. It is a binary check. The Network availability shall be checked for all the Broadband Service Providers in a manner identified at Table 1-Annex A. Coverage maps may be obtained from service providers before the actual verification testing is done.

2.2 Link Speed: The Link Speed (LS) shall be checked against the advertised speeds. The link speeds which are normally shown to the subscribers are not the actual link rates that are available to the subscribers at any given point in time. Actual link rates shall be measured during the proposed "T" test times. Once a link has been established successfully, sustainability of the service shall be checked. The link speed shall be checked in a manner identified at Table 2 at Annex A.

2.3 Service Availability (in %): Broadband Service Availability (BSA) indicates the number of times we are able to successfully access the broadband services. Network non-availability can happen due to various reasons like line failure, Authentication Authorization and Accounting (AAA) failure, backhaul failure etc. This metric indicates the reliability of the Broadband service. Since broadband is referred to as an "always on" connection so a lot many times the service is available/connected however the internet is not available. So the metric shall check for the availability of the internet.

During testing if N attempts are made to connect to the Internet and if F times the attempt failed, then

$$\text{Availability} = (1 - F/N) \times 100\%$$

An attempt is declared as failure, if we are not able to connect to Internet within 75 seconds for wireline communications and 120 seconds for Wireless communications. The availability shall be checked in a manner identified at Table 3 (Annex A).

Under this KPI two parameters shall be checked:

- 1) Connect time (for instances when the modem is started afresh or after a rest)
 - a. Transceiver Connect time – 45/ 75 seconds for wireline/ wireless respectively.
 - b. AAA Authentication Time – 30/ 45 seconds for wireline/ wireless respectively.
- 2) Service Availability

The connect time is used for authentication purposes particularly in case of wireless BB communications in Pakistan. For clarity following hypothesis is added:

- 1) Within the same HLR.
- 2) User Identification Number (UID)/Password has to be given explicitly.
- 3) Within 3 Km of radial distance from the switch (For copper only loops)
- 4) Customer Terminal powered up (fresh boot up for every applicable test).
- 5) Laptop is powered up.

- 6) 75 seconds figure is for wire line communications and 120 seconds for wireless communications.

The availability of service shall exclude downtime for the purpose of upgrading or routine maintenance of the network system provided that users are informed in advance of any such up-gradation or maintenance actions. *The availability outage time for maintenance shall not exceed two times in a month and shall be less than 5 hours.*

Following rating shall apply to the statistics: (Table 3.1 for grading at Annex-A)

- a) Grade A shall apply to percentages equivalent to 95% or above.
- b) Grade B shall apply to percentages <95% and >80%.
- c) Grade C shall apply to percentages <80% and >70%.
- d) Grade D shall apply to percentages <70% and >50%.
- e) Grade E shall apply to percentages less than 50.

2.3.1 Retainability:

This KPI shall check the retainability of the service over a period of 60 minutes. A no disconnection over a period shall be termed as Grade A. Subsequent grading applied accordingly can be found as follows. Refer Table 4(Annex A).

- a) Grade A shall apply to no DC within 60 min.
- b) Grade B shall apply to a DC within 45+ min.
- c) Grade C shall apply to a DC within 30-45min.
- d) Grade D shall apply to a DC within 15-30 min.
- e) Grade E shall apply to a DC within 5-15min.

2.4. Bandwidth:

2.4.1 Download Speed (kbps/Mbps): One of the key metric in broadband services is the download speed, which defines how much traffic a subscriber can receive to the maximum. Also the performance of many residential applications like Web-browsing, downloading content etc, depends on this metric. The actual download speed available to the subscriber shall be measured. Keeping the reasonable loading level in the intra network links up to ISP node, and the fact that in general for normal broadband operations data rate is lower than the advertised/plan data rate, the data speed must be at least 60% of the advertised speed of broadband service plan, both download and upload, and this must be experienced at least 70% of the time. For example, if your broadband service plan is 1000/128 Kbps, a pass result shall be considered if data speed is 600/76.8 Kbps or better. *The Download Speed shall be checked in a manner identified at Table 5(Annex A).*

Data download speed =Size of the test file (data) in ISP Server (in MB) ÷ Transmission Time (in seconds) required for error free transfer of the entire data.

2.4.2 Upload Speed (kbps/Mbps): Upstream speed for the Internet connection. This metric define the speed in which the subscriber can send traffic to Internet. It plays a significant role in situations which require upload hungry applications for instance software business development. *Methodology used for calculating upload speeds shall be similar to download speeds. The Upload speed shall be checked in a manner identified at Table 5.2(Annex A).*

2.4.3 Upload/Download Speed Ratio:

The data rate of the ISP's Access Plan is the maximum data rate. The effective data throughput that a consumer will achieve will vary from time to time and in general may average unto 20 percent lower than the Plan rate. The data protocols used to communicate over the Internet may need up-to 20 percent of the capacity of the broadband link. Further because of the 'best endeavor' nature of the Internet, factors outside the ISP control and the daily variation in Internet traffic, the data rate that a consumer experiences may vary. With this KPI, Upload/Download speed ratio shall be intimated

first by the Service Provider followed by PTA check for conformity through test measurements. This shall be calculated as indicated in Table 5.4. (Annex A).

2.4.4 Contention Ratio:

This ratio of number of subscribers per unit of bandwidth is commonly known as contention ratio and it may vary depending on the quality of service the ISP is planning to offer. Lower the contention ratio, higher the QoS. The ratio of total Internet Bandwidth per operator to total number of subscribers shall be recorded against Table indicated in Table 5.5 (Annex-A).

2.5. Round Trip Time (RTT , milli-sec):

Round Trip Delay is the time taken for the traffic to reach a particular destination and return. Round-trip delay time is significant in systems that require two-way interactive communication where the round-trip time directly affects the throughput rate.

Ping is a very common tool to measure the RTT. The Ping application generates a packet with a timestamp; RTT is calculated finding the difference between the current time and the received packet time-stamp. Ping and Trace-route (Tracert) shall be used for measuring the RTT. RTT shall be measured upto the Broadband Remote Access Server (BRAS). It is at the BRAS where an ISP can inject policy management. The higher the round trip time in milliseconds, the higher the latency. A higher RTT indicates a network problem between the computer and the pinged-server. *A packet must have a delay no longer than 85 ms based on a minimum standard packet size of 32 bytes. RTT shall be checked in a manner identified at Table 6(Annex A).*

2.6. Jitter (milli-sec): (deferred for 2011)

Jitter is the fluctuation/variation of end-to-end delay from one packet to the next packet within the same packet stream/connection/flow. Jitter experienced by the packets is more relevant for Real-time traffic. The metric is important and can seriously affect the quality of streaming audio and/or video. Jitter is the variance in one-way latency and is calculated based on sending and receiving time stamps of consecutive packets sent out.

2.7. Packet-Loss (%): (deferred for 2011)

Number of packets (in percentage) which doesn't reach the destination. Packet-loss can result in highly noticeable degraded performance and may affect all other network applications. The recommended benchmark of packet loss should be <3%. (7)

2.8 Tariff Comparison: The cost of all the packages provided by each Broadband Service Providers (BSP's) shall be collected on business/residential or any other package plans (if any). The cost shall be calculated in Pak Rs. as identified in Table 2 at Annex A.

2.9 Customer Service:

2.9.1 Unplanned Outage Automation Notice

The unplanned outage Automated notice should be less than 15 minutes. Reasons for outage to be recorded by the Operator and intimated to the designated officers of the Authority. The Operator shall keep logs which are verifiable by PTA with proper command line information.

2.9.2 Planned Outage Notice

Planned outage notice shall be intimated 2 days prior to the outage. Reasons for outage to be recorded by the Operator and intimated to the designated officers of the Authority. The outage time for maintenance shall not exceed two times in a month and shall be less than 5 hours.

2.9.3 Automated Ticketing System for Complaints

The availability of Computerized Customer Complaint Database is mandatory as per the license requirement. The system should be capable of generating automated tickets to the complainants. If

automated system is not available then the operator should record the reasons and intimate to the Authority within 3 days on a nationwide basis.

2.9.4 Response to Assistance Requested

The 'response to the requested assistance' should be available 98% of the time. Complaint shall be recorded within 2 minutes.

The response to Requested Assistance shall be as follows:

95% of the complaints, not related to billing or service provisioning, shall be solved within 24 hrs.

97% of the complaints, not related to billing or service provisioning, shall be solved within 48 hrs.

99% of the complaints, not related to billing or service provisioning, shall be solved within 72 hrs.

2.10 Billing Complaints:

90% of the billing complaints shall be solved within 24 hrs.

95% of the billing complaints shall be solved within 48 hrs.

99% of the billing complaints shall be solved within 72 hrs.

100% of the billing complaints shall be resolved within 7 working days.

2.11 Service Provisioning Complaints

(Provided that these, are for regions from within the announced coverage area, does not involve ROW issues not within the control of the service provider, are not created as a result of devastating natural or man-made calamities)

90% Service provisioning shall be solved within 24 hrs.

95% Service provisioning shall be solved within 48 hrs.

99% Service provisioning shall be solved within 72 hrs.

3. Broadband Service Providers(BSP) and Packages

3.1 The testing plan will benchmark all Broadband Service Providers of Pakistan who offer similar Connection Plan. The following shall apply to the above KPI's as applicable.

Speed/BSP	BSP- A		BSP-B		BSP-C		BSP-D		BSP-E		BSP-F		
	B	R	B	R	B	R	B	R	B	R	B	R		
128 Kbps														
256 Kbps														
....														
*B= Business *R= Residential *BSP= Broadband Service Provider														

3.2 Each Business package shall be tested for "T" timings defined below at Para (4) for a period of "x" days (refer Hypothesis 1.10).

Test Plan for BSP- A					
Day1					
(Table shall be repeated for "x" days onwards)					
	T1	T2	T3	Mean
128 Kbps(Business)					M1

128Kbps (Residential)					M2
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4. Time for Repetition of Experiments

Each test shall be carried out on alternate day for a total of 15 days over the below mentioned time Schedule:

	Measuring Time	Traffic Analysis	Suggested Time Slots. (Hrs)
1.	T1	<u>Off Peak Traffic Time(Lowest)</u>	0630-0830
2.	T2	<u>Peak Traffic time (Highest)</u>	1400- 0030* *Except 1830-2030
3.	T3	<u>Medium/Normal Traffic</u>	1030-1130 0230-0330

5. Recommended KPI's for Yr 2010:

Some or all of the metrics shall be measured. These are shown in below mentioned table:

Sr.	Metrics	BSP
1.	Network availability	Yes
2.	Link Rate	Yes
3.	Availability	Yes
4.	Bandwidth	Yes
5.	RTT	Yes
6.	Jitter	No
7.	Packet Loss	No
8.	Customer Service	Yes
9.	Billing Complaints	Yes
10.	Service Provisioning Complaints	Yes

Annex-A Evaluation Tables

Network Available Areas CityWise(ANAC) <i>(*Table shall be repeated for all BSP's)</i>												
BSP- A												
	ANAC 1		ANAC 2		ANAC 3		ANAC 4		ANAC 5		
	B	R	B	R	B	R	B	R	B	R	B	R
Network Availability	Y/N											
<i>*B= Business *R= Residential *BSP= Broadband Service Provider *ANAC=Advertised Network Available Areas CityWise(By BSP's) Network Coverage Maps may be obtained from BSP's before recording this KPI.</i>												

Table 1: Network Availability

Link Speed														
Speed/BSP	BSP- A		BSP-B		BSP-C		BSP-D		BSP-E		BSP-F		
	B	R	B	R	B	R	B	R	B	R	B	R		
128 Kbps														
256 Kbps														
512 Kbps														
....														
<i>*B= Business *R= Residential *BSP= Broadband Service Provider</i>														

Table 2: Link Speed

Service Availability (%) BSP-A <i>(*Table shall be repeated for all BSP's/ Package)</i>					
	T1	T2	T3	Average %

Day1					*Availability = (1- F/N) × 100%.
...					

*N= Total No. of times the experiment is done for a single BSP/ Package
 *F=No. of times internet is unreachable

Table 3: Service Availability

Service Availability(%)				
Grade A	Grade B	Grade C	Grade D	Grade E
95% or above	>95% and <80%	>80% and <70%	>70% and <50%	<50%

Table 3.1: Service Availability Grading

Retainability				
Grade A	Grade B	Grade C	Grade D	Grade E
60 min (No DC)	45+ min	45-30min	30-15min	15-5min

Table 4: Retainability

Download Speed														
Speed/BSP	BSP- A		BSP-B		BSP-C		BSP-D		BSP-E		BSP-F		
	B	R	B	R	B	R	B	R	B	R	B	R		
128 Kbps														
256 Kbps														
....														

*B= Business *R= Residential *BSP= Broadband Service Provider
 Table Shall be repeated for T timings in a day

Table 5: Download Speed

Download Speed				
Grade A	Grade B	Grade C	Grade D	Grade E
>Speed*75 %	>Speed*75% and <Speed*60%	>Speed*60% and <Speed*45%	>Speed*45% and <Speed*30%	<Speed*30%

Speed implies to advertised speeds by BSP's

Table 5.1: Download Speed Grading

Upload Speed														
Speed/BSP	BSP- A		BSP-B		BSP-C		BSP-D		BSP-E		BSP-F		
	B	R	B	R	B	R	B	R	B	R	B	R		
128 Kbps														
256 Kbps														
....														
*B= Business *R= Residential *BSP= Broadband Service Provider Table Shall be repeated for T timings in a day														

Table 5.2: Upload Speed

Upload Speed				
Grade A	Grade B	Grade C	Grade D	Grade E
>Speed*75 %	>Speed*75% and <Speed*60%	>Speed*60% and <Speed*45%	>Speed*45% and <Speed*30%	<Speed*30%
Speed implies to advertised speeds by BSP's				

Table 5.3: Upload Speed Grading

Ratio of Upload/Download Speed			
	BSP-A	BSP-B	...
128 Kbps			
256 Kbps			
...			

Table 5.4: Upload/Download Speed Ratio

Contention Ratio			
BSP-A	BSP-B
Total Bandwidth/ No. of Subscribers

Table 5.5: Contention Ratio

Round Trip Time					
BSP-A					
<i>(*Table shall be repeated for all BSP's)</i>					
	<i>T1</i>	<i>T2</i>	<i>T3</i>	<i>.....</i>	<i>Average(ms)</i>
<i>Day1</i>					
<i>...</i>					

Table 6: Round Trip Time (RTT)

RTT(For Local Latency in ms)			
<i>Grade A</i>	<i>Grade B</i>	<i>Grade C</i>	<i>Grade D</i>
<i><70ms</i>	<i>Between 70ms and 80ms</i>	<i>Between 80ms and 90ms</i>	<i>Between 90 and 100ms or 100ms+</i>

Table 6.1: Round Trip Time (RTT) Grading

Tariff in Pak Rs.														
Speed/BSP	BSP- A		BSP-B		BSP-C		BSP-D		BSP-E		BSP-F		
	B	R	B	R	B	R	B	R	B	R	B	R		
128 Kbps														
256 Kbps														
....														
<i>*B= Business *R= Residential *BSP= Broadband Service Provider</i>														

Table 2: Cost Comparison

Annex-B

Glossary

- AAA** An AAA server is a server program that handles user requests for access to computer resources and, for an enterprise, provides authentication, authorization, and accounting (AAA) services. The AAA server typically interacts with network access and gateway servers and with databases and directories containing user information. The current standard by which devices or applications communicate with an AAA server is the Remote Authentication Dial-In User Service (RADIUS).
- ADSL** **Asymmetric Digital Subscriber Line (ADSL)** is a form of DSL, a data communications technology that enables faster data transmission over copper telephone lines than a conventional voice-band modem can provide. It does this by utilizing frequencies that are not used by a voice telephone call.
- Asymmetric** Not identical on both sides of a central line; unsymmetrical; lacking symmetry.
- Bandwidth** In computer networks, bandwidth is often used as a synonym for data transfer rate - the amount of data that can be carried from one point to another in a given time period (usually a second). This kind of bandwidth is usually expressed in bits (of data) per second (bps).
- BRAS** A broadband remote access server (BRAS or BBRAS) routes traffic to and from the digital subscriber line access multiplexers (DSLAM) on an Internet service provider's (ISP) network. The BRAS sits at the core of an ISP's network, and aggregates user sessions from the access network.
- BSP** Broadband Service provider
- DSL** **DSL** or **xDSL**, is a family of technologies that provides digital data transmission over the wires of a local telephone network. DSL originally stood for **digital subscriber loop**, although in recent years, the term **digital subscriber line** has been widely adopted as a more marketing-friendly term for ADSL, which is the most popular version of consumer-ready DSL.

DSL can be used at the same time and on the same telephone line with regular telephone, as it uses high frequency, while regular telephone uses low frequency.

DTH **Direct broadcast satellite** (DBS) is a term used to refer to satellite television broadcasts intended for home reception, also referred to more broadly as **direct-to-home** signals. The expression *direct-to-home* or DTH was, initially, meant to distinguish the transmissions directly intended for home viewers from cable television distribution services that sometimes carried on the same satellite

FTTH **Fiber to the x (FTTx)** is a generic term for any broadband network architecture that uses optical fiber to replace all or part of the usual metal local loop used for last mile telecommunications. This generic term originates as the generalization of several configurations of fiber deployment (FTTN, FTTC, FTTB, FTTH...), all starting by FTT but differentiated by the last letter, which is substituted by an x in the generalization.

HFC **Hybrid fibre-coaxial (HFC)** is a telecommunications industry term for a broadband network which combines optical fiber and coaxial cable. It has been commonly employed globally by cable TV operators since the early 1990s.

KPI **Key Performance indicators**-A key performance indicator (KPI) is a business metric used to evaluate factors that are crucial to the success of an organization. KPIs differ per organization; business KPIs may be net revenue or a customer loyalty metric, while government might consider unemployment rates. KPIs are applied in business intelligence (BI) to gauge business trends and advise tactical courses of action.

QoS **Quality of service**- is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow.

VSAT VSAT is an abbreviation for a Very Small Aperture Terminal. It is basically a two-way satellite ground station with a less than 3 meters tall (most of them are about 0.75 m to 1.2 m tall) dish antenna stationed. The transmission rates of VSATs are usually from very low and up to 4 Mbit/s.