
# Telecom Regulatory Authority of India

Consultation Paper on

**Bandwidth required**
**for ISPs for better connectivity and improved quality of service**

New Delhi
15th January, 2009

Mahanager Doorsanchar Bhavan
Jawahar Lal Nehru Marg
New Delhi-110002

# Content



**Annexure**

# Preface

Broadband policy 2004 defines broadband connection as an always-on Internet access with a minimum speed of 256 Kbps from the Point of Presence (POP) of Internet Service Provider (ISP) to the customer premises equipment (CPE). The Quality of Service is extremely important for broadband service to support various time sensitive applications.

Accordingly, TRAI came up with a Regulation on "Quality of service of Broadband Service' in October 2006, which stipulated benchmarks for several parameters for provisioning of Broadband service. The main purpose of this Regulation was to protect the interests of consumers of Broadband service and enhance customer satisfaction.

Increasing number of broadband subscribers and development of various applications demanding high-bandwidth such as IPTV and peer-to-peer file sharing have further emphasized the need to ensure high quality broadband connections. Incidences have come to the notice of TRAI where subscribers allege lower speed of Broadband connections than subscribed speed. Though the existing regulation stipulates parameters for speed of connection and bandwidth utilization, need is being felt for proactive action to ensure availability of adequate bandwidth to support good broadband speed.

In order to have meaningful examination of the relevant issues and providing necessary platform for discussing them, TRAI has come up with this Consultation Paper.

The stakeholders are requested to send their comments preferably in electronic form on the various issues mentioned in the consultation paper by 2nd February 2009. The consultation paper has already been placed on TRAI's website (www.trai.gov.in). In case of any clarification/information, please contact Sh. S. K. Gupta, Advisor (CN), Tel.No.+91-11-23217914, Fax: +91-11-23211998 or email at advcn@trai.gov.in or cn@trai.gov.in.

(Nripendra Misra)
Chairman, TRAI

# CHAPTER 1
# INTRODUCTION

**Background:**

1.1.1 The number of broadband subscribers are growing in the country. A number of new value added services & applications on IP platform are being provided to broadband users. Initially most users used broadband to access e-mails and text contents requiring low bandwidth. This is changing fast with the deployment of new services like IPTV, peer to peer file transfer etc requiring high bandwidth. Time sensitive applications are also increasing. Now users are demanding higher speed and better quality of service for their broadband connections.

1.2 There have been complaints from the subscribers regarding inadequate broadband speed being provided by the Internet Service Providers. Most of the complaints allege that the available broadband speed is lower than the subscribed speed. Non-availability of subscribed speed at the customer's end deteriorates the performance of applications run by users and in turn restricts the utility of broadband connection. In today's era of competition, effective utilization of communication network and IT tools plays important roll. The concept of virtual office, remote office is gaining popularity. E-Commerce, E- health, Video world, Virtual tours and E-marts are some other emerging popular applications requiring huge bandwidth which are time sensitive also. In such a scenario, Quality of service becomes of prime importance.

1.3 The slow speed of broadband connection can be attributed to various factors such as operational problems, Network design

problems, Customer related issues. Operational problems can be related to poor quality of access network, limited availability of end links, improper connections etc. The network related problems can be attributed to designing of the network architecture, internal traffic blocking, limited availability of the bandwidth, network congestion, non synchronization of the networks etc. Customer related problems could mean limited capabilities of the end device, infection of the devices with virus, Trojans, intermittent mall functioning of the device etc. Methodology of monitoring the speed of the broadband connection is also important as speed measured using different sources can end up giving different results. The identification of actual cause of getting slow speed of the broadband connection is complex and requires good understanding of the subject. As a result, a normal user while able to realize slow speed of the broadband finds it difficult to actually pin point the cause of the problem.

1.4 In the 'Quality of Service of Broadband Service Regulations, 2006" Broadband is defined 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 services where multiple such individual Broadband connections are aggregated and the subscriber is able to access these interactive services including the Internet through this POP*".

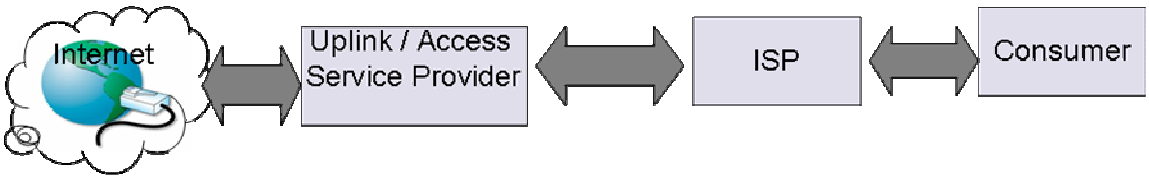
1.5 The above definition clearly lay emphasis on 'an always on data connection" and having minimum download speed of 256 Kbps to an individual subscriber from the PoP of service provider. This

256 Kbps has not been guaranteed from any specific server or application as Internet is basically a "Best Effort Service".

**Provisioning of Broadband/ Internet Connection by ISP:**

1.6 In order to analyze slow speed of the broadband, it is important to understand how Internet Service Providers operate. Internet Service providers basically hire bandwidth from upstream service providers or access providers and further allocate the bandwidth to their Internet customers. Such bandwidth is terminated at the ISPs network commonly known as gateway. A network may have one or more gateway based on the design of the network and policy adopted for the routing of traffic.

**Figure 1: Internet Connection by ISP**




1.7 Similarly ISPs may have internal links connecting various POPs. Any congestion on these links is likely to have adverse impact on the effective broadband speed and user experience.

1.8 ISPs have to provide sufficient internal bandwidth to ensure non blocking traffic flow within the network and take enough bandwidth from upstream providers to ensure good quality of service.

1.9 The bandwidth requirement at the gateway and within the network is dynamic and depends on the number of subscribers, type of subscribers (Dialup, Broadband, and Lease line), their bandwidth requirements, Applications being run etc. As such,

the bandwidth requirement is dynamic and service providers have to continuously upgrade the network and availability of upstream bandwidth. Initial design of the network generally consider certain thumb rules relating to average utilization of the bandwidth and constantly monitor traffic flow to decide network up gradation requirements. The limited availability of bandwidth either at the gateway from upstream service provider or within the network will degrade the service for every user unless ISP increases the bandwidth suitably in the network. Additional capacity requires substantial planning and cost (Capex). Therefore it is necessary to workout certain minimum benchmarks based on number and type of subscribers to ensure minimum floor of the bandwidth availability in a network.

1.10 The Internet protocol uses packets for transfer of information which is busty in nature. It leverages on other technologies due to its efficient bandwidth utilization capabilities. The technology permits use of a link (Bandwidth) by several users simultaneously. The number of users which can share the given bandwidth without impacting the quality of service depends on the applications, frequency of use and many other parameters. The bandwidth hungry applications like Video on demand (VoD), IP TV, High definition pictures and maps etc will require more bandwidth over simple text and information. Considering above fact and type of customers, bandwidth can be shared among many subscribers. This leverage allows ISPs to accommodate more subscribers using given bandwidth, and will also reduce cost of the access. 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. The requirement for bandwidth will go up when bandwidth

consuming Internet/Broadband applications such as video streaming services, IPTV etc are used. Hence design of network to provide such services have to be done considering lower contention ratio.

1.11 The 'Quality of Service of Broadband Service Regulations, 2006" define various parameters like packet loss, latency in the network, peak bandwidth utilization etc. However, monitoring of these parameters indicate the status of the congestion in the network. The existing provisions in the QoS regulations 2006 for broadband services suggest corrective action only when network is affected by congestion. These measures are corrective in nature and complex to monitor. A strong need is being felt to additionally introduce certain parameters to fix the minimum floor of bandwidth requirements to help the customers to get better QoS of broadband.

1.12 In order to fix certain parameters and apply it uniformly to all service providers, certain 'thumb-rule' has to be prescribed to estimate minimum bandwidth requirement of a ISPs having given number of customers of different type, keeping in mind the Quality of Service (QoS) issues. The thumb rule will determine minimum bandwidth requirement for different type of subscribers keeping in view International practices.

1.13 The main object of this paper is to identify the measures which will ensure the availability of minimum bandwidth to broadband and internet users. One of the models would be to analyze the network design and bandwidth availability in service provider's network. However, this may be too intrusive regulation and may kill the innovation and affect the design of network of service providers. There are many other alternatives. The Authority is of the view that certain parameters have to be worked out, which

may help to improve the end user experience of the broadband but also provide flexibility to service providers and may not have adverse impact on the cost to avail such services by the end users.

1.14 The Authority has suo-motu initiated this consultation process to seek the views of the stakeholders in order to develop a framework which will strengthen the existing regulation on quality of broadband service. The paper is divided into three chapters. Second chapter deals with existing provisions, analysis and future requirements. Third chapter summarizes all the issues for consultation.

# CHAPTER 2
# EXISTING PROVISIONS, ANALYSIS AND FUTURE REQUIREMENT

## Factors Affecting the Speed of Broadband Connection

2.1 There are many factors which may affect the speed of broadband connection such as congestion in network due to poor network designing, bad conditions of access network, insufficient availability of bandwidth etc. Some of the major factors are discussed below:

2.1.1 Bandwidth Utilisation**:** Bandwidth in computer networking refers to the data rate supported by a network connection or Interface. In other words Bandwidth is a measurement used to measure the amount of data passing through a network for a given time. Bandwidth utilization is commonly expressed in terms of percentage of use of available bandwidth at busy hour. Bandwidth utilization represents the congestion in network. Greater bandwidth utilization (more than 90%) will result in higher congestion in the network.

2.1.2 Latency**:** The term latency refers to any of several kinds of delays typically incurred in processing and flow of network data in or across network. Low latency network connection is one that generally experiences small delay in fetching the data, while a high latency connection generally suffers from long delays. Latency in the network increases due to congestion. The performance of time sensitive applications get deteriorated due to increase in latency.

2.1.3 Contention Ratio**:** Contention Ratio means the number of users competing for the same bandwidth. It can also be

defined as the number of subscribers sharing the same bandwidth capacity. The lower the contention ratio, the better will be the quality of Internet access. A 50:1 contention ratio would mean that up to 50 subscribers having a connection of say 2 Mbps may be sharing the bandwidth of 2 Mbps at any given point of time.

2.1.4 The methodology to measure broadband speed has been prescribed in the 'Quality of Service of Broadband Service Regulations, 2006", but subscriber perception of Internet speed can be very different. Different speeds[1] in the Internet environment can be defined as:

(i) **Access** line speed - This refers to the maximum speed of the data connection between the broadband modem and the local exchange or cable head end commonly known as point of presence (PoP) in the Indian scenario. This constitutes the maximum speed a consumer will be able to experience.

(ii) **Actual** throughput speed - This is the actual speed that a consumer experiences at a particular time when they are connected to the internet. This figure is often dependent on factors such as the ISP's network, its traffic shaping and management policy, the number of subscribers sharing the network at the same time and the number of people accessing a particular website.

(iii) **Average** throughput speed – This is an average of actual throughput speed for each different broadband product offered by an ISP.

2.1.5 The present regulatory efforts are to ensure availability of access line speed for a particular package to access Internet.

[1] Broadband Speeds Code of Practice, OFCOM

This is amply clear from the definition of broadband given in para 1.4. Many a time subscribers get confused and start seeking commitment for actual throughput speed or average throughput speed for the site being accessed and feel that ISPs are not providing them the promised bandwidth. The contention ratio helps to enhance the experience of users in respect of actual throughput speed or average through speed by fixing the floor for minimum upstream bandwidth at the ISPs' gateway.

**Initiative of TRAI to monitor the Quality of Service of speed of broadband connection**

2.1.6 TRAI has issued Regulations on Quality of Service Standards for Broadband Service on 6th Oct. 2006, As per this regulation benchmarks for Bandwidth Utilization and Subscribed Broadband connection speed (download) are given in table 1.

**Table 1: Benchmarks for Bandwidth Utilization and Subscribed Broadband connection speed (download)**

| **Sl** | **QoS Parameter** | **Benchmarks** | **Average over a period of** |
|---|---|---|---|
| v | **Bandwidth Utilization/ Throughput**<br>**a)Bandwidth Utilization**<br>i) POP to ISP Gateway Node [Intra-network] Link(s)<br>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 |

| | | | |
|---|---|---|---|
| | **b) Broadband Connection Speed (download)** | one month, is mandated.<br>Subscribed Broadband Connection Speed to be met >80% from ISP Node to User. | |

2.1.7 In above broadband regulation TRAI has also fixed the benchmark for Network latency in table 2:

**Table 2: Benchmark for Network latency**

| **Sl** | **QoS Parameter** | **Benchmarks** | **Average over a period of** |
|---|---|---|---|
| viii | **Network Latency (for wired broadband access)** | | One Month |
| | • User reference point at POP / ISP Gateway Node to International Gateway (IGSP/NIXI) | <120 msec | |
| | • User reference point at ISP Gateway Node to International nearest NAP port abroad (Terrestrial) | <350 msec | |
| | • User reference point at ISP Gateway Node to International nearest NAP port abroad (Satellite) | <800 msec | |

2.1.8 As per regulation 8 of Quality of Service Standards for Broadband Service regulation, "The service Providers shall make available a facility for measuring Broadband Connection Speed (download) at ISP node". Based on above, a provision for giving the link for measuring the broadband speed on the website of broadband service providers has been mandated.

2.1.9 The Quality of Service parameter for Customer perception regarding Broadband service is also measured through

customer survey being conducted by TRAI from time to time through an independent agency.

**Analysis of present Provisions and Future Requirement:**

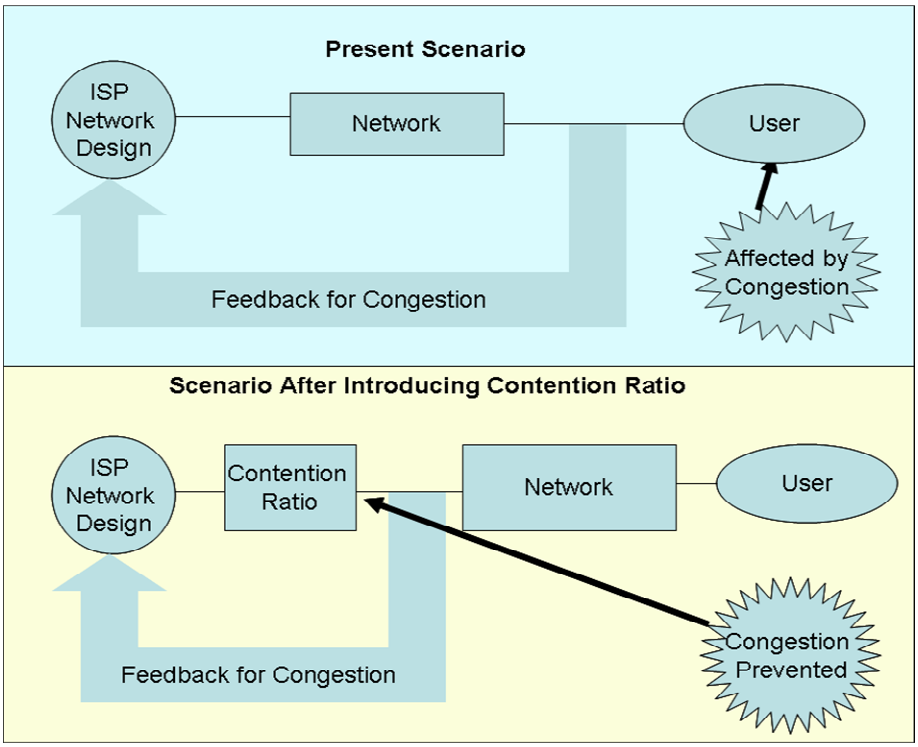
2.1.10 Present provisions in Broadband Regulations and Consumer Regulations have covered the important parameters for speed monitoring and protecting the consumer interest. However, complaints related to slow speed of broadband than subscribed are common. There is an urgent need to take further steps to ensure better quality of broadband and Internet access.

2.1.11 Provisions in existing QoS regulations for broadband services are corrective in nature i.e. actions are initiated only after the network performance has been affected. Service providers are expected to monitor their network and take corrective actions before the quality of service is impacted. It is generally seen that such corrective actions are not taken by service providers in time. This makes it difficult to ensure the consistent good quality of service to subscribers and considerable time is required to implement the corrective action. During such times generally the performance of the network remains impacted. There are other issues also related to QoS. Generally parameters defined in QoS regulations such as bandwidth utilization, throughput are monitored during pre-determined busy hour (TCBH). However, actual congestion of network may occur at any time other than TCBH due to busty nature of internet data traffic. Therefore, it is required to find out an easily monitorable and enforceable ***preventive QoS measure*** to ensure that a bare minimum (floor) bandwidth is available with service providers for provisioning of broadband

and internet services with reasonable assured quality to its subscribers.

2.1.12 As mentioned at para 2.1, it is clear that speed of broadband is largely dependent upon three factors i.e. bandwidth utilization, latency and contention ratio. After analysis of various provisions mentioned in previous para, it is observed that existing regulations have addressed the benchmark for bandwidth utilization and latency; however, it does not separately define any benchmark for maximum admissible contention ratio. The implementation of contention ratio will help subscribers to get better service and provide a framework to service providers to upgrade the bandwidth availability before congestion affects the network. This is explained in figure 2.

**Figure 2: Comparison of network with and without Contention Ratio**



2.1.13 With higher contention ratio, service provider may accommodate more number of subscribers, which may eventually bring down the quality & speed of the broadband and may result in network congestion. The monthly cost of a broadband connection for different download speeds and contention ratios in some countries is shown in table 3. This clearly indicates that the higher the contention ratio, the cheaper will be the broadband package. An ISP may sell such broadband products at a cheaper rate, where the quality is compromised. Therefore, contention ratio is an important factor impacting the price and performance of a broadband package.

**Table 3: Comparison of costs for different contention ratios[2]**

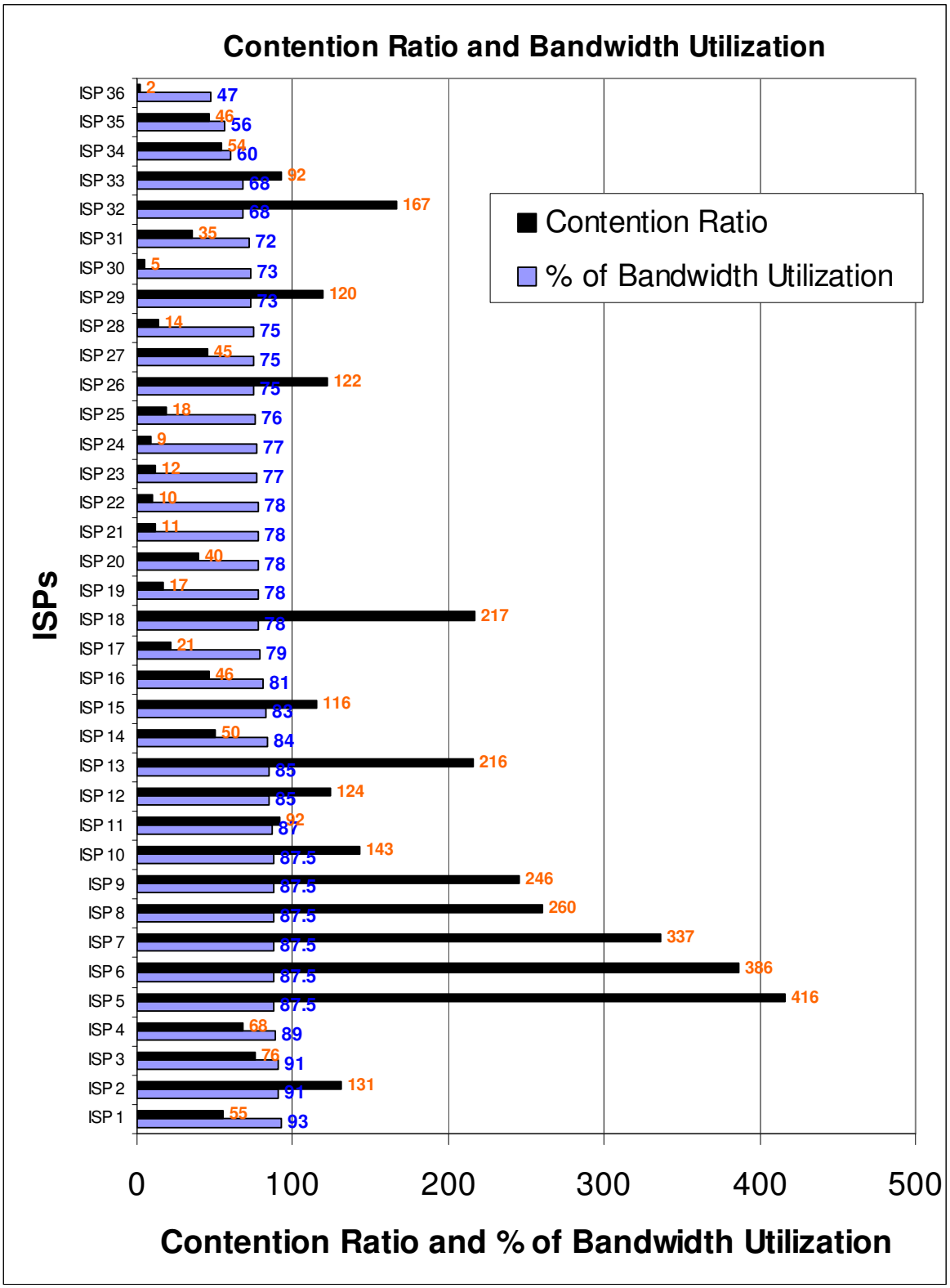
| S.No. | Country | Download | Contention | Monthly |
|---|---|---|---|---|
| 1. | Czech Republic | 512 Kbps | 20:1 | 91.33 |
| | | | 40:1 | 45.97 |
| | | | 50:1 | 43.30 |
| 2. | Ireland | 512 Kbps | 20:1 | 114.48 |
| | | | 48:1 | 35.33 |
| | | 1 Mbps | 10:1 | 154.67 |
| | | | 20:1 | 78.32 |
| | | | 48:1 | 24.16 |
| | | 2 Mbps | 10:1 | 324.84 |
| | | | 48:1 | 32.79 |
| 3. | Slovakia | 1.5 Mbps | 20:1 | 70.80 |
| | | | 45:1 | 46.94 |
| 4. | United Kingdom | 512 Kbps | 10:1 | 293.28 |
| | | | 20:1 | 83.64 |
| | | | 50:1 | 36.88 |
| | | 1 Mbps | 10:1 | 387.40 |
| | | | 20:1 | 79.82 |
| | | | 50:1 | 43.30 |
| | | 2 Mbps | 10:1 | 473.11 |
| | | | 20:1 | 100.00 |
| | | | 50:1 | 51.55 |

[2] Comparison of OECD Broadband markets, May 2006

2.1.14 Based on the information available with TRAI, contention ratio and bandwidth utilization for few ISPs operating in India is given in figure 3. The analysis of data indicates the correlation of contention ratio with bandwidth utilisation. It can be generally seen that when contention ratio is more than 50, bandwidth congestion is more than 84%. It is also observed from the figure that operator having the lower contention in a area are having less congestion as compared to the operator having the more contention ratio in same area. This indicates the importance of defining contention ratio of the network.

2.1.15 As per international practices, the average contention ratio for a home user package is 50:1 and that for business package is 20:1. These figures have been derived on the basis of busty nature of data traffic, usage pattern of different category of subscribers and statistical information. These ratios have been taken as benchmark in some of the developed countries particularly for ADSL broadband connections.

**Figure 3: Contention Ratio and Bandwidth Utilization**



2.1.16 It is observed that most of the broadband complaints are related to the inadequate broadband speed a subscriber gets at his end. Therefore, an ISP must enhance available bandwidth to provide broadband services to accommodate more subscribers in order to maintain the quality of services. Common man may use contention ratio (ratio of number of subscribers sharing total available bandwidth at the gateway of the network) being adopted by a service provider to benchmark the performance of a service provider. Presently the contentions ratio being followed by the service providers for any particular broadband package is not available to the subscribers.

2.1.17 A well defined contention ratio for different type of Internet access in the network will improve availability of minimum bandwidth in the network. However, it will not be possible to ensure subscribed bandwidth at the subscriber's end just by use of contention ratio. A combination of present QoS parameters as defined in broadband regulations and contention ratios have to be monitored simultaneously to ensure better quality of Internet at the subscriber's end.

2.1.18 The emphasis is being given to define contention ratio for all type of Internet access including leased lines. It may be argued that since subscribers generally have service level agreements (SLA) for lease line, so will contention ratio for lease line still needs to be defined? Here it is important to mention that idea is to determine total bandwidth requirement for all type of the Internet services being provided by the ISPs to ensure minimum availability of the bandwidth as calculated

considering contention ratio for different type of Internet access. Lease line subscribers also use bandwidth from the total bandwidth available with ISP. Hence, for calculation of total bandwidth requirement, certain contention ratio for lease line has to be defined.

2.1.19 As the service providers are already submitting their subscriber base for broadband, dialup, and leased line subscribers, defining contention ratio as a thumb rule for different type of Internet services will help to work out required bandwidth to support the existing subscribers. High bandwidth hungry applications such as VOD, IPTV etc, which require high internal bandwidth have to be considered as a separate category to apply appropriate contention ratio. ISPs should not have any dearth for bandwidth at present as India has sufficient capacity to support required bandwidth for catering to their present subscriber base.

2.1.20 This will ensure that a bare minimum bandwidth, fulfilling the QoS benchmarks is available to the Internet, Broadband, high bandwidth services and leased line subscribers.

2.1.21 These issues needs to be addressed in order to make transparent terms and conditions for provision of Internet /Broadband services which will facilitate good service to consumer and reduce consumer grievances. While defining contention ratio, its linkage with prevailing broadband and Internet packages have to be analyzed to ensure affordability to common masses.

# CHAPTER 3

# ISSUES FOR CONSULTATION

3.1 In order to ensure sufficient bandwidth for good quality broadband service, should some "Thumb Rule" for maximum contention ration be fixed for dial up, broadband, high bandwidth services & leased line internet access? If so, what should be the values for different Internet services:

| Services | Max. Contention Ratio for Home users | Max. Contention Ratio for Business users |
|---|---|---|
| **Dialup** | | --- |
| **Broadband** | | |
| **High Bandwidth Services (like IPTV etc.)** | | ---- |
| **Leased Line** | --- | |

Kindly give your suggestions with justification.

3.2 Will defining contention ratio likely to impact prevailing Internet/ Broadband packages to access Internet? Give your suggestions with justification?

3.3 Any other suggestion to improve quality of Internet/ Broadband access to end users?

# ANNEXURE 'A'

# INTERNATIONAL PRACTICES

**International Practices:**

A.1 ITU in its document (No.019-E) on 'Suggested Indicators for the NGN fixed network and DSL wholesale" has mentioned that "Committed contention ratios in the backhaul network Digital Subscriber Line Access Multiplexer- Broadband Access Server (DSLAM-BAS) are important to ensure a high quality of service to end users. The contention is calculated as the ratio of total theoretical customer bandwidth into a DSLAM to the amount of bandwidth between the DSLAM and the Broadband Access Server (BAS). Ratios of between 20:1 and 50:1 are common, depending on the product".

A.2 OFCOM in its Research report titled "The communications Market: Broadband Digital Progress Report" dated 2.4.2007, acknowledges the contention ratios of 50:1 and 20:1 for home and business customers respectively.

A.3 The South African regulator, Independent Communications Authority of South Africa (ICASA) issued a regulation regarding the provision of ADSL services which inter-alia states that "Telkom, Second National Operator (SNO) and ISPs shall on a quarterly basis publish on its website the contention ratio as a commitment to good business practice."

A.4 Maximum Contention Ratio for some of the OECD countries are mentioned below:

- Czech Rep. : 50:1
- Ireland : 50:1
- Slovakia : 45:1