TELECOM REGULATORY AUTHORITY OF INDIA

NOTIFICATION

New Delhi, the 6th October, 2006

No. 304-6/ 2004-QoS. In exercise of the powers conferred upon it under section 36 read with sub-clauses (i) and (v) of clause (b) of sub section (1) of section 11 of the Telecom Regulatory Authority of India Act 1997(24 of 1997), the Telecom Regulatory Authority of India hereby makes the following Regulations, namely:-

1. Short title, extent and commencement

i) These regulations shall be called as ***'Quality of Service of Broadband Service Regulations 2006' (11 of 2006).***

ii) These Regulations shall be applicable to all the Internet Service Providers, Basic Service Providers, Unified Access Service Providers and Cellular Mobile Telecom Service Providers including Mahanagar Telephone Nigam Limited and Bharat Sanchar Nigam Limited., providing Broadband Service.

iii) These Regulations shall come into force with effect from 1st January, 2007.

2. Definitions

In these Regulations, unless the context otherwise requires:

(a) **'Act'** means the Telecom Regulatory Authority of India Act, 1997.

(b) **'Authority"** means the Telecom Regulatory Authority of India (TRAI).

(c) **'Basic Service'** means service derived from a Public Switched Telephone Network (PSTN) as specified in the license.

(d) **'Broadband'** is defined in the Broadband Policy 2004 as "An always-on data connection that is able to support interactive services including Internet access and has the capability of the minimum download speed of 256 kilo bits per second (kbps) to an individual subscriber from the Point of Presence (POP) of the service provider intending to provide Broadband service where multiple such individual Broadband connections are aggregated and the subscriber is able to access these interactive services including the Internet through this POP. The

interactive services will exclude any services for which a separate licence is specifically required, for example, real-time voice transmission, except to the extent that it is presently permitted under ISP licence with Internet Telephony".

(e) **'CPE' means Customer Premises Equipment**

(f) **'Customer' or 'Consumer'** means a subscriber of Broadband service.

(g) **'DSLAM'** means Digital Subscriber Line Access Multiplexer.

(h) **'Internet'** is a global information system that is:

- logically linked together by a globally unique address, based on Internet Protocol (IP) or its subsequent enhancements/ upgradations;
- able to support communications using the Transmission Control Protocol / Internet Protocol (TCP/IP) suite or its subsequent enhancements/ upgradations, and all other IP compatible protocols.

(i) **'IP ADDRESS':** Operation of Internet Service requires IP addresses which is at present a 32 bit binary address. This address is required for each permanent connection on Internet. Typically, it is required for ports of routers and other ISP equipment and also for leased line connections to be provided to end users.

(j) '**IGSP'** means International Gateway Service Provider for Internet services.

(k) **'ILDO'** means International Long Distance Operator.

(l) **'ISP'** means Internet Service Provider licensed to provide access to Internet Service

(m) **'ISP Node'** means a location where the ISP's Gateway Router is connected with upstream service provider.

(n) **'LAN'** means Local Area Network. It is a group of computers and associated devices that share a common communications line or wireless link.

(o) **'License'** means a licence granted or having effect as if granted under section 4 of the Indian Telegraph Act 1885 and Indian Wireless Telegraphy Act, 1933.

(p) **'Licensee'** means a registered Indian Company that has been awarded licence for providing specified public telecommunication services under sub-section (1) of section 4 of the Indian Telegraph Act 1885 (13 of 1885) for providing.

(q) **'NAP'** means Network Access Point. It is a major oversees Internet interconnection point that serves to logically link global Internet.

(r) **NIXI'** means National Internet Exchange of India

(s) **'NLDO'** means National Long Distance Operator.

(t) **'PC'** means Personal Computer**.**

(u) **'POP'** means Point Of Presence of the service provider intending to provide Broadband service where multiple such individual Broadband connections are aggregated and the subscriber is able to access interactive services including the Internet through this POP.

(v) **'Quality of Service':** The term "Quality of Services" (QoS) is defined as "the collective effect of service performance which determines the degree of satisfaction of a user of the service indicating the performance of a broadband network and of the degree to which the network conforms to the stipulated norms".

(w) **'Service Provider'** means a licensee of Internet Service, Basic Service, Unified Access Service and Cellular Mobile Service, Commercial VSAT Service etc. including Mahanagar Telephone Nigam Limited / Bharat Sanchar Nigam Limited., who is licensed to provide Internet service.

(x) **'Time Consistent Busy Hour (TCBH)':** The one hour period starting at the same time each day for which the average traffic of the resource group concerned is greatest over the days under consideration. ITU recommends analysis of 90 days to establish TCBH.

(y) **'UASP'** means Unified Access Service Provider.

3. Benchmarks for Quality of Service (QoS) Parameters

The service providers shall meet the benchmarks for the Quality of Service parameters for Broadband as laid down below:-

Sl	QoS Parameters	Benchmarks	Averaged over a period of
i.	**Service Provisioning /Activation Time**	100% cases in =<15 working days (subject to technical feasibility). In all cases where payment towards installation charge & security deposit is taken and the Broadband connection is not provided within 15 working days, a credit at the rate of Rs.10/ per day, subject to a maximum of installation charge or equivalent usage allowance shall be given to the customer, at the time of issue of first bill.	

ii.	**Fault Repair / Restoration Time**	By next working day: > 90% and within 3 working days: 99% Rebate: (a) Faults Pending for > 3 working days and < 7 working days: rebate equivalent to 7 days of minimum monthly charge or equivalent usage allowance (b) Faults Pending for > 7 working days and < 15 working days: rebate equivalent to 15 days of minimum monthly charge or equivalent usage allowance (c) Faults Pending for > 15 working days: rebate equivalent to one month of minimum monthly charge or equivalent usage allowance	One month
iii.	**Billing Performance** • Billing complaints per 100 bills issued • %age of Billing Complaints resolved • Time taken for refund of deposits after closure:	< 2% 100% within 4 weeks 100% within 60 days	One month
iv.	**Response time to the customer for assistance**	% age of calls answered by operator (Voice to Voice) Within 60 seconds > 60% Within 90 seconds > 80%	One month
v.	**Bandwidth Utilization/ Throughput:** **a) Bandwidth Utilization** **i) POP to ISP Gateway Node [Intra-network] Link(s)** **ii) ISP Gateway Node to IGSP / NIXI Node upstream Link(s) for International connectivity**	<80% link(s)/route bandwidth utilization during peak hours (TCBH). If on any link(s)/route bandwidth utilization exceeds 90%, then network is considered to have congestion. For this additional provisioning of Bandwidth on immediate basis, but not later than one month, is mandated.	One month

	b) Broadband Connection Speed (download)	Subscribed Broadband Connection Speed to be met >80% from ISP Node to User.	
vi.	**Service Availability / Uptime** (for all users)	> 90% quarter ending June 2007; > 98% with effect from quarter ending September 2007 and onwards	One Quarter
vii.	**Packet Loss** **(**for wired broadband access)	<1%	One month
viii.	**Network Latency** (for wired broadband access) • User reference point at POP / ISP Gateway Node to International Gateway (IGSP/NIXI) • User reference point at ISP Gateway Node to International nearest NAP port abroad (Terrestrial) • User reference point at ISP Gateway Node to International nearest NAP port abroad (Satellite)	<120 msec <350 msec <800 msec	One month
ix.	**Customer perception of Services**		One Quarter
(a)	% satisfied with the provision of service	>90%	
(b)	% satisfied with the billing performance	>90%	
(c)	% satisfied with help services	>90%	
(d)	% satisfied with network performance, reliability and availability	>85%	
(e	% satisfied with maintainability	>85%	

(f)	% satisfied with Overall customer satisfaction	>85%	
(g)	% satisfied with Customer satisfaction with offered supplementary services such as allocation of static/fixed IP addresses, e-mail IDs etc.	>85%	

4. Reporting Requirement

The service providers shall submit the Performance Monitoring Reports on the QoS benchmarks for all the parameters in the format to be prescribed by the Authority on Quarterly basis, ending 31st March, 30th June, 30th September and 31st December, but not later than 6 weeks from the end of the Quarter. The Authority may review from time to time the periodicity and the format of such report.

5. Registration of Demands for Broadband Connections

5.1 Service Providers, who intend to provide Broadband service, in a particular service area or exchange area/ locality/ city shall advertise and make public the Broadband availability plan at periodic interval of at least once in 6 months so that prospective customers can make registration.

5.2 In order to ensure that applications for Broadband connections are registered without any discrimination, the service provider shall register all demands for Broadband connections and give registration number to the prospective customer. If it is technically feasible to provide the Broadband connection on demand, the same shall be provided within the time frames indicated in the Regulation. In all other cases, waiting list shall be maintained and connections released in a non-discriminatory manner as per the waiting list.

6. Auditing

6.1 The service providers shall maintain complete and accurate records of Service Provisioning /Activation, Fault Repair/ Restoration, Billing Complaints, Response Time to the Customer for assistance, Bandwidth Utilization/ Throughput, Service Availability/Uptime, Packet Loss and Latency measurements.

6.2 Network performance parameters like Bandwidth Utilisation/Throughput including Broadband Connection Speed, Packet Loss and Latency shall be measured on sample basis by the Authority from time to time, directly or if need so arises, through an independent agency.

6.3 The Authority shall audit / inspect, either directly or through an independent agency, the records relating to the reporting of compliance to the QoS parameters. The Authority, if it thinks fit, may require the service providers to get the reports submitted to the Authority audited, at its own cost, through independent and qualified agencies.

7. Customer Perception of Service

The Quality of Service parameter for Customer perception regarding Broadband service shall be measured through customer survey conducted by the Authority through an independent agency. The results of this survey may be made public for the information of the customers to generate healthy competition amongst service providers to improve service.

8. Broadband Connection Speed (download)

The service Providers shall make available a facility for measuring Broadband Connection Speed (download) at ISP node within a period of three months of coming into force of these Regulations.

9. Review:

The Authority, suo-moto or on reference from any affected party, or for good and sufficient reasons, may review and modify these regulations.

10. Interpretation:

In case of any doubt regarding interpretation of any of the provisions of these Regulations, the decision of the Authority shall be final and binding.

11. **Explanatory Memorandum:**

These Regulations contain at Annex - an Explanatory Memorandum to provide the background and reasons for the issuance of these regulations, detailed meaning of the various parameters and their measurement methods.

(Rajendra Singh)
Secretary

ANNEX.

EXPLANATORY MEMORANDUM

BACKGROUND:

1. The Broadband Policy issued by the Government in October, 2004 provides for fixation of the Quality of Service standards for Broadband Service by TRAI. At the time of issue of the Broadband Policy, Broadband connections in India were of the order of 50,000 only. This has crossed 17 lakhs connections by August, 2006. Alongwith the increase in the numbers of customers, the numbers of consumer complaints pertaining to Broadband Services are also increasing. The analysis of complaints received by the Authority indicates the customers concern for fault repair, service provisioning, and network & billing related problems. To address customers' concern and to create conditions for consumer satisfaction, a need is, therefore, felt to fix the Quality of Service benchmarks for Broadband.

2. The Authority had undertaken public consultation by releasing a Consultation Paper on 23rd May, 2006 and comments of stakeholders were sought by 16th June, 2006. Open House Discussions with the stakeholders were held at Delhi on 28th June, 2006. After the Open House Discussions, a core group, consisting of representatives from COAI, AUSPI, ISPAI, BSNL, MTNL, VSNL, Spectranet and an independent Consultant, was formed to further deliberate on some of the issues relating to Quality of Service for Broadband.

3. The Authority considered the comments received from stakeholders during the consultation process and the deliberations of the core group while finalizing the Quality of Service norms for Broadband. The meaning of the various parameters, its measurement methodology and rationale for the Quality of Service Benchmarks is given below.

Objective of laying down Quality of Service Parameters:

4. The objective of laying down Quality of Service Parameters for Broadband service is to:

i) Create transparency and monitorable standards in services through predetermined Quality of Service norms for Broadband which the

service provider is required to provide and the user has a right to expect.

ii) Measure the Quality of Service for Broadband provided by the Service Providers from time to time and to compare them with the norms so as to assess the level of performance.

iii) Protect the interests of consumers of Broadband service and thus enhance consumer satisfaction.

MEANING OF THE QoS PARAMETERS & MEASUREMENT METHODOLOGY

(a) Service Provisioning/ Activation Time:

5. The service provisioning/ activation time means the time taken from the date of receipt of an application to the date when the service is activated.

6. Core group, recommended that in case an advance payment of any sort, for installation or service provisioning, has been taken, then the service must be activated within 15 days. If this is not done, then the service provider must return the money to the customer. The service provisioning benchmark of 15 days has been prescribed accordingly.

7. Technically Non Feasible (TNF) cases such as unavailability of Broadband infrastructure/ equipment in the Area or Spare Capacity i.e. Broadband Ports including equipment to be installed at the customer premises for activating Broadband connection shall be excluded from the calculation of this parameter. Also, problems relating to customer owned equipment such as PC, LAN Card/USB Port and internal wiring or non-availability of such equipment shall be excluded from the calculation of this parameter.

(b) Fault Repair/ Restoration Time:

8. Fault Repair/ Restoration Time means the time taken to restore an existing customer's service to operational level from the time that a problem or fault is reported.

9. Only those complaints, which have been registered till the close of the business hours of the day, will be taken into account. Complaints registered after the business hours will be taken as being registered in the next day business hours. At the same time, faults due to the customer premises equipment which is owned by customer such as computer hardware and software including LAN card/USB Ports etc. shall be excluded from the measurement of performance against this benchmark, as the service provider is not directly responsible for these faults.

10. The benchmarks proposed for this parameter in the Consultation Paper was different from the benchmarks prescribed in these Regulations. This is mainly because during discussions with the core group members, it was felt that the benchmark for Fault Restoration Time given in the ISP licence agreement cannot be diluted. Accordingly, similar benchmarks have been prescribed in these Regulations for Fault Repair/ Restoration Time.

11. During consultation, the service providers, core group members and consumer organizations had accepted the proposal to give rebate/credit for downtime, although there were different views regarding the quantum of rebate for downtime including provision for rebate of excess down time on the same principles as voice telephony services. . In order to have uniformity in the QoS regulations, the Authority has prescribed rebates on the same principles as for basic service (wireline) for excessive downtime. In all cases where the fault is not rectified within 3 working days, rebate shall be given as per the provisions in Regulation 3 (ii).

(c) Billing Performance:

12. The percentage of bills resulting in a customer complaint indicates the billing performance.

$$\text{Billing complaints per 100 bills issued} = \frac{\text{Total number of disputed bills X 100}}{\text{Total number of bills issued during one billing cycle.}}$$

The benchmark for this parameter has been prescribed, in line with the proposal in the consultation paper and the views of the stakeholders. The Billing

Performance parameters have been specified for online charging systems as well as for offline billing system. It also includes charging errors in preparation of bills by the service providers.

(d) Response Time to the customer for Assistance

13. The duration from the instant a call is made to helpline number and a ring back is received to the instant the human operator answers the calling user to provide the service requested.

14. The calculations shall be provided based on the percentage of calls answered within 60 seconds and within 90 seconds, averaged over a period of one month.

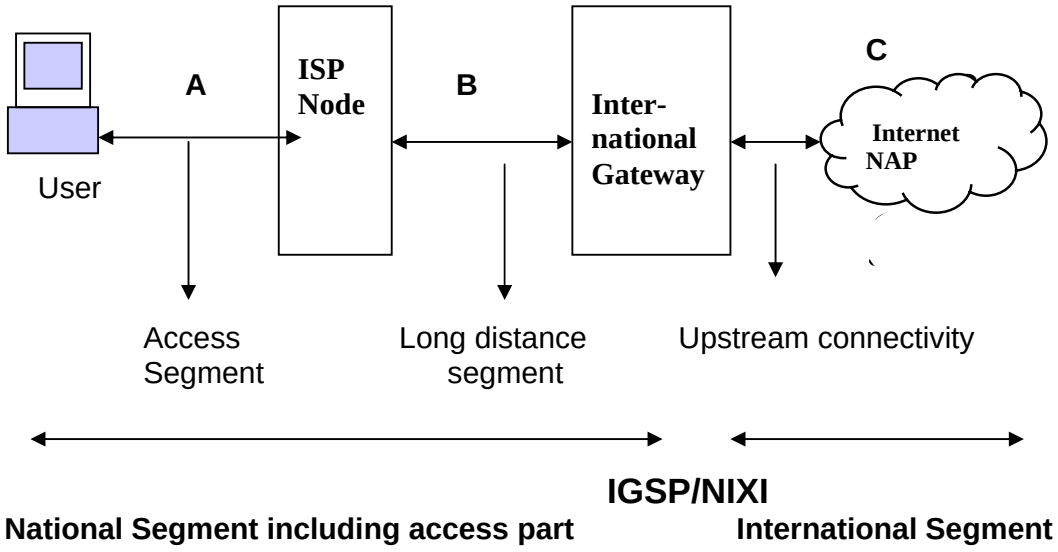
15. This parameter was not proposed in the Consultation Paper. But considering the fact that complaints/ service requests are normally made over on telephone, it is necessary to measure the effectiveness of the customer care helpline numbers. Only voice to voice calls to the customer care helpline/ call centre/ help desk numbers are included in the Regulation and this does not mean IVR response from the customer care centre of the service provider.

(e) Bandwidth Utilization/Throughput:

16. During consultation process there were different suggestions regarding measurement of the parameter and in the core group discussions it was generally agreed that the benchmark proposed in the Consultation Paper was difficult to measure and implement. It was deliberated in the core group discussions and generally agreed that measurement of the bandwidth utilisation for network links can be made using Multi Router Traffic Grapher (MRTG).

17. The Internet Service Provider could offer a good quality of service to the customers only if there is enough bandwidth in the Access segment, long distance segment and Overseas NAP segment. The Access segment is entirely managed and operated by the ISP. The broadband service can be provided through DSL, OFC, Cable TV Network, VSAT and Broadband Wireless Access (BWA) technologies. The national long distance segment is usually taken on lease from

NLDOs/ UASPs and the Overseas NAP segment is generally provided by the ILDOs in the form of International Private Leased Circuit (IPLC) or Internet Leased Line (ILL). Therefore, enough bandwidth should be made available in all the three segments for ensuring good quality of service.



18. The Authority has considered the deliberations of the core group while fixing the benchmarks for this parameter and decided that the service providers are required to monitor the bandwidth utilization during Time Consistent Busy Hours (TCBH) for all network link(s)/route. ISPs/ Service Providers shall report to TRAI the bandwidth utilization (loading) of all the upstream links going to IGSP/ NIXI with Multi Router Traffic Grapher (MRTG). However, for local links/intra-network links the service provider need to report, only, exceptions having loading more than 80%. In case there is more than one link, then the average utilization of all the route links should not exceed 90% of loading level for a period of at least one month. The broadband service provider is required to make provision for additional bandwidth if the bandwidth utilization of the network links exceeds the 90% loading level for a period of at least one month. Average utilization of bandwidth in a route means utilization of bandwidth capacity on all the links of the route. For example, if there are 3 links consisting of one link of 34 Mbps, two links of 155 Mbps each, in a route from ISP gateway to IGSP then the total bandwidth available in the route is 344 Mbps (34+155+155) and 90% of loading means bandwidth utilization of 309.06 Mbps.

Measurement Methodology for Link Bandwidth Utilization/Throughput:-

19. Both in Broadband access network/ intra-network links and links to upstream service provider, the bandwidth utilization shall be monitored using Multi Router Traffic Grapher (MRTG). This is a tool to monitor the traffic load on network links. MRTG generates HTML pages containing images which provide a live visual representation of the traffic. It works on UNIX platforms and Windows NT. MRTG uses a highly portable Simple Network Management Protocol (SNMP) implementation to read the traffic counters of routers and creates graphs representing the traffic on the monitored network connections. These graphs can be embedded into web pages which can be viewed from any Web-browser. In addition to detailed daily view, MRTG also creates visual representations of the traffic over a period. The measurement for reporting purposes is to be made only on working days during TCBH.

(f) Broadband Connection Speed (download):

20. In the consultation paper under the proposed benchmark Bandwidth utilization/ throughput, it was proposed that "the bandwidth utilization between the user and the nearest serving ISP node during download shall not be less than 70% of the subscribed level for 95% of the time". Views of stakeholders are different such as: (i) proposed benchmark can be committed and achieved between the user and nearest ISP Node; (ii) the dependency of link utilization on the availability of the content/application to be supplied from the other end is one of the factors to be considered here and dependency is on the other end server, far end ISP link and far end ISP's upstream connectivity; (iii) beyond POP there is always a sharing of bandwidth and the effective throughput at any instant depends on the contention which increases manifold in the International domain; (iv) it is not possible to measure throughput as a historic measure; (v) it is not possible to establish that the traffic as less than 70% due to non-usage of the circuit, or less usage; (vi) any measurement has to be on current basis; and (vii) bandwidth can be effectively measured by a down-loaded server dedicated for this purpose.

21. The Authority has considered the views of the stakeholders while fixing the benchmarks for this parameter. This parameter has been prescribed to enable the users and service providers to measure the connection speed. As per Broadband

Policy, the Broadband has been defined as “an always on data connection that has the capability of the minimum download speed of 256 kbps to an individual subscriber from the Point of Presence (POP) of the service provider where multiple such individual broadband connections are aggregated”. In order to facilitate measurement of download speed from POP by the user independently, a measurement facility is needed at each POP. However, it would be difficult for the Broadband service provider to install the measurement facility in each POP to facilitate the user to test independently the download speed. Therefore, service providers can install the facility at a central location or at an ISP Node. The measurement in this way shall include the intra-network links and loading of intra-network links may affect the speed measurement sometime. Therefore, keeping the reasonable loading level in intra-network links upto ISP Node, the benchmark has been prescribed that service providers shall ensure the speed of Broadband connection is >80% of the subscribed speed.

Measurement of Broadband Connection Speed (download):

22. The parameter can be measured on a sample basis by the user and service provider. The service providers need to install download speed measurement software in the Server at ISP Node to facilitate the user to measure independently the download connection speed through a web link. The facility shall be made available and the required procedure & information to facilitate such testing by the customer shall be made known to the customers by the service provider within a period of three months of coming into effect of these Regulations.

$$\text{Data download speed} = \frac{\text{size of the test file (data) in ISP Server}}{\text{Transmission time required for error free transfer of the entire data}}$$

(g) Service Availability/ uptime:

23. Service availability/ uptime is the measure of the degree to which the Broadband access network including ISP Node is operable and not in a state of failure or outage at any point of time for all users. It also includes the upstream connectivity uptime. Therefore, it measures the total downtime of the network for all users, including the LAN Switches, Routers, Servers, e-mail facilities etc at ISP Node and connectivity to upstream service providers over a period of one quarter.

Service Availability = $\frac{\text{(Total operational hours – Total hours of service downtime) X 100\%}}{\text{Total operational hours}}$

During consultation, some of the stakeholders had suggested a lower benchmark for this parameter. However, the Authority has fixed the benchmark for this parameter, keeping in view the fact that Broadband being an always on connection the downtime should be minimal.

24. Downtime for the purpose of upgrading or routine maintenance of the network system shall be excluded from the calculation of the service availability/ uptime provided that users are informed in advance of any such upgradation or maintenance action.

(h) Latency:

25. During consultation process the general view was that the proposed benchmark of <90 msec for latency from User to IGSP Gateway is too inadequate. There were also suggestions that the measurement to be made on a sample basis and there should be a reference point for measurement. The reference point was discussed in the core group and the group considered reference points as User, ISP Node/POP and NIXI/IGSP nodes. Considering the fact that the latency measurement to NIXI/IGSP Gateway reference point is more holistic than measuring the latency for each component of the network, the Authority felt that latency in the national leg from the User (Reference Point) to International Gateway (IGSP/NIXI) shall be specified and decided that the benchmark shall be <120 msec, which is achievable.

26. The ISPAI also accepted that latency of 300 msec in the international link from NXI Node/IGSP Gateway to the nearest NAP is reasonable. Since the measurement of latency for the international link to the nearest NAP port cannot be made by the Broadband service provider from IGSP, it is considered to measure the latency for international link from ISP Node, which is under the control of the service provider. As such, the benchmark will also include the latency from the ISP Node to the NIXI Node/IGSP Gateway. Considering this aspect, the Authority has decided that the latency for the terrestrial link from the

ISP Node to the nearest NAP be < 350 msec. The core group and stakeholders have generally agreed to the proposal in the consultation paper for the latency for satellite media as <800msec and the same is accepted by the Authority.

(i) Packet Loss:

27. On Packet loss, different views emerged during consultation process. Some stakeholders had raised doubt about measurement of packet loss, while some had agreed with the parameter proposed in the Consultation Paper. In the core group, industry representatives had proposed packet loss of <2%, while others had indicated that it is too lenient. Considering the International practices and the fact that benchmark of <2% is too lenient, the Authority has decided to retain the benchmark of <1% proposed in the consultation paper.

Packet Loss and Latency Measurement:

28. **Packet Loss:** Packet loss is the percentage of packets lost to the total packets transmitted between two designated CPE/ Router Ports.

29. **Network Latency**: Latency is the measure of duration of a round trip for a data packet between specific source and destination Router Port/ Customer Premises Equipment (CPE).

30. **Packet Loss and Latency** Parameters indicate the quality of Broadband access network equipment including leased line resources used as well as the equipment at the ISP/ Service Provider Node. Being responsible to the customer for end to end QoS, the Broadband service provider needs to ensure that QoS is maintained on all the connected links. For this purpose, the service provider should negotiate Service Level Agreements (SLA) with the upstream service providers, i.e., leased line providers (NLD/UASP/BSO/IP-II) and IGSP/ILDO. There is a need to measure the packet loss and latency at different points using ping tests.

31. The Packet Loss and Latency parameters proposed are for wired Broadband access network only having Optical Fibre Technologies, Digital Subscriber Lines (DSL) on copper loop and Cable TV Network in the access network and terrestrial media in the national backbone. For the broadband wireless access (BWA), since the technology is evolving and implementation is at the nascent stage, no benchmark for packet loss and latency is proposed. The Authority would revisit this issue later.

32. The measurement will be made for Packet Loss and Latency by the service provider on a sample basis taking the Broadband customer (User) configuration as User Reference Test Point at ISP Node/ POP. This configuration shall have local loop, CPE, ADSL-router/modem or Cable modem and PC/Laptop. The PC/Laptop shall have a minimum configuration of Pentium – IV, Windows 2000 operating system/XP/ UNIX with 256 MB RAM, hard disk 40 GB which normally a broadband user is expected to have for getting broadband speed.

33. Minimum sample reference points for each service area shall be three in number or multiple reference points, if needed. The Packet Loss and Latency shall be measured from user reference points at ISP Node/ POP to IGSP/ NIXI Gateway location and also to the nearest NAP port abroad.

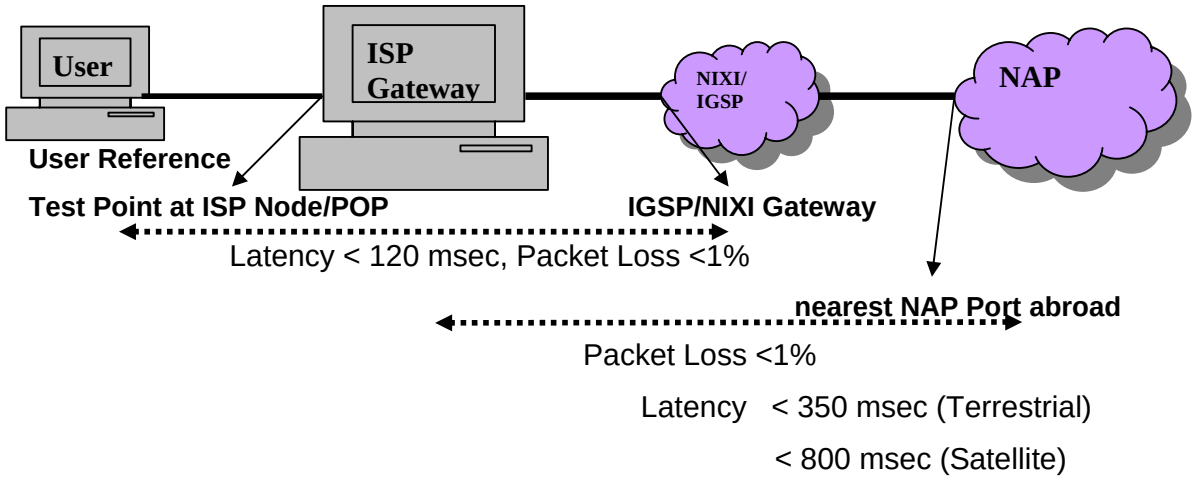
34. Ping Test will be generated during the time consistent busy hour (TCBH). For Ping test the defined Packet size shall be of 64 bytes. The test conducted on daily basis shall be averaged for a month and the result of the Ping Test to be indicated for the Packet Loss and Latency.

35. **Packet Loss Measurement** shall be done by computing the percent packet loss of 1000 pings (with acknowledgement for each previous packet received) of 64 byte packet each. This packet loss is the measurement of packet lost from Broadband customer (User) configuration/ User Reference Point at ISP Node/ POP to the IGSP/ NIXI Gateway and to the nearest NAP Port abroad**.**

36. **Latency Measurement** shall be done from user reference points at ISP Node/ POP to IGSP/ NIXI Gateway location and to the nearest NAP Port abroad**.**

The round trip delay for the Ping packets from ISP premises to the IGSP/ NIXI Gateway and to the nearest NAP port abroad will be measured by computing the delay for 1000 Pings of 64 bytes each, where pings are only sent subsequent to an acknowledgement being received for the same for the previous ping.

The following figure shows the various locations from where the packet loss and latency can be measured by the Service Providers on sample basis during TCBH:-



37. All the measurements of engineering standards such as Bandwidth Utilisation/Throughput, Packet Loss and Latency are to be carried out in the Time Consistent Busy Hour (TCBH) as specified by ITU-T.

(j) Static I.P. Address Allocation:

38. IP address allocation for Broadband users is normally done by dynamic allocation method on per session basis. Static/Fix IP address allocation is required for few applications as per the requirement of customer. During consultation process the stakeholders had generally opined that this should not form part of the QoS benchmarks for Broadband. Therefore, considering the views of the service providers and the normal practice followed, Static IP address allocation is not proposed for the QoS benchmarking criteria. But in case a Broadband customer desires to have one or more static IP addresses, it is

expected to be made available by service provider as per normal commercial conditions.

(k) Customer Perception of Service:

39. This parameter has been prescribed to assess the customer perception of service.