Consumer Broadband Labels

Strengthening Disclosure and Transparency of Broadband Services in India

CUTS International

#1818

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Contents

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CUTS International, in partnership with the Indian Institute of Technology (IIT) Delhi, implemented a project entitled, 'Building Capacity and Advocating for a Nutrition Label for Broadband Services in India', with the support from Ford Foundation, New Delhi, India. One of the main goals of this project was to create a narrative for improving the information disclosure mechanism for broadband services in India. The project suggested broadband labels as the possible tool to ensure transparency and accountability in broadband Internet services in India. Backed with evidence from research, involving relevant stakeholders, the project envisaged to bring about the policy and practice changes.

Efforts of several individuals have gone into making this research report a reality. Involvement in forms of direct inputs, thought provoking discussions, timely reviews and guidance from partners, experts and other key stakeholders have been crucial in the formulation of this report.

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Pradeep S Mehta
Secretary General

Executive Summary

Ensuring quality access of broadband Internet services to citizens has become a global priority. It is universally acknowledged that broadband contributes extensively towards improving quality of citizens' lives and can aid in meeting the global objective of inclusive growth. Thus, an efficient network infrastructure and good quality broadband services may be perceived as a first key step towards the creation of a knowledge economy. Many studies have highlighted how broadband contributes significantly towards socio-economic progress, enhances overall productivity, competitiveness and inclusive growth of a country. It also brings public services closer to its citizens through e-governance, apart from creating and maintaining a direct connection between producers and consumers.

While the Internet has penetrated in most countries quickly, its inclusive and efficient use has been lower in developing countries – due to slow penetration and adoption. As a result, majority of global population's lives remain largely untouched by digital revolution. Efforts are being made by relevant stakeholders to address this digital divide by providing accessibility of broadband services to the offline population. However, besides focussing only on connectivity, there is a need to ensure that broadband Internet is adequate, reliable and affordable. India is also facing problems with respect to accessibility and adoption of broadband services.

In December 2017, Internet penetration in India was 34.1 percent of the total population, with only 53 percent daily Internet users in rural segment and total female Internet users at approximately 30 percent. Even in terms of average Internet speed, while South Korea clocked 28.6 Mbps in 2017, India could only achieve 6.5 Mbps. While the present government and Information and Communications Technology (ICT) industry of India is making consistent efforts to make broadband Internet services accessible and affordable. It is also critical for these services to

be reliable and efficient to ensure seamless last-mile connectivity, better Quality of Service (QoS), Quality of Experience (QoE) and transparent information disclosure of these services for consumers.

As compared to other countries, India's telecom market is very unique as close to 95 percent of the total Internet subscriber base uses 'Mobile Wireless' mode to access Internet. With such significant share of consumers dependent on the wireless network for connectivity, poor QoS, QoE and lack of information disclosure may cause a major setback in efforts made towards broadband services and the Digital India programme. Some prominent disclosure issues often quoted in research reports and print media, include mis-selling, misleading advertisements, failure to deliver the promised QoS, QoE, *et al*. This suggests that India needs to undertake further reforms to ensure better quality broadband services for all citizens.

The TRAI, established as a regulator under the TRAI Act, 1997, has taken many path-breaking initiatives on transparency, protection and empowerment for Indian consumers over the year. While these initiatives have also focussed on broadband Internet consumers, limited progress has been seen on the improvement of current QoS and QoE situation in the country.

Combining all efforts and initiatives of the entire telecom ecosystem players is the need of the hour to bring necessary changes, so that consumers are empowered with standard tools and accurate information disclosure mechanism to demand better broadband Internet services. Thus, creating a label for broadband services that is user-friendly, easily accessible and provides relevant information on QoS and QoE parameters, would empower consumers in making an informed decision while selecting their service provider and plan.

Labelling is a common practice being followed for many consumer products and encourages consumers to make informed buying decisions and assures safety, quality and durability on products. Labelling on food products, medicines, appliances, etc. has also protected the interests of Indian consumers. Such experiences suggest that there is a need to extend labelling to services as well. Broadband labels could benefit existing and potential broadband consumers that underlie social and economic activities across the globe.

Advocacy for broadband labels began way back in 2009, when the Open Technology Initiative (OTI) of the New America Foundation, came up with an idea of creating the first broadband label – Broadband Truth-in-Labelling disclosure. Since then, many civil society organisations (CSOs) and telecom regulators across the globe have undertaken many policy initiatives and advocacy efforts to improve QoS and QoE metrics for broadband Internet consumers.

Notable global experiences, as seen in Australia, Brazil, Singapore, the UK and the US, have shown that while cohesive efforts of all relevant stakeholders have resulted in better QoS and QoE delivery, much more ground needs to be covered. While mature markets have been able to develop and implement voluntary practices, developing markets have developed mandatory practices to ensure transparency and consumer protection. However, both practices have not been successful as envisaged.

As stated previously, of the total Internet subscribers in India today, close to 95 percent are accessing Internet through wireless mode. In other words, 3G/4G mobile broadband is the prominent way to access Internet in India, which is assisted by growth in penetration of smartphones. Given this scenario, development and implementation of broadband labels is very critical so as to protect consumer interest. However, there are several challenges related to the adoption of these labels, such as lack of capacity and awareness, weak infrastructure and connectivity, varying mobile network dynamics, opaque and delayed policies, primitive compliance and reporting mechanism, etc.

The TRAI initiated a public consultation in June 2017, entitled, 'Data Speed under Wireless

Broadband Plans', to explore the possibility of speed governance and information disclosure of wireless data speeds of broadband Internet services, and whether services should have a standard label to empower consumer choice and increase their awareness. Together, the regulator, the broadband industry, CSOs, academia and other stakeholders have started to engage and discuss the subject through this consultation process. Once a sustained increase in awareness and subsequent demand from consumers is generated, it is expected that telecommunications service providers/internet service providers (TSPs/ISPs) would voluntarily create such tools to showcase their strengths on QoS and QoE, as compared to competition. In the long run, this would inspire a change in the behaviour of TSPs/ISPs, who will certainly see the value and demand for such a practice.

To facilitate this consultation process and the research agenda, CUTS International and its regional partners organised seminars and focus group discussions (FGDs) across the country,[1] which were well-attended by relevant stakeholders, including consumers. These interactions revealed that most consumers appreciated the utility of broadband labels and demanded several parameters, such as reliability, coverage information, QoS metrics at city-levels, as additions to the proposed prototype labels (as shown in annexure I). During these discussions, it was also realised that most consumers were unaware of key information on network performance, such as bandwidth and latency, and compared a broadband internet service purely on price per gigabytes (GB). With the ultimate objective of empowering consumer choices for broadband Internet services through 'Broadband Labels', the year-long advocacy journey has been well-recognised by all relevant stakeholders.

However, ensuring the right mix of stakeholder representation in such activities would be fundamental. It is hoped that details covered in this research report would serve as an informative resource and help stakeholders in India to move forward, with firm steps, in defining contours of the safe harbour in greater detail. Furthermore, it is anticipated that related existing and future activities will ultimately empower broadband Internet consumers in India and perhaps in turn, spur more competition in the broadband Internet market.

This project report summarises some of the key recommendations (as mentioned below) to achieve this objective, as well as proposes two prototype labels for measuring QoS and QoE, which may be taken up for further deliberation by stakeholders and build an adoption roadmap for broadband labels and better information disclosure mechanism.

Capacity-Building of CSOs

CSOs should be thoroughly sensitised on the subject as most of them lack the capacity to understand the complexity and technicality of broadband services, as they will be eventually advocating with regulators and educating consumers. In the US, strong pressure from a think tank forced the Federal Communications Commission (FCC) to come up with a model label, despite stiff resistance from TSPs/ISPs. Academia and prominent technical institutions would also play a critical role in enhancing the capacity and knowledge of CSOs.

Awareness Campaigns

There would be a need for concrete and coordinated efforts for an awareness campaign once a broadband label is developed. All relevant stakeholders in the value chain – decision makers, policymakers, TSPs/ISPs and CSOs – must equally and consistently contribute towards the efficient and effective implementation of these campaigns. The TRAI has already created an outreach web page, which may be harnessed for such awareness campaigns.

Compliance Mechanism

Effective monitoring system should be adopted for this labelling programme to succeed. An effective institutional structure must be designed to include national, state and local administration for speed governance, implementation, inspections and overall compliance. Also, a continuous evolution of standards, prescribed in labels and information disclosure, would be required to keep up with development and innovation of technology needs.

Label Information

Broadband labels that provide highly technical, trivial or irrelevant data information do nothing to help improve consumer's knowledge. Ambiguous and vague terms, such as 'up to' must be completely avoided. When claims are used consumers will become confused, discouraged, and sceptical. These labels need to be designed in a way to display complete information in a standardised and simple format that may also be adapted to local language requirements. Use of visuals, icons and voiceover instead of text, would have a greater impact on various sections of the society, including the specially-abled, and enable them to have equal access to such labels.

Placement of Labels

Such broadband labels may be mandated to be placed on the TSP/ISP's website, TRAI's consumer outreach website and MySpeed app, at the point of sale in TSP/ISP outlets as well as third-party multi-brand retail stores and shops, on monthly bills and notifications sent to consumers, etc. Such labels may also be pre-loaded through a mobile app on Internet-enabled computing devices sold within India. While the primary label may remain dynamic to maintain accessibility on devices, the same label may be developed in static form – posters, hand-outs, etc. – periodically at multiple consumer touch points.

Inclusivity

Creation of various consumer profiles who access broadband Internet services, such as business professional, homemaker, student, gamer, tech entrepreneur, policymaker, service provider, etc. would aid in making different and more inclusive labels.

Phased Approach

Lessons could be taken from the Bureau of Energy Efficiency (BEE) label design process, which is an excellent example of how to develop a national label and utilise considerable consumer and stakeholder input. BEE used a phased-approach mechanism to first implement Star labels on a voluntary basis, and once the sales of a particular appliance crossed 50 percent, labelling on that appliance was made mandatory. Similar approach to ensure active consumer adoption of broadband labels may be explored by the TRAI as a pilot project in few telecom circles to begin with.

The NDCP 2018

The National Digital Communications Policy (NDCP) 2018, expected to be announced in July 2018, provides an excellent opportunity to all stakeholders to focus on QoS and work cohesively to ensure efficient implementation and streamlining of various initiatives. The policy also aims to include other technologies, such as satellite communications, start-ups, etc. in improving connectivity, network performance and providing more clarity to TSPs/ISPs.

Innovative Tools

Currently, the TRAI's MySpeed App measures QoS and QoE in terms of the speed only. There is a need for an application/website that gauges broadband Internet services on a number of QoS and QoE parameters. Such tool will help consumers in determining the delivered QoS & QoE levels. Such an app/website would need to be integrated to a mechanism that regularly monitor the measurement of network data and associated QoS metrics. Start-ups, micro, small and medium-sized enterprises (MSMEs) and other third-party application developers may be incentivised to work in tandem with TSPs/ISPs and contribute in this monitoring exercise providing support on measuring 'dynamic' parameters, such as power and memory of end user devices, network congestion, spectrum shortage and range limitations of access networks, backhaul bandwidth constraints, etc.

Frugal Tools

While innovation will surely benefit in ensuring robustness, it is also important that the developed applications are certified in the Indian context. This would help developers to be more aware of limitations and constraints of Indian telecom networks while building and optimising these apps. Emphasis should also be laid on removing related bottlenecks so as to enable 'frugal development' of apps that enhance the broadband labels and overall information disclosure mechanism.

Amendments to existing QoS Regulations

The current QoS reporting and disclosure mechanisms governed by the TRAI (covered in Section 2 above), do not take into account many critical QoS and QoE parameters which are readily available with TSPs/ISPs. Hence, it is crucial for such reporting to be more granular and include as many available parameters as possible. It is a known fact that TSPs/ISPs conduct their own tests to check network performance, while the TRAI also conducts independent drive tests at various locations. However, both tests must also gauge metrics, such as handover of Inter Radio Access Technologies (IRAT) frequency, which significantly impact the utility and further improved through better configuration. Instead of aiming for 'averages', these tests must assess the diversity of network performance to get better sense. Doing these tests in more locations will also factor in the redundancy, in case other networks malfunction. Such amendments would immensely benefit the regulator in getting a better sense of the variation in performance across different locations.

1 Introduction

Ensuring quality access of broadband Internet services to citizens has become a global priority. It is universally acknowledged that broadband contributes extensively towards improving quality of citizens' lives and can aid in meeting the global objective of inclusive growth.[2] Thus, an efficient network infrastructure and good quality broadband services may be perceived as a first key step towards creation of a knowledge economy.

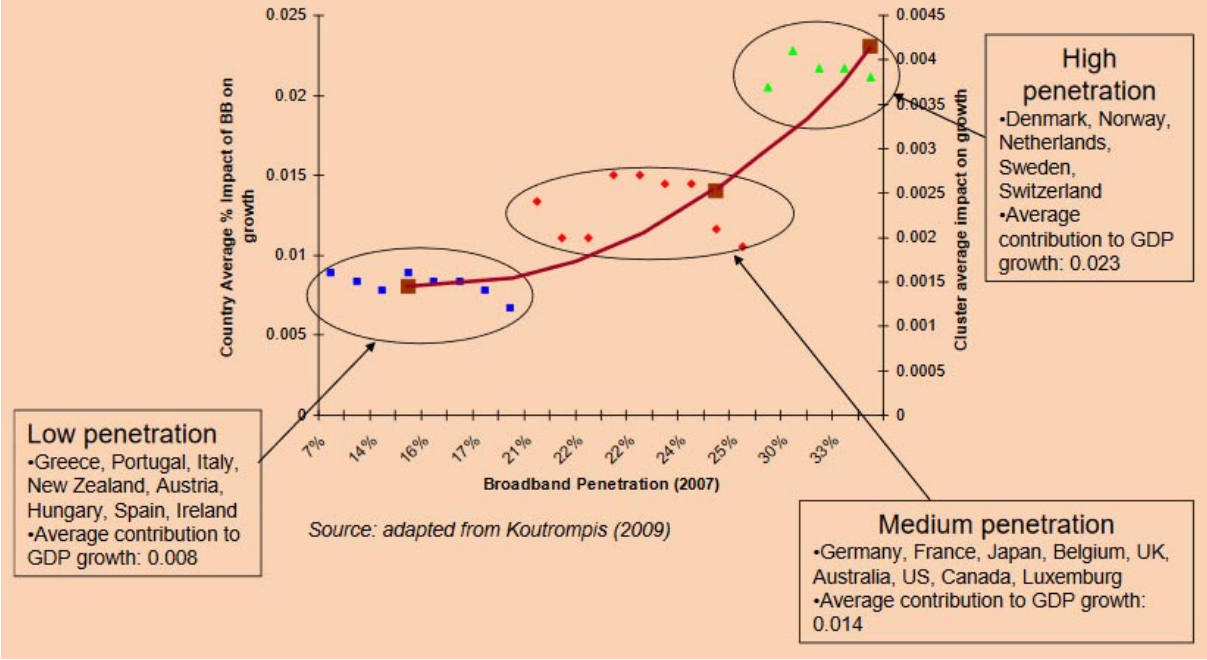
The TRAI,[3] regulator for telecommunications, broadcasting and cable services in India, defines broadband as: "Broadband is a data connection that is able to support interactive services including Internet access and has the capability of the minimum download speed of 512kbps to an individual subscriber from the point-of-presence (POP) of the service provider intending to provide broadband service".

The minimum speed for broadband services as 512kbps was classified by TRAI in 2016. Before 2016, the same was 256kbps.

Many studies[4] have highlighted how broadband contributes significantly towards socio-economic progress, enhances overall productivity, competitiveness and inclusive growth of a country. It also brings public services closer to its citizens through e-governance, apart from creating and maintaining a direct connection between producers and consumers. Banking, labour and employment, education, public services and safety, healthcare services are now more accessible than ever and broadband has made last-mile connectivity easier at a comparatively lower cost than the conventional models. Some prominent examples are Online Banking, Digital Payment, E-governance, Massive Open Online Courses (MOOC), Online Job Postings, etc.

Studies have highlighted the correlation between Internet penetration levels and associated positive economic impacts. For example, Koutroumpis (2009) found that for Organisation for Economic Cooperation and Development (OECD) countries the contribution of broadband to OECD economic growth

Figure 1: Broadband Penetration Impact on GDP Growth of OECD Countries



Source: Dr Raul Katz, The Impact of Broadband on the Economy, ITU, April 2012, is accessible at: http://snip.ly/b9ptqj

increased with rise in availability of broadband services (Figure 1).[5]

Countries with broadband penetration less than 20 percent and between 20 percent and 30 percent, a 1 percent increase in broadband adoption contributed to 0.008 and 0.014 percent in Gross Domestic Product (GDP) growth respectively. While in countries with penetration higher than 30 percent, the impact was 0.023 percent.[6] Likewise, a study by The World Bank (2010)[7] estimated that a 10 percent increase in broadband penetration accelerates economic growth by 1.38 percent in developing countries. It is, therefore, evident that today most of the countries are striving to create a robust broadband infrastructure.

Broadband Internet access has also been linked to the Sustainable Development Goals (SDGs) set by the United Nations.[8] Aiming for several advancements by 2030, the SDGs set a vision to end extreme poverty and hunger, improve access to healthcare and education, protect the environment and build peaceful inclusive societies. Paragraph 15 of the 2030 Agenda for Sustainable Development outlines: "ICT has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies".

While the Internet has penetrated in most of the countries quickly, its inclusive and efficient use has been lower in developing countries due to slow penetration and adoption. As a result, majority of the global population's lives remain largely untouched by digital revolution. Only around 15 percent[9] can afford access to broadband Internet. Mobile phones, reaching almost four-fifth[10] of the world's population, is the most common mode of Internet access in developing countries. But even then, nearly 2 billion people do not own a mobile phone, and

nearly 60 percent[11] of the global population still remain offline, mainly in India and China, but more than 120 million in North America.[12]

Efforts are being made by relevant stakeholders to address this digital divide by providing accessibility of broadband services to the offline population. However, besides focussing only on connectivity, there is a need to ensure that broadband Internet is adequate, reliable and affordable. India is also facing problems with respect to accessibility and adoption of broadband services, the baseline scenario for which is discussed in the following section.

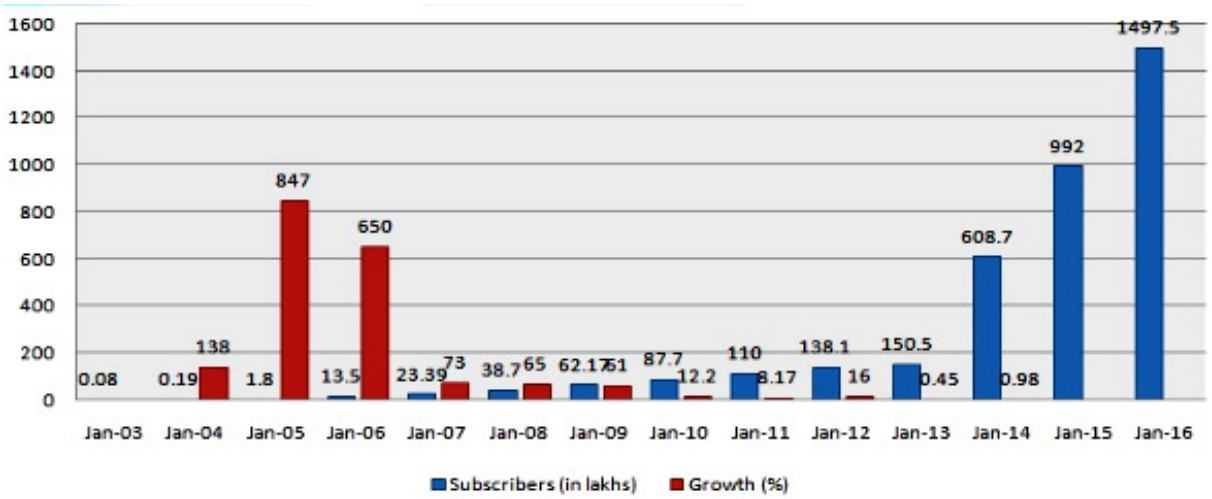
According to Internet Service Providers Association of India (ISPAI), number of broadband subscribers increased from 8000 in 2003 to 1497.5 lakh in 2016 (see Figure 2). The growth, in percentage, may seem overwhelming; however, adoption as compared to the total population of India, i.e. 1.35 billion is miniscule. As per TRAI statistics, the total broadband subscriber base was 276.52 million in March 2017.[13]

In order to connect remaining citizens with broadband services, the Government of India has launched a number of initiatives and policies.

The draft NDCP 2018[14] has envisaged promoting 'Broadband for All' as a tool for socio-economic development under its 'Connect India' mission for 2022. The Digital India programme,[15] a flagship programme of the current Government of India, sets out a vision to transform India into a digitally empowered society and knowledge economy. The government has laid out a mission *to provide 100 Mbps broadband connectivity to more than 0.25mn gram panchayats*[16] across the country by 2019 through its 'Broadband Highways' programme pillar.

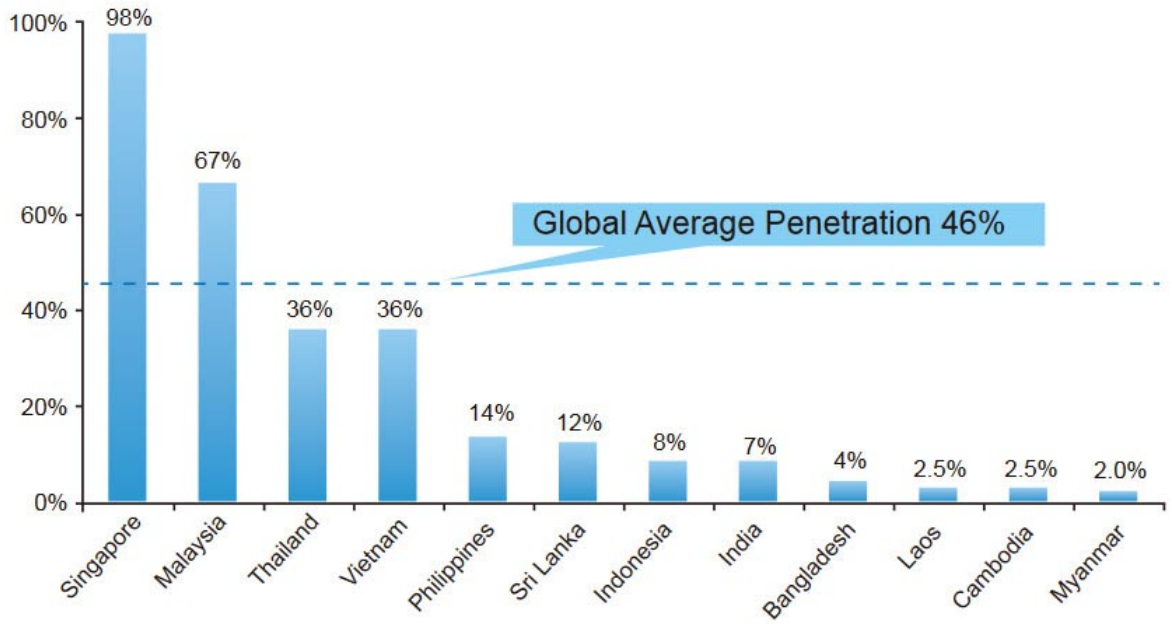
Despite such efforts, Internet penetration in India was 34.1 percent of the total population in December 2017, with only 53 percent daily Internet users in rural segment and total female internet users at approximately 30 percent.[17] Till 2015, as compared to the global average of 46 percent for fixed broadband penetration, India

Figure 2: Growth of Broadband Subscribers in India: (256 Kbps or more)



Source: Internet Service Providers Association, http://snip.ly/r1mqlw

Figure 3: Fixed Broadband Penetration (Households) in Asia-Pacific, 2015



Source: White Paper on Broadband Regulations and Policy in Asia-Pacific Region, ITU, November 2016 accessible at: http://snip.ly/3f05ic

ranked even below Vietnam and Sri Lanka, with only 7 percent penetration[18] as shown in Figure 3.

Even in terms of average internet speed, while South Korea clocked 28.6 Mbps in 2017, India could only achieve 6.5 Mbps.[19] While the present government and industry is making consistent efforts to make broadband services accessible and affordable, it is also critical for these services to be reliable and efficient to ensure seamless last-mile connectivity, better QoS, QoE and transparent information disclosure of these services for consumers.

2 Broadband Services and Indian Consumers

Problem Statement

As compared to other countries, India's telecom market is very unique as close to 95 percent of the total Internet subscriber base uses 'Mobile Wireless' mode to access Internet.[20] With such a high share of consumers dependent on the wireless network for connectivity, poor QoS, QoE and lack of information disclosure may cause a major setback in efforts made towards broadband services and the 'Digital India' programme. Some prominent disclosure issues often quoted in research reports and print media, include mis-selling, misleading advertisements, failure to deliver the promised QoS, QoE, *et al*. This suggests that India needs to undertake further reforms to ensure better quality broadband services for all the citizens. A detailed research on the impact of QoS on final QoE for consumers has been covered under Annexure II of this Research Report.

A study undertaken by CUTS International and IIT Delhi highlighted that the perception of consumers in India towards QoS of their mobile Internet services, in general, is poor.[21] Another study,[22] which captured problems faced by *Bharat Sanchar Nigam Limited* (BSNL) broadband subscribers observed that majority of respondents were dissatisfied with the QoS, particularly with reference to download limit and broadband speed. In August 2017, TRAI released results of a detailed consumer perception survey[23] in the licence service areas (LSAs) of Delhi, Madhya Pradesh and Karnataka, which revealed that none of the service providers in the three service areas have achieved the benchmark for consumer satisfaction. In fact, the consumer satisfaction level was a dismal 50 percent, with the worst dissatisfaction in the two areas: 1) data speed and network; and 2) signal and coverage.

Another major grievance of broadband consumers is on actual connection speed, which is constantly or unpredictably slow, as compared to the speed advertised by TSPs and/or ISPs at the point of sale. In addition to this, information relating to critical QoS and QoE factors, such as actual throughput, bandwidth, latency, etc. are not disclosed to consumers at the

time of signing up for broadband services. Terms, such as 'up to' for data speed and 'unlimited' for data limit is quite common. Moreover, under the garb of fair usage policy, broadband speeds are substantially reduced after a certain usage limit. Primary reason for consistent rise in such issues is inadequate and inaccurate information provided to consumers.

Broadband Services and Consumer Rights

Every broadband consumer is entitled to receive QoS and QoE as promised by the service provider. For instance, service providers are expected to explain the tariff plan selected by a consumer and parameters which influence QoS of the plan. Thus, the terms of contract between consumer and service provider, should clearly state the expected or average QoS and QoE for services offered, which the service provider should mandatorily adhere to. In case a contract is breached, a consumer should be empowered with provisions to demand for suitable compensation from the service provider.

QoS, Disclosure and Transparency Regulations

TRAI, established as a regulator under the TRAI Act, 1997, aims to protect consumer interests and facilitate the growth of telecommunications, broadcasting and cable services in a manner and at a pace which will ensure and enable India as a global leader in the emerging information society.[24] As one of the most inclusive regulators in the country, TRAI releases consultation papers to seek stakeholders' comments, before formalising any regulation. TRAI has prescribed the QoS standards for broadband service providers through the QoS of Broadband Service Regulations, 2006. As per this regulation, benchmarks for bandwidth utilisation and subscribed broadband connection speed (download) are provided below:

In December, 2012, TRAI issued 'Standards of Quality of Service for Wireless Data Services Regulations, 2012'.[25] It introduced a list of QoS parameters, with minimum benchmarks for compliance by service providers. Following the 2012 Regulations, TRAI in July 2014, introduced a clause in the regulation that mandates service providers to publish minimum download speed for the wireless data plans. Service providers also have to ensure that the minimum download speed specified in their advertisements, is delivered not less than 80 percent[26] of the usage time. This was introduced since the advertised speeds and actuals often differed substantially. The complete set of QoS parameters, laid out by TRAI, are showcased in Table 2:

TRAI has also placed certain measures to ensure compliance of these regulations and publishes quarterly performance reports[27] for all 22 telecom circles in India. TRAI also conducts periodic audits, drive tests and assessment of QoS through independent agencies across the country, to monitor the compliance of prescribed benchmarks.

Recognising the importance of information disclosure for consumers in ensuring transparency in the delivery of broadband services, in 2012, (subsequently revised in 2016) TRAI notified service providers to provide consumers with information on various parameters, through various channels, such as service provider's website, advertisements, emails, SMS, etc. Such disclosures are intended to assist consumers in making an informed decision for their selection of broadband service. However, the direction for disclosure (Box 1) covers limited portion of vast information's that broadband providers are generally required to disclose to their consumers.

Table 1

QoS Parameters for Broadband Services in India	
QoS Parameter	**Benchmarks**
Service provisioning/activation time	100 % within 15 working days
% of fault repaired by next working day	> 90 %
% of fault repaired within three working days	> 99 %
% of bills disputed (billing complaints)	<2 %
% of billing complaints resolved	100 %within 4 weeks
Time taken for refund of deposits after closure	100 % within 60 days
% of calls answered by the operators (Voice to Voice) within 60 seconds	>60 %
% of calls answered by the operators (voice to voice) within 90 seconds	>80 %
% of service availability/Uptime (for all users)	>98 %
Packet loss (for wired broadband access) in percent	<1 %
Network Latency • User reference point at POP/ISP Gateway Node to 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 ms <350 ms <800 ms
Bandwidth utilisation/throughput 1) bandwidth Utilisation i) POP to ISP Gateway Node [Intra-network] Link(s) ii) ISP Gateway Node to IGSP / NIXI Node up-stream Link(s) for international connectivity 2) Broadband Connection Speed (download)	<80 percent link(s)/route bandwidth utilisation during peak hours. If on any link(s)/route bandwidth utilisation exceeds 90 percent, then network is considered to have congestion. For this an additional provisioning of Bandwidth on immediate basis, but not later than one month is mandated. Subscribed broadband Connection speed to be met >80 % from ISP node to user.

Source: TRAI Website, Accessible at: http://snip.ly/6nc3wk

Table 2

QoS Standards for Wireless Data Services in India	
QoS Parameter	Benchmark
Regulation 2012	
Service activation/provisioning	Within 4 hours with 95% success rate
Successful data transmission download attempts	> 80%
Successful data transmission upload attempts	> 75%
Minimum download speed	To be measured for each plan by the service provider and reported to TRAI
Average throughput for packet data	> 75% of the subscribed speed
latency	Data < 250 ms
Packet Data Protocol (PDP) context activation success rate	> 95%
Drop rate	< 5%
Amendment 2014	
Minimum download speed	> 80% of the usage time

Source: TRAI Website, Accessible at: http://snip.ly/6nc3wk

Taking forward its agenda of transparency and consumer protection, TRAI launched the MySpeed mobile application[28] in August 2016 that empowers a wireless broadband consumer to check the delivered quality of data speed on any smartphone, at anytime and anywhere across the country. The mobile application also allows the consumer to rate the delivered quality by through a star-rating mechanism. This interaction generates data in anonymous form, which get accumulated on the TRAI MySpeed Analytics portal[29] and is available in downloadable format for interested stakeholders to perform big data analytics. This was an important step taken by TRAI so as to work effectively on data speed governance.

In April 2018, TRAI launched a beta version of 'Tariff Portal'[30] that allows consumers to access information on various available tariff plans offered by TSPs, along with comparing these plans on multiple parameters, further empowering consumer choices. This was soon followed by the beta version of 'Network Coverage Map,'[31] introduced in June 2018, where a consumer may view the status and conditions of a TSP's network coverage for a specific location.

Appreciating the TRAI's path-breaking initiatives on transparency, consumer protection and empowerment, limited progress has been seen on the improvement of current QoS and QoE situation. Combining all efforts and initiatives of the entire telecom ecosystem players is the need of the hour to bring necessary changes, so that consumers are empowered with standard tools and accurate information disclosure mechanism to demand better broadband Internet services. Thus, creating a Label for broadband services that is user-friendly, easily accessible and provides relevant information on QoS and QoE parameters, would empower consumers in making an informed decision while selecting their service provider and plan.

Box 1: TRAI's 2016 Direction on Information Disclosure for Broadband Services (Fixed & Mobile)

In supersession of its earlier direction in 2012, the TRAI – in order to ensure transparency in delivery of internet and broadband services, protect interest of telecom consumers and facilitate progress of broadband services in India – directs all providers of broadband (wireline and/or wireless) services to:

1. Provide on their website and also in all advertisements published through any media, the following information in respect of all broadband tariff plans offered under Fair Usage Policy: -

    a. For fixed broadband service
        i. Data usage limit with specified speed
        ii. Speed of broadband connection up to specified data usage limit and
        iii. Speed of broadband connection beyond data usage limit

    b. For mobile broadband service
        i. Data usage limit with specified Primary technology (3G/4G) for providing data services and
        ii. Speed offered for providing data services beyond data usage limit

2. Provide information specified in para (a) above to both new and existing subscribers on their registered email address and through SMS on their mobile number registered with the service provider, as opted by consumer

3. Ensure that download speed of broadband service provided to the fixed broadband subscriber is not reduced below minimum download speed for broadband as defined by Department of Telecommunications (DoT) from time to time, in any fair usage broadband tariff plan after expiry of assigned data quota of consumers

Provide alert to the subscriber through SMS on his registered mobile number or to his registered e-mail address each time when his data usage reaches 50 percent, 90 percent and 100 percent of the data usage limit under his plan. TSP should also maintain a portal/website, so that user can access his usage at any point of time.

Source: TRAI Direction under Sec 13 to service providers for delivering broadband services, October 31, 2016. Accessible at: http://snip.ly/zj9b5h

3 Broadband Labels – Evolution, Parameters and Global Experiences

Labelling is a common practice being followed for many consumer products. For instance, a packaged food product anywhere in the world would typically have details, such as ingredients, nutritional content, source of origin, price, directions for use, precautions to be taken, expiry date, etc. mentioned on a label prominently visible. Such a label encourages consumers to take informed buying decisions and assures safety, quality and durability of products. Similarly, appropriate labelling of food products, medicines, appliances, etc. have also protected the interests of Indian consumers. A 2015 survey[32] provides support for these assertions.

Experience from labelling of consumer goods suggests that there is a need to extend labelling to services as well, currently in the form of carbon footprint in airlines and eco labels. Broadband labels could benefit existing and potential broadband consumers that underlie social and economic activities across the globe.

Evolution of Labels in Broadband Sector

1. Why?

Media articles and reports around the world have highlighted that consumers are often perplexed when choosing a broadband service provider. Cited below are various studies and surveys, undertaken by consumer organisations and network regulators that have confirmed these observations.

In 2009, the OTI of the New America Foundation, came up with an idea of creating the first broadband label – Broadband Truth-in-Labelling disclosure.

It stated that broadband subscribers are often frustrated with actual performance of their Internet access service, which regularly falls far below the advertised speeds. Consumers set their expectations based on phrases like 'up to 16 Mbps', and are disappointed to learn that these quotes are

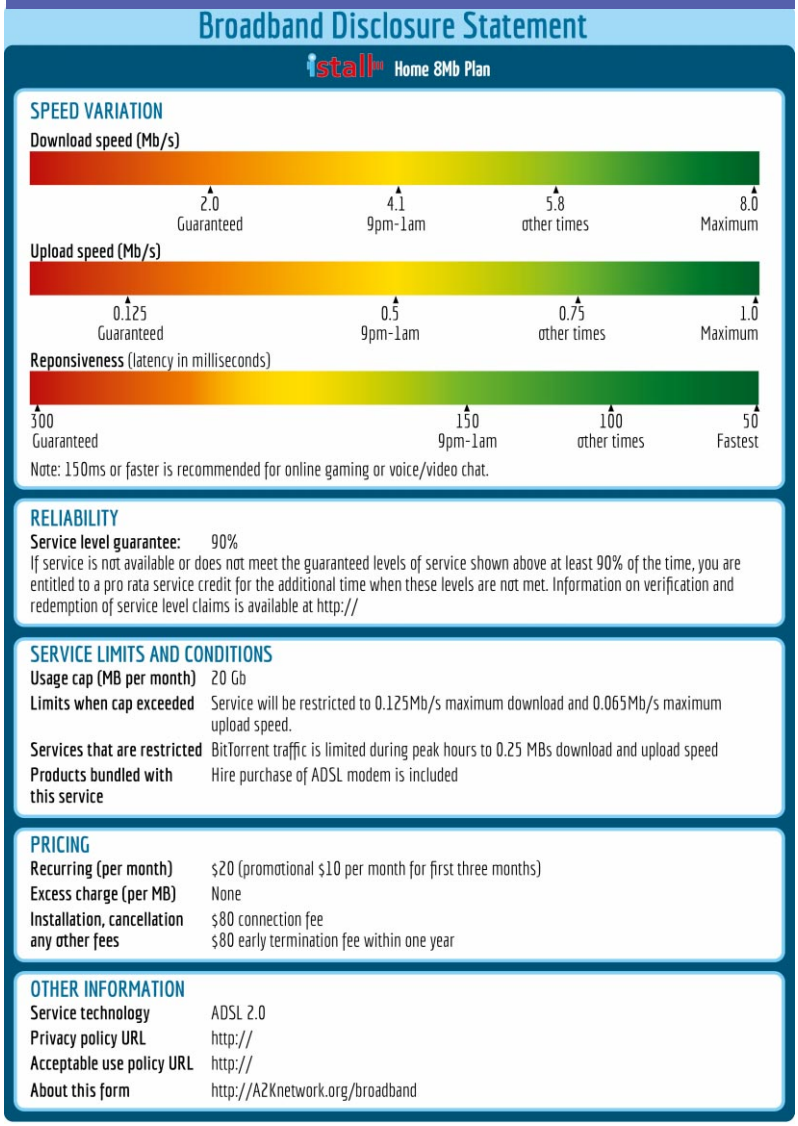
worthless as assurances.[33] Besides, as there was no lawful requirement for service providers then to reveal contents of the broadband services they are providing, which led to consumers being harmed by invalid and/or ambiguous languages.

In 2012, a global consumer survey[34] on broadband Internet was administered by Consumers International (CI) in 40 countries (including India), in five languages, drawing over 9,000 responses. This survey elicited information about prevalent problems faced by consumers of broadband Internet services. The survey results revealed that Internet speeds are often slower than advertised, and in many cases unpredictable. The cost of internet access is often prohibitive in locations where there is insufficient competition between broadband providers. Even in locations where competition does exist, consumers are kept from taking advantage of it by lock-in provisions in their service contracts. Finally, majority of consumers were dissatisfied with handling of complaints on speed or service problems.

2. How?

The OTI recommended that TSPs/ISPs should disclose important facts and details of the broadband offering before subscribers sign up. Such a disclosure should be meaningful, and failing to meet minimum standards should be treated as an important service outage. Such an outage must result in a refund or service credit to the consumer. Where there are choices between different products or providers, the disclosure should be made available in a way that allows consumers to compare them. Providing clear, meaningful, comparable disclosures ultimately spurs competition between TSPs/ISPs and encourages future development of broadband technology. As a result of this initiative, OTI developed a sample Broadband Truth-in-Labelling disclosure in 2009, which is discussed in detail in the succeeding section.

Figure 4: Broadband Disclosure Statement by CI



Source: http://snip.ly/ea5hi2

Since 2009, CI has been promoting the idea of a broadband nutrition label among its member countries. As the name implies, this label resembles a nutrition label seen on food products and discloses actual Internet speeds that broadband users may expect in a simple, hype-free format, further encouraging service providers to back this up with a service guarantee. Thus, a Standard Broadband Disclosure Statement was developed by CI based on feedback from its members and from other best practices, such as Ofcom's Voluntary Code of Practice on Broadband Speeds. This disclosure statement sets out the most important variables in a standardised, easily understood and comparable form, including speed, reliability, service limits and conditions, pricing and other information, such as privacy policy.

Essential Parameters

A simple and consistent label will enable consumers to make apples-to-apples comparisons when considering broadband Internet service selection or when considering a change.[35]

According to the US FCC,[36] a label programme would provide the following information:

- Performance: upload speed and download speed
- Price (monthly fee averaged over three years)
- Usage restrictions (any point at which the terms of service that apply change)

Similarly, service providers may also mention peak and off-peak, average and minimum speed, thereby making them more accountable. Likewise, a label may also capture important technical features like the latency, jitters, etc. that might be important for some consumers, expert analysis and service offering comparison. Table 3 summarises the essential ingredients covered by existing broadband labels in the global market.

The following section covers global experiences of conceptualising and implementing different types of information disclosure mechanisms for broadband services that have immensely benefited consumers.

Global Experiences

As discussed in the previous section, CI's Standard Broadband Disclosure Statement Label suggested to its member countries, a model for information disclosure for internet services in their country. The service providers may adopt it as a voluntarily or mandated industry standard.

CI's campaign 'Holding Broadband Service Providers to Account' encouraged service providers and regulators of member countries to use such information labels. Many organisations, including CUTS International, India; IDEC, Brazil; Consumer Council, Fiji; Kenya Consumers Organisation; Colectivo Ecologista Jalisco, Mexico; ADEC, Senegal and Consumers Korea, etc. were involved in this campaign during the period 2011-2013.

United States of America

The OTI 'Broadband Truth-in-Labelling' encourages service providers of US to present information about their service packages in a uniform format that enables consumers to better understand and compare offerings from different ISPs. Accordingly, in 2009 it came up with a model label, which was subsequently updated as time progressed.

Table 3

Essential Ingredients in Existing Broadband Labels (As extracted from respective labels)		
Broadband Disclosure Statement (Consumers International)	Fixed Broadband Labels(US-Federal Communications Commission)	Broadband Truth-in-Labelling Standardised Disclosure(New America's Open Technology Institute)
Speed variations Guaranteed/ 9pm-1am/other times/maximum • Download Speed (Mb/S) • Upload speed • Responsiveness (latency in milliseconds)	Choose your service data plan for: • Monthly charge for month-month plan • Monthly charge for 2-year contract plan	Pricing • Monthly recurring fee • One-time required fees • Conditional fees
Reliability Service level guarantee in percentage	Other charges and terms • Data included with monthly charge • Charges for additional data usage • Optional modem or gateway lease – customers may use their own modem or gateway • Other monthly fees • One-time fees	Performance • Speed • Average speed during peak hours • Download • Upload
Service limits and conditions • Usage cap (Mb per month) • Limits when cap exceeded • Services that are restricted • Products bundled with this service	Government related taxes and other applicable fees	Terms of Agreement • Contract • Privacy Practices • Network Management • Complaints Processing
Pricing • Recurring (per month) • Excess charge (per MB) • Installation, Cancellation • Any other fees	Performance • Typical speed downstream • Typical speed upstream • Typical latency • Typical packet loss	
Other Information • Service technology • Privacy policy URL • Acceptable use policy URL • About this form	Network Management • Application specific network management practices? • Subscriber triggered network management practices? • More details on network management	
	Complaints or inquiries	

Figure 5: Broadband Truth-in-Labelling Standardised Disclosure

ExampleCom Ultra 25/10

Electronically Generated: July 16, 2015
Compliant with FCC Broadband Disclosure Standards

PRICING

Monthly recurring fee	$40 per month during promotion $60 per month after promotion	Promotion, valid for first 12 months	-$20
		Plan Price	$50
		Taxes	$10
One-time required fees	$70 Total	Installation	$50
		Activation	$20
Conditional Fees	Varies	Early termination fee (Cancellation in first year)	$150
		Router purchase	$90

PERFORMANCE

Speed	Average speed during peak hours 15 Mbps download 7 Mbps upload	Average speed over 24h period (upload/download)	26/8
		Percentage of time at or above average speed	71%
		Average latency	3 ms
		Average latency, peak hours	5 ms
		Average packet loss	0.4%
		Average packet loss, peak hours	1%

TERMS OF AGREEMENT

Contract	2 years	Early termination fee (Cancellation in first year)	$150
		Monthly recurring fee guaranteed for term of contract	
Privacy Practices	FCC Rules on Broadband Privacy Company Privacy Policy		
Network Management	Company Network Management Practices		
Complaints Processing	Company Complaint Form FCC Complaint Portal		

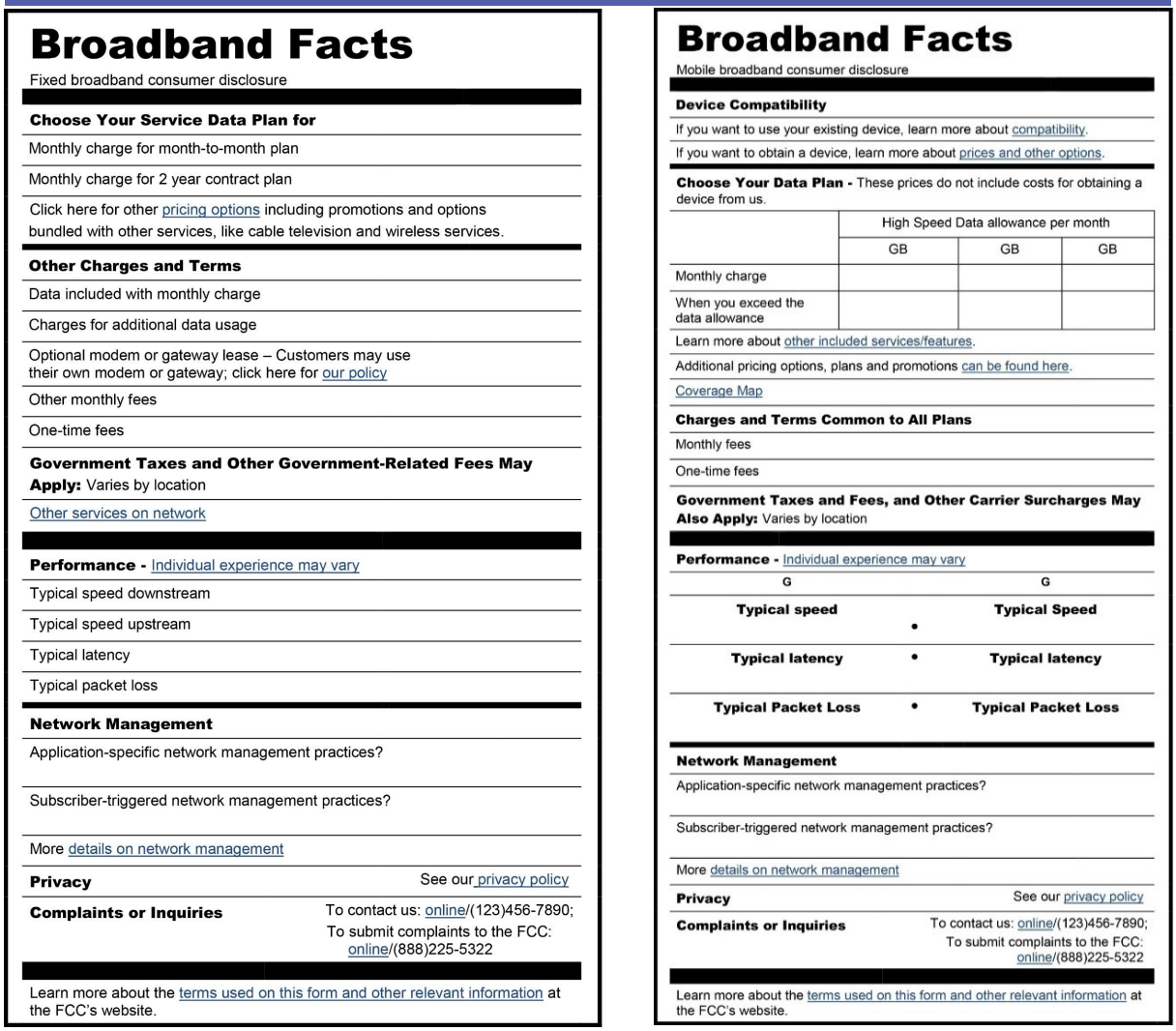
Source: Emily Hong, Laura Moy, and Isabelle Styslinger, Broadband Truth-in-Labelling: Empowering consumer choice through standardised disclosure, New America's Open Technology Institute (Jul. 2015). Accessible at: http://snip.ly/nnu07z

In 2012, based on National Broadband Plan[37] and also taking into consideration the OTI campaign, the FCC issued its Open Internet Study[38] that recommended the adoption of a voluntary labelling programme similar to nutrition labels. In the 2015 Open Internet Order, the FCC enhanced the transparency requirements by addressing the content and format of disclosures that broadband providers were required to implement. In light of these developments, the FCC involved the Consumer Advisory Committee (CAC) to recommend a disclosure format, which was issued in 2015.

Based on the CAC recommendations, the FCC announced the templates for two broadband labels on April 04, 2016 – one each for fixed and mobile broadband – which service providers could use to supply consumers with information about their services. Fixed broadband service is delivered through cables in a closed environment and under predictable performance measurements, whereas mobile broadband service is delivered wirelessly in an open environment where measurements are challenging and vary with topography, infrastructure, number of subscribers on a network node, etc. Hence, it is important to have separate labels for both these services so as to justify the comparison and measurements. And to ensure these justified measurements, label for mobile broadband service would capture unique parameters, such as device compatibility, data download speeds, etc.

When these templates were released, the FCC stated that service providers were free to use a different format if it complied with the rules, but using the sample labels designed by the FCC would be considered as a 'safe harbour' for demonstrating compliance.

Figure 6: Fixed Broadband Consumer Disclosure/Mobile Broadband Consumer Disclosure



Broadband Facts

Fixed broadband consumer disclosure

Choose Your Service Data Plan for

Monthly charge for month-to-month plan

Monthly charge for 2 year contract plan

Click here for other pricing options including promotions and options bundled with other services, like cable television and wireless services.

Other Charges and Terms

Data included with monthly charge

Charges for additional data usage

Optional modem or gateway lease – Customers may use their own modem or gateway; click here for our policy

Other monthly fees

One-time fees

Government Taxes and Other Government-Related Fees May Apply: Varies by location

Other services on network

Performance - Individual experience may vary

Typical speed downstream

Typical speed upstream

Typical latency

Typical packet loss

Network Management

Application-specific network management practices?

Subscriber-triggered network management practices?

More details on network management

Privacy See our privacy policy

Complaints or Inquiries To contact us: online/(123)456-7890; To submit complaints to the FCC: online/(888)225-5322

Learn more about the terms used on this form and other relevant information at the FCC's website.

Broadband Facts

Mobile broadband consumer disclosure

Device Compatibility

If you want to use your existing device, learn more about compatibility.

If you want to obtain a device, learn more about prices and other options.

Choose Your Data Plan - These prices do not include costs for obtaining a device from us.

	High Speed Data allowance per month		
	GB	GB	GB
Monthly charge			
When you exceed the data allowance			

Learn more about other included services/features.

Additional pricing options, plans and promotions can be found here.

Coverage Map

Charges and Terms Common to All Plans

Monthly fees

One-time fees

Government Taxes and Fees, and Other Carrier Surcharges May Also Apply: Varies by location

Performance - Individual experience may vary

G G

Typical speed • **Typical Speed**

Typical latency • **Typical latency**

Typical Packet Loss • **Typical Packet Loss**

Network Management

Application-specific network management practices?

Subscriber-triggered network management practices?

More details on network management

Privacy See our privacy policy

Complaints or Inquiries To contact us: online/(123)456-7890; To submit complaints to the FCC: online/(888)225-5322

Learn more about the terms used on this form and other relevant information at the FCC's website.

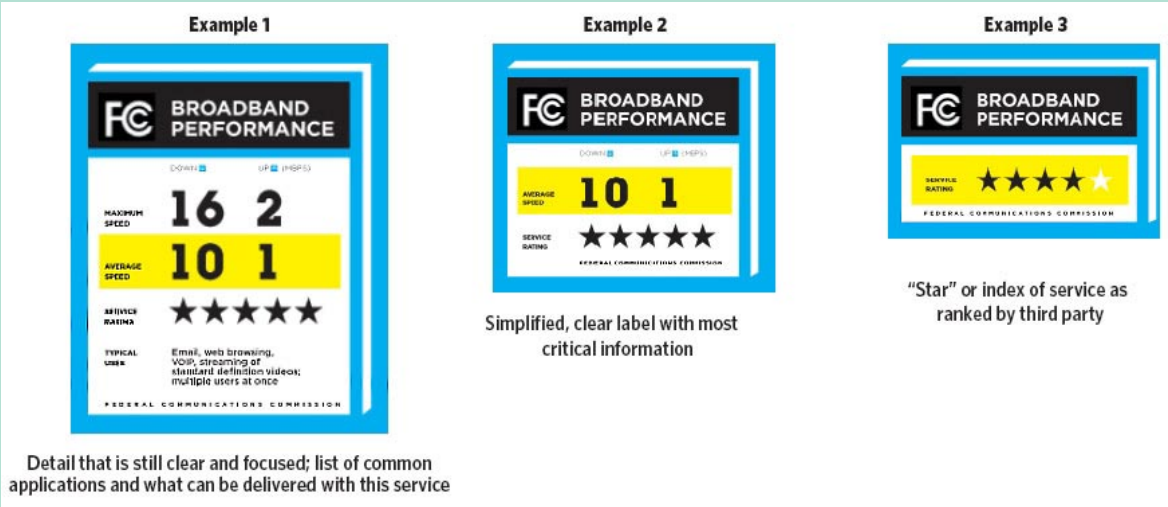
Source: http://snip.ly/wvr9nc

By June 2016, none of the TSPs/ISPs or organisations representing broadband service providers complied with this recommendation and exhibited reluctance[39] to comply on voluntary basis. Hence, the FCC independently collated each detail that a TSP/ISP was expected to provide in the above recommended formats. Thus, a proactive step was taken to empower consumer choices for high speed broadband Internet service. Service providers argued that such resistance was because of the fact that competition in the broadband industry already ensured that they deliver more to consumers than regulations would accomplish.[40]

Among the many disclosure mechanisms being implemented, the FCC has published rough estimations for minimum download speeds of several activities while accessing broadband services, which are captured in Table 4:

Box 2: A Model Proposed to FCC during a Discussion on Broadband Labels

*Illustrative Label Models for Broadband Speed and Performance*In Example 1, consumers would know maximum and average upload/download speeds, along with an aggregated QoS rating that incorporates uptime, delay and jitter, as well as a list of standard applications which could be used with that service. Example 2 includes only actual upload and download speeds along with a QoS rating. Example 3 would create a weighted average 'Broadband Quality Index' rating for a service, from zero to five stars. This scoring system is similar to what was proposed by Cisco and Corning and would evolve with interactions and discussions with consumer and industry groups.



Source: Broadband Competition and Innovation Policy, is accessible at: http://snip.ly/izfp40

Table 4

FCC Estimations for Minimum Download Speeds of Online Activities	
Activity	Minimum Download Speeds (Mbps)
General Usage	
General browsing and email	1
Streaming online radio	Less than 0.5
VoIP calls	Less than 0.5
Student	5 - 25
Telecommuting	5 - 25
File downloading	10
Social media	1
Watching Video	
Streaming standard Definition Video	3 - 4
Streaming High Definition (HD) Video	5 - 8
Streaming Ultra HD 4K Video	25

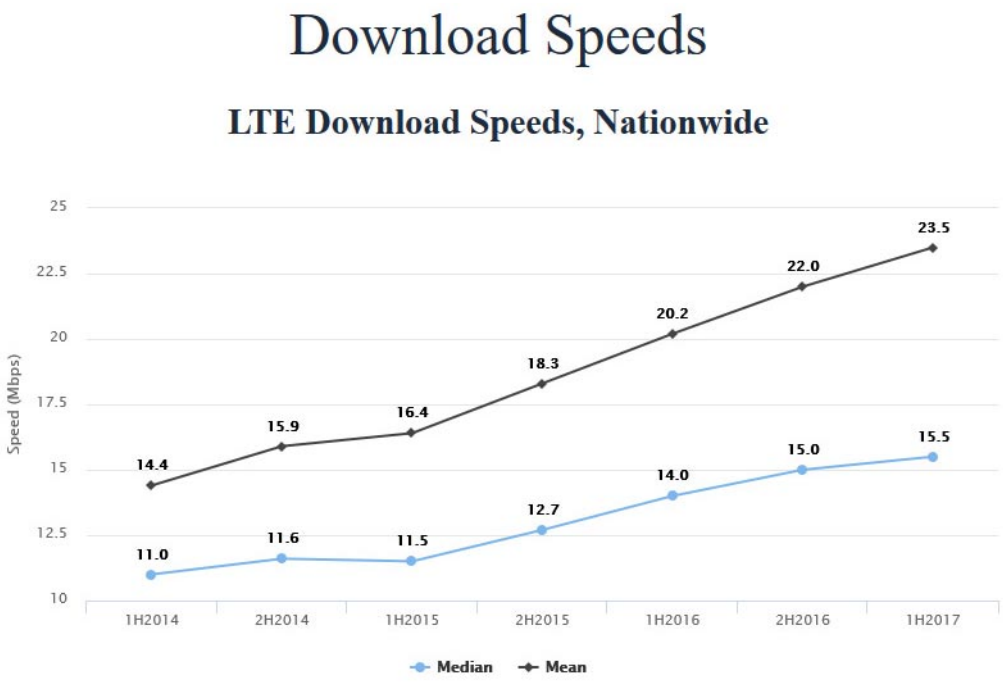
Activity	Minimum Download Speeds (Mbps)
Video Conferencing	
Standard personal video call (like skype)	1
HD Personal video call (like skype)	1.5
HD video teleconferencing	6
Gaming	
Game console connecting to the Internet	3
Online multiplayer	4

Source: http://snip.ly/ydd5an

Through its Annual Mobile Wireless Competition Report, the FCC also published the national download speeds attained every six months, which is compiled using Ookla SPEEDTEST Intelligence data. A recently published graph in the report's 20th edition is shown below:

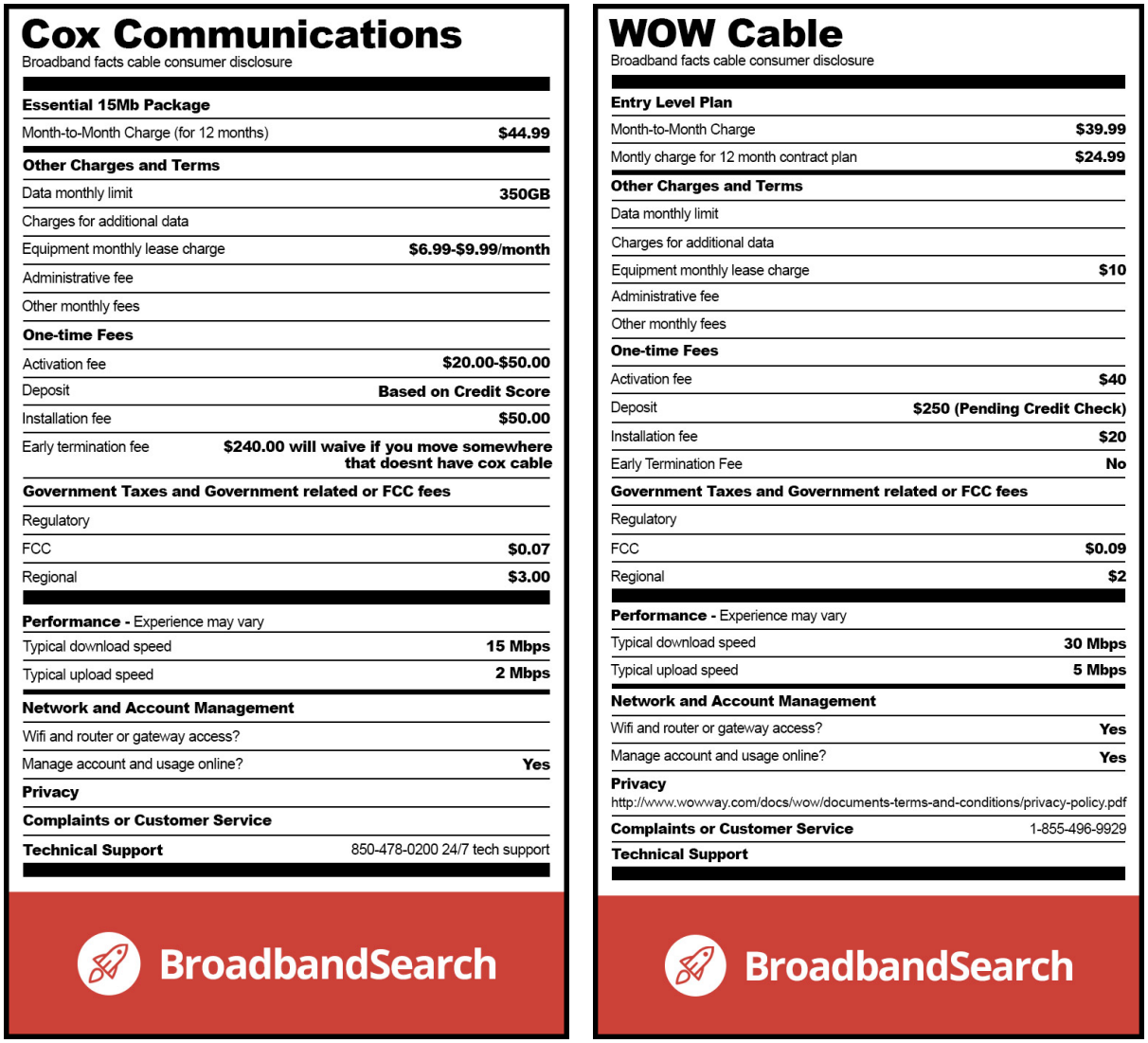
The 'Fixed Broadband Deployment Map'[41] and 'Speed Test Mobile Application'[42] are other important transparency measures implemented by the FCC for consumer welfare. At sub-national level, the West Virginia Broadband Council proactively launched the 'Speed Test Portal'[43] to encourage state residents to test the speed of their Internet service to determine the state's performance in connectivity.[44]

Figure 2: Growth of Broadband Subscribers in India: (256 Kbps or more)



Source: http://snip.ly/segnnc

Figure 7: FCC Broadband Label for COX Communications & Wide Open West (WOW) Cable (Drafted by FCC)



Cox Communications
Broadband facts cable consumer disclosure

Essential 15Mb Package	
Month-to-Month Charge (for 12 months)	**$44.99**
Other Charges and Terms	
Data monthly limit	**350GB**
Charges for additional data	
Equipment monthly lease charge	**$6.99-$9.99/month**
Administrative fee	
Other monthly fees	
One-time Fees	
Activation fee	**$20.00-$50.00**
Deposit	**Based on Credit Score**
Installation fee	**$50.00**
Early termination fee	**$240.00 will waive if you move somewhere that doesnt have cox cable**
Government Taxes and Government related or FCC fees	
Regulatory	
FCC	**$0.07**
Regional	**$3.00**
Performance - Experience may vary	
Typical download speed	**15 Mbps**
Typical upload speed	**2 Mbps**
Network and Account Management	
Wifi and router or gateway access?	
Manage account and usage online?	**Yes**
Privacy	
Complaints or Customer Service	
Technical Support	850-478-0200 24/7 tech support

BroadbandSearch

WOW Cable
Broadband facts cable consumer disclosure

Entry Level Plan	
Month-to-Month Charge	**$39.99**
Montly charge for 12 month contract plan	**$24.99**
Other Charges and Terms	
Data monthly limit	
Charges for additional data	
Equipment monthly lease charge	**$10**
Administrative fee	
Other monthly fees	
One-time Fees	
Activation fee	**$40**
Deposit	**$250 (Pending Credit Check)**
Installation fee	**$20**
Early Termination Fee	**No**
Government Taxes and Government related or FCC fees	
Regulatory	
FCC	**$0.09**
Regional	**$2**
Performance - Experience may vary	
Typical download speed	**30 Mbps**
Typical upload speed	**5 Mbps**
Network and Account Management	
Wifi and router or gateway access?	**Yes**
Manage account and usage online?	**Yes**
Privacy http://www.wowway.com/docs/wow/documents-terms-and-conditions/privacy-policy.pdf	
Complaints or Customer Service	1-855-496-9929
Technical Support	

BroadbandSearch

Source: *http://www.broadbandsearch.net/page/broadband-facts-labels*

United Kingdom

In 2008, Ofcom,[45] the UK's communication regulator, introduced a Voluntary Code[46] that encouraged ISPs to provide residential consumers with more point-of-sale (POS) information on expected speeds on broadband service. In particular, the Code requires service providers to furnish information on their access line speed. This would ensure that consumers choose the most suitable package based on their capacity and needs. The Code applies to all fixed line access broadband service providers who sign up to it.

The operation and application of the Code is regularly reviewed by Ofcom in consultation with signatories and others, primarily to ensure its commitment to serve consumer interest and reflect any new developments within the market. Since the Code's introduction in 2008, Ofcom revised it in 2010 and then again in 2015, based on mystery shopping research findings of Code compliance measurement.

Overall, Principles of the 2015 Code (for residential consumers) are as following:
Principle 1: Training
Principle 2: Information at POS and following the sale
Principle 3: Accuracy of information on access line speed provided by ISPs
Principle 4: Managing customers' speed-related problems
Principle 5: Presentation of broadband information on the website
Principle 6: Timescales
Principle 7: Monitoring of compliance with the Code
Principle 8: Consumers' awareness of ISPs' adoption of the Code

While the initial Code was for domestic consumers, the Voluntary Code of 2016 was specifically designed to provide UK businesses with more accurate and reliable information on the broadband speeds they should receive from ISPs. The new Code applies to all businesses, regardless of size, and to all standard business broadband services across all technologies (including Fibre to the Cabinet and Fibre to the Premises services).

Overall, principles of this new 2016 Code (for businesses) are:
Principle 1: Transparent and accurate information on broadband speeds at point of sale
Principle 2: Detailed information after the sale and on the website
Principle 3: Manage speed-related problems
Principle 4: Right to exit the contract without penalty when speed problems cannot be resolved and
Principle 5: Deliver objectives of the Code through appropriate processes.

From March 01, 2019,[47] Ofcom would be implementing further improvements to these codes with the following changes:
Principle 1: More realistic speed estimates at the POS
Principle 2: Always providing a minimum guaranteed speed and the right to exit connected to this speed at the point of sale
Principle 3: Strengthening customers' rights and extending the right to exit to bundled products and
Principle 4: Ensuring all customers benefit from the codes, regardless of their broadband technology

In an ideal and advanced business environment, a 'Voluntary Codes' mechanism is the most favoured approach for governance and responsibility towards consumer. However, such an approach may not be successful at all times. While the Ofcom and ISPs have cooperated to implement a voluntary scheme on automatic compensation for delayed installation or restoration services,[48] there have been instances when regulatory agencies came down hard[49] at ISPs on advertising misleading[50] broadband speeds, impacting household consumers.

Singapore

Infocomm Media Development Authority (IMDA),[51] the telecom regulator of Singapore, has a different approach on QoS management. Singapore ISPs are required to submit quarterly reports on select QoS parameters to IMDA, along with mandatorily publishing accurate and complete information for services they provide and advertise. This ensures transparency on services offered and also enhances overall consumer satisfaction.

The underlying principle of this entire mechanism is based on the speed of Internet service experienced by consumers. Such a mechanism mandates ISPs to publish speed, service plan and other details on their websites, digital and press advertising materials, and any other publicity or marketing materials. Publication requirement details may be found on IMDAs website.[52] All TSPs/ISPs publish typical broadband Internet download speeds that consumers are likely to experience, in addition to the theoretical maximum speeds.

In October 2015, IMDA launched the IMConnected[53] mobile application to understand experience of mobile broadband consumers through voluntary crowdsourcing mechanism.

Since its inception, the IMConnected app has captured tonnes of data points, which assist in identifying areas with high utilisation as well as potential cellular blind spots. The app results are shared with TSPs to aid in enhancing mobile coverage for consumer benefit.[54]

Australia

Australia Communications and Media Authority (ACMA),[55] the national telecom regulator, developed a mandatory code of conduct in 2012, namely the Telecommunications Consumer Protections (TCP) Code,[56] to provide safeguards for mobile, landline and Internet consumers as well as giving telco providers' greater flexibility in when and how key information is provided to consumers. The Code conforms to the existing Australian Consumer Law.

The TCP code requires telco providers to:

- provide clarity on services offered without using confusing terms;
- provide unit pricing for calls, SMSes and downloading 1 MB of data in advertisements;
- provide a two-page document called the Critical Information Summary, that includes critical information on service, pricing and complaints-handling, as well as volumetric information so consumers can easily understand how many two-minute calls or texts they can make under their plan and compare this value against alternative plans;
- provide mandatory spend management tools designed to avoid bill shock, including alerts about their usage levels and expenditure of data, calls and texts;
- have fair billing and credit management processes;
- have effective and clear complaints-handling processes, with urgent complaints to be resolved within two days; and
- advise customers having difficulty paying their bills or meeting unexpectedly high bills about spend management tools, financial hardship advice and options to restrict services.

Australia has undertaken a massive upgradation exercise of its nation-wide broadband network from existing copper cables to advanced optical fibre cables. The National Broadband Network (NBN),[57] touted as the biggest infrastructure project in the country, has envisaged providing consumers with faster broadband connections. This project is closely monitored by the ACMA[58] and the Australian Competition & Consumer Commission (ACCC),[59] which has laid down several details and information to assist consumers in moving to the NBN network.[60]

Under this initiative, the ACCC provides details on 'Broadband Speeds' that helps consumers to select a broadband service based on its busy evening period performance. The ACCC has also issued 'Broadband Speed Advertisement' guidance,[61] which all service providers must mandatorily comply with.[62] A proactive and positive impact of these compliances, Aussie Broadband[63] started publishing its internal performance data (for last 24 hours) in the public domain to show when its NBN services are getting congested.[64]

4 Benefits and Challenges of Labels

Labelling is an important market and measurement tool that provides both consumers and industry several key benefits as summarised in the Table below:

Table 5: Key Benefits of Labels

Stakeholder	Benefits
Industry	• Ensures delivery of essential information • Helps in benchmarking with competitors • Acts as a means to justify price tag
Consumer	• Encourages to make an informed decision on product/service purchase • Product/service usage and safety information

Box 4: Case Study: Energy Saving Standards & Labelling Programme

In 2006, the BEE introduced the Standards & Labelling (S&L) Programme, which rated energy efficiency of several electrical equipment and appliances using star labels. The objective of the programme was to equip consumers with substantial information on these products and enabling them to make an informed choice on efficiency and energy saving. The programme's intention was to reduce the nation's overall energy consumption without diminishing the utility of such products for consumers.

Currently, the S&L scheme covers 21 equipment's, out of which four are mandatory and 17 are covered under voluntary scheme. According to BEE, the scheme successfully achieved the following benefits:

- It created a positive impact among consumers to purchase energy efficient equipment through a structured awareness programme;
- Market transformation occurred from non-energy efficient products to energy efficient products; and
- It resulted in reduction of capacity generation by 7766MW in the Planning Commission's 11th Five-Year Plan for the country.

With consistent efforts, BEE is bringing more equipment from the voluntary stage to mandatory stage. The *US Agency for International Development* (USAID) had collaborated with the Ministry of Power and the Bureau of Indian Standards (BIS) to research the design and effectiveness of the star label. The

USAID stated that this label design process was an excellent example of how to develop a relevant national energy label and utilise considerable consumer sand stakeholder input.

Since BEE enjoys significant credibility among stakeholders, they showed significant interest in this S&L programme. Reports indicate that several major appliance manufacturers participated in the programme and continue to do so. In its Annual Report for 2007-2008, BEE noted that 80 percent of refrigerator manufacturers, 90 percent of tube light manufacturers, and 80 percent of air conditioner manufacturers participated in the programme. Studies carried out by BEE found that between 2009 and 2010, 4.4 billion kWhs of electricity was saved on account of the programme, and that between 2006 and 2011, the programme helped avoid 4,898 MW of new generation capacity addition.[65]

Effective outreach and awareness building have proven critical to the success of S&L programme in India. Involvement of several voluntary consumer organisations in the programme created remarkable positive impacts, particularly on consumer awareness. A World Resource Institute study observed that participatory decision-making not only improves final decision of consumers, but also builds their awareness and develops valuable knowledge and skill on a specific issue.[66]

As seen in the previous sections, broadband labels have the ability to offer several benefits for consumers and service providers, some of which are captured in Table 5.

Table 6: Key Benefits of Broadband Labels

Stakeholder	Benefits
TSPs/ISPs	• Provides a platform to showcase better QoS & QoE numbers than competition • Ensures compliance to regulations and creates a positive image • Increases positive competition and transparency in the broadband internet ecosystem
Consumers	• Raises awareness on the nuances of broadband internet services • Standard and simple information would assist in comparison, identify value-for-money features and lead to better decisions based on usage habits.

Challenges

As stated previously, of the total internet subscribers in India today, close to 95 percent are accessing the internet through wireless mode. In other words, 3G/4G mobile broadband is the prominent ways to access Internet in India, which is assisted by growth in penetration of smartphones. Given this scenario, development and implementation of broadband labels is very critical so as to protect consumer interest. However, there are several challenges related to the adoption of such labels:

1. Capacity & Awareness: There is lack of capacity and awareness on such a mechanism among decision makers, policymakers, CSOs, TSPs/ISPs and individual consumers.

2. Compliance Mechanism: The current compliance mechanism, for ensuring better QoS of wireless data, is being implemented and governed by the TRAI through its six regional offices across the country. Considering the scale and magnitude of

broadband Internet services and its ever-increasing consumers, this mechanism is unable to address QoS and QoE challenges. As seen in the previous chapter, current global experiences suggest that 'Codes of Conduct' – either mandatory or voluntary – have failed to improve consumer satisfaction, while also burdening the TSPs/ISPs with increased compliances.

3. Label Information: Current information disclosure guidelines have been insufficient in making consumers more informed and resolving their grievances. A major reason for this information asymmetry has been the ever-complex language and terms used, without much efforts on capacity building. Moreover, with absence of awareness and compliances, some TSPs/ISPs may intentionally misrepresent broadband Internet service performance in order to bolster profits. What information goes into a broadband label? Who takes this decision? How to embrace future technologies and innovation? How to make these labels accessible to stakeholders? These questions need speedy and definite resolution to move ahead.

4. Opaque & Delayed Policies: This has been a major challenge for many years. Vagueness and delays in critical policies and initiatives, such as the Right of Way Rules,[67] the BharatNet Project,[68] revision of existing QoS regulations 2012,[69] cable broadband penetration,[70] high spectrum pricing,[71] etc. have further dented the 'Ease of Doing Business' efforts for the telecom sector and overall broadband Internet service performance of the country. This has pushed the telecom sector in substantial financial stress since last three years, with no immediate respite in the near term.

5. Poor Connectivity: The above-mentioned delays, coupled with multiplicity of authorities in most infrastructure-related departments in India at national and sub-national levels, have led to significant gap in providing seamless connectivity to Indian consumers, especially those present in rural areas and difficult terrains, such as forests, deserts, hills, islands, international borders, etc.

6. Network Dynamics: Considering the wireless Internet usage base, which accesses internet in various dynamic environments, such as indoors, outdoors, while travelling, the mobile broadband network would throw different performance metrics for the same consumer in each of these environments.

7. Inclusivity: A label may only present the most common parameters of a broadband internet service that a consumer may consider. This goes against the label's inclusivity as it may omit some attributes that are suitable for a particular consumer category.

8. Methodology Robustness: With most consumers using mobile broadband Internet, the methodology behind developing labels would need to ensure that they are able to capture QoS and QoE parameters in 'dynamic' conditions, such as in-building, in-flight, on-road, national/international roaming, highly secured locations, international border areas, rural and hilly regions with low network coverage. Currently, there is less capacity to build such a robust methodology. The TRAI MySpeed mobile application is also plagued with this issue, as it relies solely on crowdsourcing framework to gather usage data from smartphones, which is not robust and may be misrepresented.

9. Lack of Frugal Innovation: There seems to be over-dependence by the TRAI and the DoT on TSPs/ISPs alone to improve the existing QoS and QoE of broadband Internet services in India. The ICT start-up ecosystem is currently left out of the current discourses and scope of stakeholder community.

10. Current QoS Reporting of Wireless Data Performance: This quarterly reporting[72] includes only eight parameters to measure QoS performance of wireless data, covers the 22 telecom circles but not specific locations or cities, focusses only on outdoor network performance, and is uploaded on the TRAI website in PDF format using English language. Such an approach has not been successful in improving consumer awareness and/or QoS of mobile broadband, even with nearly 95 percent user base.

11. The 'Technology Disruption' Argument: The telecom sector's wireless data segment has recently experienced technology disruption with the advent of Reliance Jio in 2015 as the sole TSP using Voice over Long-Term Evolution (VoLTE) technology for mobile services. Further disruption in this segment is expected through the BharatNet WiFi network,[73] increasing accessibility for more consumers in the rural region of the country. The TRAI is also facilitating this disruption by running WiFi pilot projects[74] to improve internet access. While such disruptions have been applauded by consumers, the fundamental issue of quality remains to be addressed. As seen in 2G/3G services also, once there is a surge in subscriber numbers and usage, network performance begins to degrade leading to bad QoS and QoE. Hence, arguments for technology disruption and light-touch regulations are quite prominent in public forums, assurance and strict adherence to achieving QoS and QoE performance seem to be missing.

5 Conclusion & Recommendations

The TRAI has given directions as well as taken initiatives to enhance transparency and empower consumers with respect to information disclosure for broadband services. The TRAI also initiated a public consultation in June 2017, entitled, 'Data Speed under Wireless Broadband Plans', to explore the possibility of speed governance and information disclosure of wireless data speeds of broadband Internet services, and whether services should have a standard label to empower consumer choice and increase their awareness.[75] But much more ground needs to be covered, with cohesive efforts, to create more impact.

To facilitate this consultation process and the research agenda, CUTS International and its regional partners organised seminars and FGDs across the country,[76] which were well-attended by relevant stakeholders, including consumers. These interactions revealed that most consumers appreciated the utility of broadband labels and demanded several parameters, such as reliability, coverage information, QoS metrics at city-levels, as additions to the proposed prototype labels (as shown in Annexure I). During these discussions, it was also realised that most consumers were unaware of key information on network performance, such as bandwidth and latency, and compared a broadband internet service purely on price per gigabytes (GB).

Together, the regulator, the broadband industry, CSOs, academia and other stakeholders have started to engage and discuss the subject through this consultation process. However, insufficient consumer awareness and poor infrastructural development within the broadband sector are primary roadblocks for India to come up with strong disclosure statements, such as in Australia, UK or US.

Therefore, there is an urgent need to raise awareness and build capacity across the stakeholder communities, to propel the development of a standard disclosure mechanism as well as labels for broadband services. Once a sustained increase in awareness and

subsequent demand from consumers is generated, it is expected that TSPs/ISPs would voluntarily create such tools to showcase their strengths on QoS and QoE, as compared to competition. In the long run, this would inspire a change in the behaviour of TSPs/ISPs, who will certainly see the value and demand for such a practice.

However, ensuring the right mix of stakeholder representation in such activities would be fundamental. It is hoped that details covered in this Research Report would serve as an informative resource and help stakeholders in India to move forward, with firm steps, in defining contours of the safe harbour in greater detail. Furthermore, it is anticipated that related existing and future activities will ultimately empower broadband Internet consumers in India and, perhaps in turn, spur more competition in the broadband Internet market.

Recommendations

1. Capacity-Building of CSOs: CSOs should be thoroughly sensitised on the subject as most of them lack the capacity to understand the complexity and technicality of broadband services, as they will be eventually advocating with regulators and educating consumers. In US, strong pressure from a think tank forced the FCC to come up with a model label, despite stiff resistance from TSPs/ISPs. Academia and prominent technical institutions would also play a critical role in enhancing the capacity and knowledge of CSOs.

2. Awareness Campaigns: There would be a need for a concrete and coordinated effort for an awareness campaign once a broadband label is developed. All relevant stakeholders in the value chain – decision makers, policymakers, TSPs/ISPs and CSOs – must equally and consistently contribute towards efficient and effective implementation of these campaigns. The TRAI has already created an outreach web page, which may be harnessed for such awareness campaigns.

3. Compliance Mechanism: Effective monitoring system must be adopted for this labelling programme to succeed. An effective institutional structure must be designed to include national, state and local administration for speed governance, implementation, inspections and overall compliance. Also, a continuous evolution of standards, prescribed in labels and information disclosure, would be required to keep up with development and innovation of technology needs.

4. Label Information: Broadband labels that provide highly technical, trivial or irrelevant data information do nothing to help improve consumer's knowledge. Ambiguous and vague terms such as 'up to' must be completely avoided. When claims are used consumers will become confused, discouraged, and sceptical. These labels need to be designed in a way to display complete information in a standard and simple format that may also adapt to local language requirements. Use of visuals, icons and voiceover instead of text, would have a greater impact on various sections of the society, including the specially-abled, and enable them to have equal access to such labels.

5. Placement of Labels: Such broadband labels may be mandated to be placed on the TSP/ISP's website, TRAI's consumer outreach website and MySpeed app, at the point of sale in TSP/ISP outlets as well as third-party multi-brand retail stores and shops, on monthly bills and notifications sent to consumers, etc. Such labels may also be pre-loaded through a mobile app on Internet-enabled computing devices sold within India. While the primary label may remain dynamic to maintain accessibility on devices, the same label may be developed in static form – posters, hand-outs, etc. – periodically at multiple consumer touch points.

6. Inclusivity: Creation of various consumer profiles who access broadband Internet services, such as business professional, homemaker, student, gamer, tech entrepreneur, policy maker, service provider, etc. would aid in making different and more inclusive labels.

7. Phased Approach: Lessons could be taken from the BEE label design process, which is an excellent example of how to develop a national label and utilise considerable consumer and stakeholder input. BEE used a phased-approach mechanism to first implement Star labels on a voluntary basis, and once the sales of a particular appliance crossed 50 percent, labelling on that appliance was made mandatory. Similar approach to ensure active consumer adoption of broadband labels may be explored by the TRAI as a pilot project in few telecom circles to begin with.

8. The NDCP 2018:[77] The policy, expected to be announced in July 2018, provides an excellent opportunity to all stakeholders to focus on QoS[78] and work cohesively[79] to ensure efficient implementation and streamlining of various initiatives. The policy also aims to include other technologies, such as satellite communications, start-ups, etc. in improving connectivity, network performance and providing more clarity to TSPs/ISPs.

9. Innovative Tools: Currently, the TRAI's MySpeed App measures QoS & QoE in terms of the speed only. There is a need for an application/website that gauges broadband internet services on a number of QoS & QoE parameters. Such tool will help consumers in determining the delivered QoS & QoE levels. Such an app/website would need to be integrated to a mechanism that regularly monitor the measurement of network data and associated QoS metrics. Start-ups, MSMEs and other third-party application developers may be incentivised to work in tandem with TSPs/ISPs and contribute in this monitoring exercise providing support on measuring 'dynamic' parameters, such as power and memory of end user devices, network congestion, spectrum shortage and range limitations of access networks and backhaul bandwidth constraints, etc.

10. Frugal Tools: While innovation will surely benefit in ensuring robustness, it is also important that the developed applications are certified in the Indian context. This would help developers to be more aware of limitations and constraints of Indian telecom networks while building and optimising these apps. Emphasis should also be laid on removing any related bottlenecks so as to enable 'frugal development' of apps that enhance the broadband labels and the overall information disclosure mechanism.

11. Amendments to existing QoS Regulations: The current QoS reporting and disclosure mechanisms governed by the TRAI (covered in Section 2 above), do not take into account many critical QoS and QoE parameters, which are readily available with TSPs/ISPs. Hence, it is crucial for such reporting to be more granular and include as many available parameters as possible. It is a known fact that TSPs/ISPs conduct their own tests to check network performance, while the TRAI also conducts independent drive tests at various locations. However, both tests must also gauge metrics, such as handover of IRAT frequency, which significantly impact the utility and may be further improved through better configuration. Instead of aiming for 'averages', these tests must assess the diversity of network performance to get better sense. Doing these tests in more locations will also factor in the redundancy, in case other networks malfunction. Such amendments would immensely benefit the regulator in getting a better sense of the variation in performance across different locations.

Annexure I

Proposed Broadband Labels for India

By CUTS International and IIT Delhi

CONSUMER BROADBAND LABEL

QoS Parameters	Download	Upload
Max Speed	1.8 Mbps	1.2 Mbps
Average Speed	1.2 Mbps	1.0 Mbps
Latency	32ms	
Availability	89%	75%
DNS delay	289ms	
Stability: Mean Time Between Switch	2.1s	3.5s

Service quality	Assessment
Activation time	10 hours max, 3.5 hours avg
Coverage	Bihar - Overall: 75% - Rural: 56% - Urban: 89% National: 18/22 circles
Performance improvement over last year	Speed: ++ (25%) Latency: No change Stability: - (10%) Coverage: +++ (50%)

Network improvement practices	
Content Delivery Networks	Enhanced performance for Facebook, Youtube
Data compression proxies	Ad blocker, image compression
Available capacity for new users	65% utilization
Goals for 2017	Coverage inc. to 95% Avg. speed to 1.5Mbps

CONSUMER BROADBAND LABEL

QoE Parameter	Download (in Mbps)	Upload (in Mbps)
Max Speed	1.8	1.2
Average Speed	1.2	1.0
Social networking	★★★★☆	
Video streaming	★★★★★	
HD video	★☆☆☆☆	
Mapping apps	★★★☆☆	
Web browsing	★★★★☆	
Messaging apps	★★★☆☆	
Voice calling	★★★★★	

Data pricing	Limit	Upgrade
Rs 100/pm	1 GB	5p / MB
Rs 200/pm	2 GB	5p / MB

Guidance notes:
- Choose a plan based on your needs
- 5min of Youtube streaming @ 240p will consume 15MB of data
- 5min of Facebook browsing will consume XXX of data
- Example: With a 1GB plan, you can watch 30 Youtube videos of 5min each, and spend XXX minutes on Facebook

Annexure II

Impact of QoS on QoE[80]

1. QoE of Popular Services and Applications

Global adoption of mobile devices has created an unprecedented demand for access to e-commerce, social media and entertainment applications. This has not only increased the amount of mobile broadband traffic transported by carrier networks, but also transformed its composition; mobile traffic that was traditionally voice-only is now dominated by video and data owing to applications like video streaming, Facebook, Twitter and mobile browsing. This trend continues to increase as variety and number of applications and services increase, with growing subscriber-base.

In light of these trends, network operators need to configure and provision their networks in a way that provides a satisfactory and competitive end-user experience for a diverse set of applications. The concept of QoE, therefore, presents a new guiding paradigm for managing quality in cellular networks, because it allows operators to gain insight into contribution of the network's performance to overall level of customer satisfaction for different kinds of applications.

In order to deliver a high QoE, it is important to know the network parameters that contribute to user's perception of quality. For example, video streaming applications, such as YouTube are bandwidth intensive, file sharing with Whatsapp requires high speed connection whereas interactive applications, such as Skype, Facebook, and Google Maps are highly sensitive to network delay and delay variations.

This note presents secondary research results obtained from lab tests and field trials that show the relationship between QoE and QoS for different kinds of applications. The results presented in this note provide a sound basis for a better understanding of the QoS requirements of popular services and mobile apps, and how these translate into QoE for users.

2. Impact of Bandwidth on the QoE of Popular Applications

This section presents the QoE of popular applications measured against various constant download bandwidth (BW) conditions. The results presented in this section are taken from the study conducted by P.Casas, et al in.[1] QoE values were obtained by conducting subjective tests in controlled laboratory environment. Different constant bandwidth profiles were defined using NetEm emulator. Field trials were also done in the city of Vienna to obtain the QoE values in actual operational networks. The laboratory test results were then compared to field trial measurements. It was shown that laboratory results were highly applicable to real networks. The results of their study are presented below:

QoE of YouTube

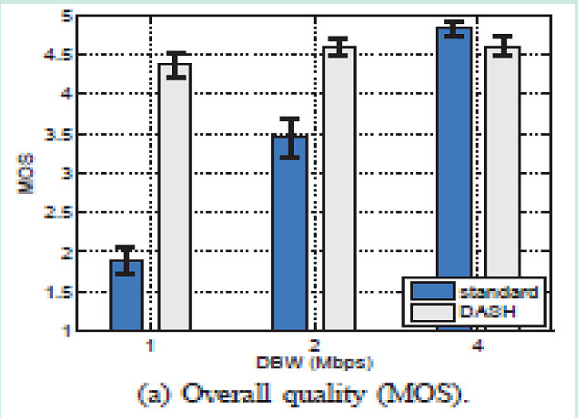
Two versions of YouTube video streaming were considered the following:

1) Standard: Fixed HD video quality is used.
2) Dynamic Adaptive Streaming (DASH): Videos are requested in HD quality, but the server adapts the subsequent video quality resolutions to the BW estimated by player)

YouTube QoE Mean Opinion Scores (MOS) were measured for a Downlink Bandwidth of 1, 2 and 4 Mbps.

For Standard Case (Fixed HD)

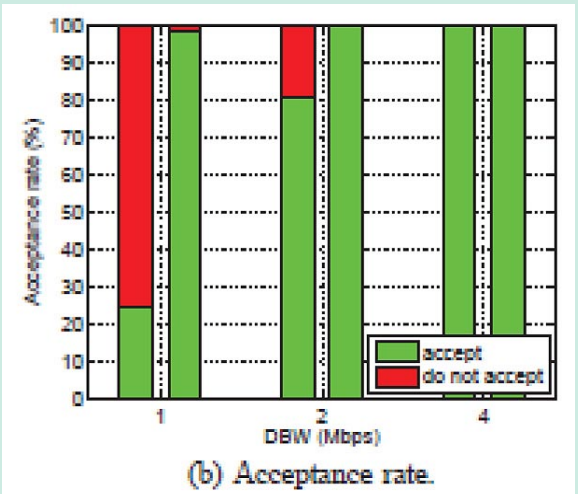
1) Poor QoE below 4 Mbps
2) 1 mbps Heavy stalling occurs
3) 2 mbps-Some stalling occurs



(a) Overall quality (MOS).

For DASH version

1) Resulted in near optimal QoE for all cases
2) No stalling seemed to occur
3) Quality switches induced by DASH do have an important impact on QoE. However, in case of Smartphone, smaller screen size does not affect user perception

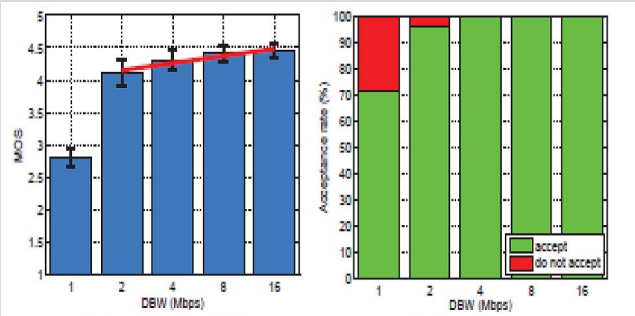


(b) Acceptance rate.

QoE of Google Maps

Google Maps QoE (MOS) measured for Downlink Bandwidth of 1, 2, 4, 8 and 16 Mbps

1) 4 Mbps ~ resulted in near optimal QoE (4.3 MOS)
2) 2 Mbps ~ provided good enough quality and almost full acceptance (4.1 MOS)
3) 1 Mbps ~ gives poor user experience

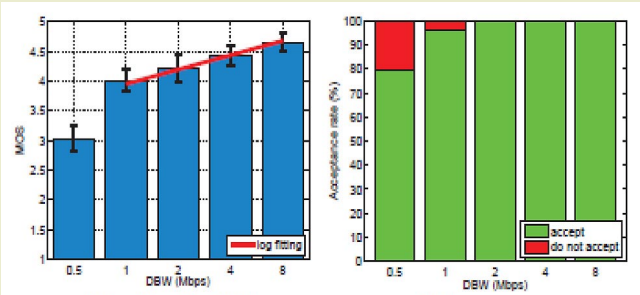


(a) Overall quality (MOS). (b) Acceptance rate.

QoE of Facebook

Facebook QoE (MOS) measured for Downlink Bandwidth of 0.5, 1, 2, 4 and 8 Mbps

1) 2 Mbps ~ full acceptance (very good QoE ~ 4.2 MOS)
2) 1 Mbps ~ almost full acceptance (good enough ~ 4MOS)
3) 500 kbps ~ not high enough to reach full user acceptance - 80 % acceptance (fair ~ 3 MOS)

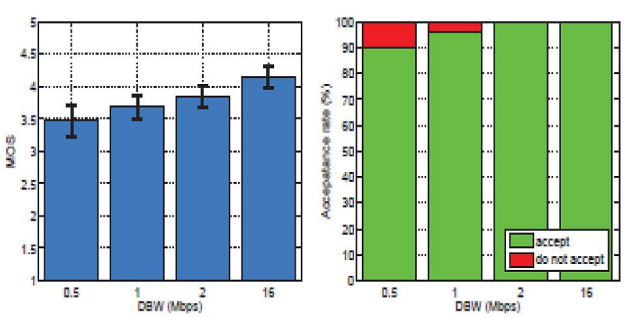


(a) Overall quality (MOS). (b) Acceptance rate.

QoE of Web Browsing

Web Browsing QoE (MOS) measured for Downlink Bandwidth of 0.5, 1, 2 and 16 Mbps

1) 2Mbps ~ Good experience (4 MOS approximately)
2) Above 2 Mbps only slight difference (4.15 MOS)
3) Even Slowest tested condition had MOS 3.5 and 90% acceptance rate.

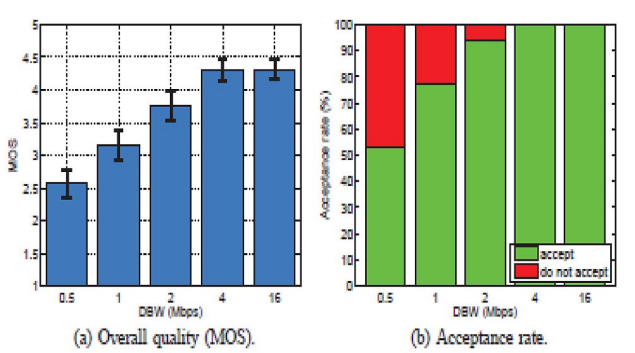


(a) Overall quality (MOS). (b) Acceptance rate.

QoE of Whatsapp

Whatsapp QoE (MOS) measured for Downlink Bandwidth of 0.5, 1, 2, 4 and 16 Mbps

1) 4Mbps ~ Near optimal QoE (~4.3 MOS)
2) 2Mbps ~ Good Experience and high acceptability (3.7 MOS)
3) Below 2Mbps QoE degrades, very poor for 500 Kbps



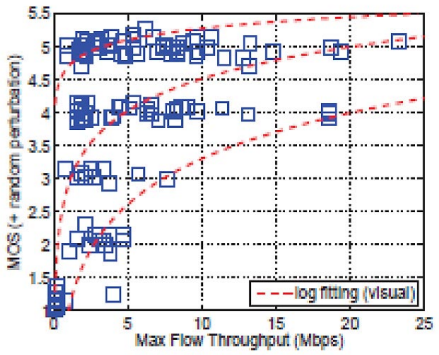
(a) Overall quality (MOS). (b) Acceptance rate.

3. Field Trial Results: QoE for Facebook, YouTube and Google Maps

Similar tests were performed in city of Vienna where all ISPs had good network coverage. The participants logged their QoE feedback on an android-based application designed specifically for this purpose. The curves of MOS measured against mean flow throughput (MFT) of session are presented below:

QoE of YouTube

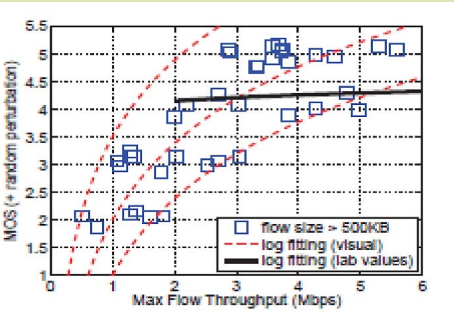
1) MFT >5Mbps ~ Good QoE (MOS>4)
2) MFT between 1-4Mbps ~ Fair (MOS between 2-5)
3) low MFT ~ Poor QoE (MOS 1)
4) Logarithmic relationship observed between MFT & QoE
5) The results are very similar to ones observed during laboratory study.



(a) YouTube QoE vs. MFT.

QoE of Google Maps

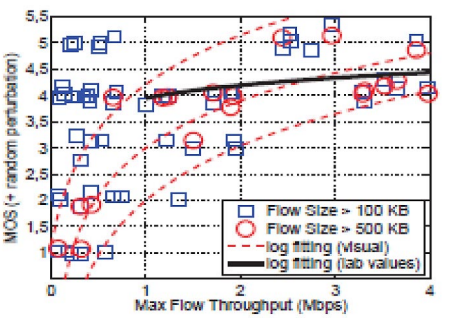
1) MFT >2Mbps ~ Good QoE (MOS>4)
2) MFT <1 Mbps ~ QoE rapidly degrades
3) Logarithmic relationship observed between MFT and QoE
4) The results are aligned with MOS and DBW curves obtained in the lab study.



(b) Gmaps QoE vs. MFT.

QoE of Facebook

1) MFT >1Mbps ~ Good QoE (MOS>4)
2) MFT <0.5Mbps ~ Poor QoE (MOS 1 or 2)
3) Logarithmic relationship observed between MFT and QoE.
4) The results are aligned with MOS and DBW curves obtained in the lab study.



(c) Facebook QoE vs. MFT.

The obtained results suggest that a downlink bandwidth of 4 Mbps is good enough to reach near optimal results in terms of overall quality and acceptability for YouTube when accessed in smartphones. This threshold drops to 2 Mbps and 1 Mbps for Google Maps and Facebook apps respectively. As a consequence, network operators should target such downlink bandwidth thresholds for provisioning their access networks. Given these requirements, resources could be re-allocated or scheduled to manage the network more efficiently while avoiding over-provisioning and maintaining high QoE.

4. Impact of Bandwidth Fluctuation and Outages on QoE

While download speed or throughput are the most widely used and accepted metrics for measuring network performance, their average values fail to capture transient network behaviours. The main limitation of quantifying performance indicators in terms of averages is that it assumes that QoE and user perception are influenced by average stimulus and not volatile and transient network conditions.

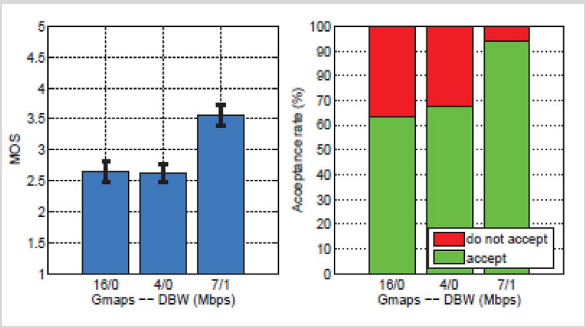
In the case of mobile networks, bandwidth variations are common due to radio access technology handovers, interference, and dynamic cell load. Throughput fluctuates as a consequence of these bandwidth variations. Some of the applications are highly sensitive to these throughput fluctuations like interactive applications, such as web browsing, video and voice calling suffer more from such fluctuations, but there is no significant impact in the case of file transfers.

The above fact has been shown by P .Casas, et al.[2] The impact of throughput fluctuations and outages on QoE was studied for the case of popular mobile applications, such as Google Maps, YouTube, and Web browsing.

Tests were conducted for given BW fluctuation profiles, but keeping a fixed average download bandwidth (ADW). Results of their study are given in the Table below.
Profile 1: 1/3 –periodic increase from 1 Mbps to 3 Mbps. {ADW 1.5 Mbps}
Profile 2: 4/0 – periodic drop from 4 Mbps to 0 Mbps. {ADW 2 Mbps}
Profile 3: 7/1 – periodic drop from 7 mbps to 1 Mbps. {ADW 4 Mbps}
Profile 4: 16/0 – periodic drop from 16 Mbps to 0 Mbps. {ADW 8 Mbps}

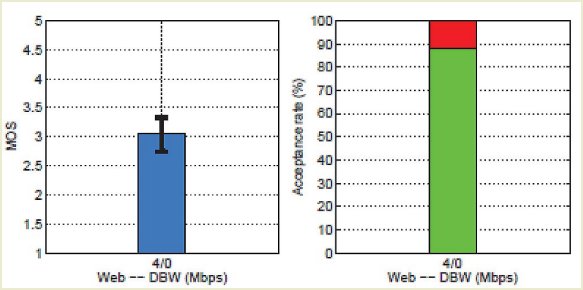
Impact of DBW fluctuation on QoE of Google Maps

1) Tested with 16/0 (ADW-8Mbps) and 4/0 (ADW-2Mbps) outage profiles.
2) These profiles caused a very strong QoE degradation (MOS ~2.6, acceptance rate 65%
3) Quality degradation caused by 7/1 (ADW 4Mbps) is very much noticeable. (MOS 3.5)
4) Contrast with constant DBW case – Constant 2Mbps case Google Maps resulted in near optimal QoE(MOS>4)



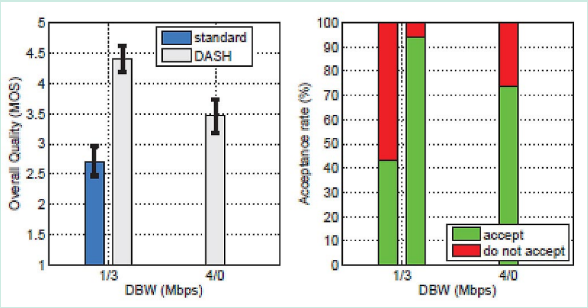
Impact of DBW fluctuation on QoE of web browsing

1) Tested with 4/0 profile (ADW- 2Mbps)
2) Fluctuation profile resulted in much degraded performance (as compared to constant 2 Mbps case).
3) Acceptance rate dropped down in fluctuation case.
4) Impact of outage was less strong in case of web browsing (less interactive application).



Impact of DBW fluctuation on QoE of YouTube

1) YouTube DASH*version was tested with 4/0 profile (ADW-2Mbps).
2) DASH version kept offering good results.
3) However acceptance rate slightly dropped (as compared to constant 1Mbps case) probably due to additional quality switches triggered by fluctuations.
4) As far as bandwidth outage is concerned (0 Mbps for 10 second), DASH version too suffered from QoE degradations (probably due to absence of pre-emptive caching).



These findings have four major implications for the cellular network operators: First, it showed that faster and more responsive cellular networks should not be the only guidelines to be accounted for when designing and provisioning networks, but stability in terms of bandwidth should be a concern as well; Second, when it comes to monitoring and measuring throughput in today's cellular networks, operators should realise that traditional Key Performance Indicators (KPIs) based on average throughput are not as informative as have been assumed so far, and that operators should evolve their monitoring systems to capture such fluctuations. Third, even short-duration bandwidth outages (i.e. drops to 0 Mbps for some milliseconds) have a major negative impact on end-user experience. Fourth, higher peak download bandwidth does not compensate for impact of outages.

5. Going from QoS to QoE

Quantifying the QoE-QoS relationship is extremely important. A great deal of research is geared in particular towards identifying the correlation between individual QoS parameters and QoE. The following Table gives an overview of generic relationships that have been extensively studied in literature.

Linear	$QoE \propto QoS_i$
Logarithmic	$QoE \propto \log(QoS_i)$
Exponential	$\log(QoE) \propto QoS_i$
Power	$\log(QoE) \propto \log(QoS_i)$

M. Fiedler, et al[3] presented fundamental relationships between QoE and QoS, formulating partial differential equations to describe changes in QoE with respect to specic QoS parameters. According to Fiedler, user-centric approach towards modelling QoS-QoE correlation leads to an exponential relationship (IQX hypothesis) between QoE and QoS. The next section gives an overview of QoE requirements of various types of services.

QoE of Video

Video streaming applications, such as YouTube are widely used in delivering stored multimedia content. Unlike other User Datagram Protocol (UDP) based services, these applications make use of Hyper Text Transfer Protocol (HTTP) over Transmission Control Protocol (TCP) for streaming videos. The reliability of TCP ensures that the video quality is not degraded due to packet loss and reordering. However, these network impairments may result in reduced throughput and if throughput falls below the playback rate, the video playback

gets paused, resulting in stalling. Network delays due to congestion may also lead to stalling events that may degrade QoE to a great extent. QoE of such applications primarily depends on the initial buffering delay, duration of stall events and frequency of stalls. Indeed, QoE exhibits exponential dependence on frequency of stall events.

A study conducted by R.K.P Mok, et al[4] showed that packet loss rate and packet delay are dominating factors affecting video QoE. Their findings suggested that throughput is lowered by packet losses and Round-trip Time (RTT), thus increasing the re-buffering frequency, the main factor responsible for MOS variance.

Another study was conducted by R Laghari, et al[5] for video streaming applications that are based on UDP. Packet loss has been shown to follow an exponential relationship with respect to human-perceived QoE. Their findings suggest that viewers are critically responsive to packet loss higher than 7 percent. Similarly, packet reordering ratio exhibits exponential interdependency with QoE. Video bit rates, on the other hand, have been shown to share a logarithmic relationship with QoE.

QoE for video conferencing applications is also influenced more by packet loss as compared to bit rate. QoE declines exponentially with increasing packet loss; where as it grows logarithmically with increasing bit rates. These results can serve as guidelines for obtaining more generic and application specific QoE from QoS parameters.

QoE of Audio/Speech

Voice over Internet Protocol (VoIP) telephony is emerging as a strong competitor to existing telephone networks. Studies have been done to investigate the impact of QoS parameters, such as network delay, packet loss, packet reorder and throughput on QoE. Apparently, QoE of VoIP applications is influenced more by packet loss as compared to encoding bit rate. It has been shown that for VoIP traffic, packet loss and packet reorder degrades QoE in an exponential manner.[6] Also, QoE degradation caused by increased packet loss is much higher than QoE degradation caused by reduced bandwidth which shares a logarithmic dependency with QoE.[7] This follows from the fact that applications, such as skype adapt themselves to lower bandwidth conditions by switching to appropriate codec in order to maximise its own QoE.

Network Delay and jitter have the utmost impact on interactive applications. As per the ITU-T Recommendation G.114, network delay from sender to receiver must be lower than 150ms to avoid loss of interaction between end-points in a conversation. In[8] the authors showed that the effects of packet jitter on the experience quality are similar to those of packet loss. This is because the packets that do not arrive on time are seen as lost information by the decoder at the destination. Consequently, these two have striking impact on QoE.

QoE of Web Applications

Web applications are becoming indispensable on both fixed and mobile networks. Web traffic contributes a major part to the overall Internet traffic.[9]

In contrast to the domains of audio and video quality, where psycho-acoustic and psycho-visual phenomena are dominant, end-user waiting time is a key determinant for Web QoE[10]. The longer users have to wait for the web page to load, the more dissatisfied they tend to become with the service. Studies have shown that Page Load Time (PLT) is the key parameter that governs the user Web QoE[11]. QoE drops remarkably as the page load time increases; and as PLT goes beyond 2 seconds, any further increase result in exponential decay in MOS.

In addition to the above factors the ease and smoothness of browsing depends on a range of factors. In particular, large packet delays or low bandwidth are well known to cause long loading times of objects and thus unacceptable

completion times of page views. Moreover, mobile broadband networks are susceptible to failures and transient outages; mostly due to mobility and configuration issues. Resource allocation related issues in high network load conditions further aggravate the problem and deteriorate the QoE. The transient failures result in ON and OFF phases giving rise to delays and increased waiting time for users.

A study conducted by R. Schatz, et al examined the impact of network downlink bandwidth on web QoE. The results showed that the network bandwidth shares a logarithmic relationship with QoE. The QoE ratings are fairly poor for very low downlink bandwidth conditions (32, 64 kbps), it rise logarithmically with increasing bandwidth and go into saturation (4.3 MOS) for high values of bandwidth.

Balachandran, et al[12] explored the influence of signal-to-noise (SNR), network load and Inter-Radio-Access Technology (IRAT) handovers on web QoE. Their results showed that Web QoE is very sensitive to IRAT handovers. They also showed that improving SNR, decreasing network load and reducing handovers can improve user experience. The findings further proved that very high radio data link rate does not necessarily lead to improvement in Web QoE.

The above results are in line with another study conducted by J. Sheikh, et al[13] which presented a correlation between user perceived QoE and network level QoS parameters including loss ratio, download time and throughput for web surfing services. The download time was shown to follow exponential relationship with QoE, while throughput and loss ratio were found to have logarithmic and linear relationships with QoE respectively.

QoE of Online Gaming Applications

The key property of online gaming applications is that they involve different types of multimedia, including audio, video and voice with multiple players in different locations. Typically, online games mostly use User Datagram Protocol (UDP) as the transport layer mechanism because of their stringent latency requirements. Gaming traffic is typically characterised by its high periodic nature between the clients and the server, so as to keep the clients synchronised and updated with the continuous changing state of the game.

Two quality factors that influence gaming experience the most are 'interactivity' and 'consistency'.

Interactivity refers to the responsiveness to actions from specific players. The QoS parameters that have greatest influence on interactivity include network end-to-end delay and jitter. The experiments conducted in[14] shows that jitter have higher influence than delay for first-person shooting type games.

Consistency has two broad components – temporal and spatial. Temporal consistency accounts for time synchronisation between different multimedia streams, while spatial consistency involves maintaining the same state in different player locations. This too is affected heavily by delay and jitter in the underlying network.

Impact of Content Delivery Networks (CDNs) on QoE

A large portion of today's traffic is hosted by CDNs that act as basic building blocks of today's Internet infrastructure. Most popular Internet services, such as YouTube and Facebook are backed by large CDN providers like Akamai and Google CDN. The basic goal of CDNs is to push data as close to the user as possible in order to improve overall performance and enhance QoE. Highly distributed server deployment and adaptability of CDNs allows them to achieve load balancing, reduced latency and high availability, however at the same time they pose important challenges to the ISPs.

A study presented by D. Alconzo, et al[15] revealed that cache selection policies used by CDNs may lead to large fluctuations in traffic volume. The unexpected load balancing events may cause the data to be carried through different network ISP paths and may result in additional transport cost to ISPs as well as service outages.

Further experiments done for the case of YouTube showed that the undesired cache selection and load balancing policies (employed by YouTube CDN) lead to a significant drop in average download throughput for end users watching YouTube videos. This effect had a strong impact on QoS experienced by users.

In the above study, transient server failures of Akamai CDN were shown to cause Facebook service outages as well. In the given scenario, standard network monitoring procedures used by service providers must be complemented with verification of the status of services being accessed by users.

5. Obtaining QoE from QoS Parameters in Mobile Networks

The studies presented above substantiate that QoE ratings can be obtained from QoS parameters. In order to translate network-centric QoS parameters to QoE, network-side passive measurements must be complemented with measurements obtained from UEs to capture the overall end-user experience. In such approaches, measurement agents might run on end-user devices and perform both active and passive measurements in real time. Collecting measurements from end-user side allows both user profiling and user-centric network planning, monitoring, provisioning and optimisation.

References

[1] Casas, Pedro, et al. "Next to you: Monitoring quality of experience in cellular networks from the end-devices." *IEEE Transactions on Network and Service Management* 13.2 (2016): 181-196.

[2] Casas, Pedro, et al. "On the quest for new KPIs in mobile networks: the impact of throughput fluctuations on QoE." *Communication Workshop (ICCW), 2015 IEEE International Conference on*. IEEE, 2015.

[3] Fiedler, Markus, and Tobias Hoßfeld. "Quality of experience-related differential equations and provisioning-delivery hysteresis." *21st ITC Specialist Seminar on Multimedia Applications-Traffic, Performance and QoE*. IEICE, 2010.

[4] Mok, Ricky KP, Edmond WW Chan, and Rocky KC Chang. "Measuring the quality of experience of HTTP video streaming." *Integrated Network Management (IM), 2011 IFIP/IEEE International Symposium on*. IEEE, 2011.

[5] Issa, Omneya, Filippo Speranza, and Tiago H. Falk. "Quality-of-experience perception for video streaming services: Preliminary subjective and objective results." *Signal & Information Processing Association Annual Summit and Conference (APSIPA ASC), 2012 Asia-Pacific*. IEEE, 2012.

[6] Fiedler, Markus, Tobias Hossfeld, and Phuoc Tran-Gia. "A generic quantitative relationship between quality of experience and quality of service." *IEEE Network* 24.2 (2010).

[7] Reichl, Peter, et al. "The logarithmic nature of QoE and the role of the Weber-Fechner law in QoE assessment." *Communications (ICC), 2010 IEEE International Conference on*. IEEE, 2010.

[8] Claypool, Mark, and Jonathan Tanner. "The effects of jitter on the perceptual quality of video." *Proceedings of the seventh ACM international conference on Multimedia (Part 2)*. ACM, 1999.

[9] Akamai's state of the internet, 2015 Akamai Technologies, Inc. https://www.akamai.com/us/en/multimedia/documents/secure/akamai-state-of-the-internet-report-q2-2013.pdf

[10] Hoßfeld, Tobias, et al. "The memory effect and its implications on Web QoE modelling." *Teletraffic Congress (ITC), 2011 23rd International*. IEEE, 2011.

[11] Egger, Sebastian, et al. "Waiting times in quality of experience for web based services." *Quality of Multimedia Experience (QoMEX), 2012 Fourth International Workshop on*. IEEE, 2012.

[12] Balachandran, Athula, et al. "Modelling web quality-of-experience on cellular networks." *Proceedings of the 20th annual international conference on Mobile computing and networking*. ACM, 2014.

[13] Shaikh, Junaid, Markus Fiedler, and Denis Collange. "Quality of experience from user and network perspectives." *annals of telecommunications-annales des telecommunications* 65.1-2 (2010): 47-57.

[14] Wattimena, A. F., et al. "Predicting the perceived quality of a first person shooter: The Quake IV G-model." *Proceedings of 5th ACM SIGCOMM workshop on Network and system support for games*. ACM, 2006.

[15] Fiadino, Pierdomenico, et al. "On the detection of network traffic anomalies in content delivery network services." *Teletraffic Congress (ITC), 2014 26th International*. IEEE, 2014.

Endnotes

1 The 'Consumer Broadband Labels' Project Website is accessible at: http://snip.ly/oh766

2 Does Broadband Bandwidth Variability Improve Quality of Life? Lessons from Sweden, Study is accessible at: http://snip.ly/pb0x8k

3 The Telecom Regulatory Authority of India Website, is accessible at: http://snip.ly/dd3vme

4 [i] Michael Minges, Exploring the Relationship between Broadband and Economic Growth, Background Paper, World Development Report 2016, is accessible at: http://snip.ly/xtxr0h [ii] Broadband and the Economy, Ministerial Background Report, DSTI/ICCP/IE (2007)3/Final, OECD, 2008, is accessible at: http://snip.ly/dxkh0n [iii] Christine Zhen et al, Economic Impacts of Broadband, Information and Communications for Development 2009, study is accessible at: http://snip.ly/1weiyi

5 Dr Raul Katz, The Impact of Broadband on the Economy, ITU, April 2012.The Report is accessible at: http://snip.ly/b9ptqj

6 *Ibid*

7 Kim Y, et al, Building broadband: Strategies and Policies for the Developing World, Global Information and Communication Technologies (GICT) Department, World Bank, January 2010, is accessible at: http://snip.ly/2scgto

8 Delivering Broadband Quickly: What do we need to do? Consultation Paper, Telecom Regulatory Authority of India, 2014, is accessible at: http://snip.ly/iavzmi

9 World Development Report 2016 – Digital Dividends, is accessible at: http://snip.ly/bntab8

10 *Ibid*

11 *Ibid*

12 *Ibid*

13 TRAI Annual Report 2016-17, is accessible at: http://snip.ly/cwls4g

14 The Draft National Digital Communications Policy, 2018, is accessible at: http://snip.ly/9q3qhe

15 To know more about the programme refer: http://snip.ly/dhpipa

16 *Gram Panchayat* means an institution of self-government for a village. There is a *Panchayat* for each village or a group of villages in case the population of these villages happens to be too small. The *Panchayat* chiefly consists of representatives elected by the people of the village.

17 Internet in India 2017 Report by Internet & Mobile Association of India (IAMAI) published in The Economic Times dated February 20, 2018, is accessible at: http://snip.ly/pu874k

18 White Paper on Broadband Regulations and Policy in Asia-Pacific Region, ITU, November 2016, is accessible at: http://snip.ly/3f05ic

19 State of the Internet, Akamai's, Q1 2017 Report, is accessible at: http://snip.ly/yb4i8t

20 Supra Note 12

21 Mobile Internet Services in India – Quality of Service, CUTS-IIT Delhi report, is accessible at: http://snip.ly/4fb1b

22 Vanishree et al, A Study on Customer Satisfaction towards Broadband Facilities Provided by BSNL with Special Reference to Palakkad Town, IJARIIE-ISSN(O)-2395-4396, Vol-1 Issue-3 2016, is accessible at: http://snip.ly/jsogzy

23 Assessment of Customer Perception of Service performed by Cellular Mobile Telephone Service Providers, TRAI Report, is accessible at: http://snip.ly/rachqo

24 Consumers Handbook on Telecommunications, Telecom Regulatory Authority of India, 2015, is accessible at: http://snip.ly/2b254a

25 *Ibid*

26 The Standards of Quality Of Service For Wireless Data Services (Amendment) Regulations, 2014, TRAI, is accessible at: http://snip.ly/6nc3wk

27 Quarterly Performance Reports on QoS of Wireless Data Services, TRAI, are accessible at: http://snip.ly/a5ksco

28 TRAI MySpeed Mobile Application is accessible at: http://snip.ly/1ortmy

29 TRAI MySpeed Analytics Portal is accessible at: http://snip.ly/b0mjnv

30 TRAI Tariff Portal is accessible at: http://snip.ly/qxywe6

31 TRAI Network Coverage Map Portal is accessible at: http://snip.ly/58q92q

32 Misbah E, Samreenlodhi, Brand Packaging and Consumer Buying Behaviour: A Case of FMCG Products, International Journal of Scientific and Research Publications, Volume 5, Issue 11, November 2015 paper is accessible at: http://snip.ly/39txe2

33 Broadband Truth-in-labelling, Open Technology Initiative, accessible at: http://snip.ly/k5rbjt

34 Jeremy Malcolm (ed.): Consumers in the Information Society: Access, Fairness and Representation, Consumers International, 2012, pp. 75-90, is accessible at: http://snip.ly/ea5hi2

35 Open Internet Label Study, Transparency Working Group, Federal Communications Commission, August 20, 2013, is accessible at: http://snip.ly/0qvq1g

36 FCC website is accessible at: http://snip.ly/z85ek5

37 Connecting America - National Broadband Plan, FCC, 2010, is accessible at: http://snip.ly/rxp8yv

38 Open Internet Label Study Transparency Working Group, Released August 20, 2013, is accessible at: http://snip.ly/s7ijpe

39 FCC's new 'nutrition labels' for broadband services leave out a few ingredients. April 05, 2016, is accessible at: http://snip.ly/rjmesy

40 Broadband Nutrition Facts Label, is accessible at: http://snip.ly/rxx1mb

41 'FCC Fixed Broadband Deployment Map' is accessible at: http://snip.ly/zsc1i8

42 'FCC Speed Test Mobile Application' is accessible at: http://snip.ly/1bmhbu

43 'West Virginia Speed Test Portal' is accessible at: http://snip.ly/hfiwd8

44 The Register Herald news story dated November 01, 2017, is accessible at: http://snip.ly/5e01ie

45 Ofcom Website is accessible at: http://snip.ly/levqa5

46 Ofcom Codes of Practice is accessible at: http://snip.ly/8ezlya

47 Ofcom New Codes of Practices, accessible at: http://snip.ly/i53hcn

48 Which? News story dated November 10, 2017 is accessible at: http://snip.ly/2h59u0

49 The Scottish Farmer news story dated May 30, 2018 is accessible at: http://snip.ly/ftcue

50 The Guardian news story dated November 23, 2017 is accessible at: http://snip.ly/0yl7vy

51 IMDA Website is accessible at: http://snip.ly/mjqhyg/

52 IMDA Information Paper: Publication Requirement for All Internet Service Provider, is accessible at: http://snip.ly/ozdlby

53 IMDA IMConnected Mobile Application is accessible at: http://snip.ly/gff2a7

54 OpenGovAsia News Article dated June 12, 2018, is accessible at: http://snip.ly/uleysv

55 ACMA Website is accessible at: http://snip.ly/ie27hi

56 ACMA TCP Code is accessible at: http://snip.ly/0cq0u7

57 More information on National Broadband Network is accessible at: http://snip.ly/84ahji

58 'ACMA Improving the NBN consumer experience' is accessible at: http://snip.ly/8sajfe

59 ACCC Website is accessible at: http://snip.ly/4q4clp

60 'ACCC Moving to the NBN for Consumers' is accessible at: http://snip.ly/efo4id

61 'ACCC Broadband Speeds' notes are accessible at: http://snip.ly/avicda

62 The Sydney Morning Herald news story dated August 21, 2017, is accessible at: http://snip.ly/gj1afb

63 Aussie Broadband Website is accessible at: http://snip.ly/91tlxc

64 The Sydney Morning Herald news story dated March 19, 2018, is accessible at: http://snip.ly/697tn4

65 BEE website is accessible at: http://snip.ly/paxpjy

66 Bharath Jairaj et al., Strengthening Governance of India's Appliance Efficiency Standards and Labelling Programme, Issue Brief, World Resources Institute, is accessible at: http://snip.ly/wtl1ak

67 The Economic Times news story dated August 07, 2017 is accessible at: http://snip.ly/r2a6yl

68 The Hindu news story dated July 19, 2017 is accessible at: http://snip.ly/mp0cgp

69 The Livemint opinion story dated October 30, 2017 is accessible at: http://snip.ly/m823a5

70 The Hindu Business Line opinion story dated April 08, 2018 is accessible at: http://snip.ly/gj7ob4

71 The Economic Times news story dated February 27, 2018 is accessible at: http://snip.ly/g9h7pq

72 Supra Note 23

73 The Economic Times news story dated May 27, 2018 is accessible at <http://snip.ly/tke0v4>

74 TRAI WiFi Pilot Projects details are accessible at <http://snip.ly/te00j9>

75 The TRAI Consultation on 'Data Speed under Wireless Broadband Plans', is accessible at: http://snip.ly/zaysy0

76 The 'Consumer Broadband Labels' Project Website is accessible at: http://snip.ly/oh766

77 Supra Note 13

78 The Hindu Business Line opinion story dated March 19, 2018 is accessible at: http://snip.ly/hv4uzf

79 The Communications Today opinion story published in May 2018 is accessible at: http://snip.ly/3jk9e4

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