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Via Electronic Submission

Mr. Asit Kadayan
Mahanagar Door Sanchar Bhawan,
J.L. Nehru Marg, (Old Minto Road)
New Delhi - 110002, India

Re: TRAI Consultation Paper on Net Neutrality

Dear Mr. Kadayan,

Measurement Lab (M-Lab) submits this letter in order to express its support for the Telecom Regulatory Authority of India (TRAI) in its efforts to promote public transparency on broadband access. M-Lab is an international consortium of research, industry, and public interest partners dedicated to providing an ecosystem for the open, verifiable measurement of global Internet performance. The platform began as a pilot project to improve data collection, analysis, and research on broadband in response to early debates over content blocking. Our experience as a partner to national regulatory agencies (NRAs) around the world, including in several countries discussed within the Consultation Paper, has demonstrated that transparent and reproducible measurement of broadband access is critical to ensuring a healthy Internet that serves as an engine of innovation.

M-Lab was founded on the principle that open measurement enables public learning on how factors of demographics, geography, policy, and socioeconomic status influence the digital divide. Historically, there have been limited metrics available to the public on broadband health and deployment, as most important information is held in commercial confidentiality by network operators. This secrecy limits the ability of policymakers to understand the status of broadband deployment in their communities and identify where gaps persist. In order to foster an educated conversation around broadband access and empower communities to pursue innovative policies, the public needs access to trustworthy and independent metrics on digital inclusion and neutrality.

For the purposes of this comment, it is also critical to note that M-Lab has never taken a position on regulation; we only seek to provide a common set of facts to inform research and public dialog on

broadband deployment and its impact on society. Therefore, our response will focus mostly on *Question 7 and 14* (as numbered in the “Issues for consultation” section), those questions directly related to measurement.

At its core, Measurement Lab provides dedicated infrastructure that hosts several tools focused on measuring different aspects of Internet access in partnership with academic institutions, private companies, and civil society organizations. These measurement tools range in the metrics collected and the methods used, however, they all share a common commitment to the collection of data on broadband Internet access using open source software, transparent methods, and public data. As per the requirements of the platform, all measurements hosted on M-Lab are required to be open source and publish their data within a short period of time after collection. M-Lab is open to collaboration with measurement projects that share these simple principles, and could provide infrastructure support for additional experiments in the future, such as TRAI’s MySpeed application.

M-Lab’s infrastructure is globally distributed, as are the clients that perform measurements.¹ M-Lab anticipates deploying multiple measurement endpoint sites to India within the coming several months, which serve as infrastructure to conduct tests against and collect measurements results. This will improve our ability to service our existing user base. The planned deployment will include multiple M-Lab sites with connectivity through different transit providers for multiple cities in India. Diversity in transit networks and location will increase opportunities to monitor the impact of interconnection, location, and routing on quality of experience and accessibility, among other research. M-Lab also maintains an open invitation for providers that fit its space, power, and connectivity requirements. If TRAI, or any other partner in India, is interested in further deployments to other transit networks or Internet exchanges, M-Lab would be eager to collaborate and willing to provide hardware.

As a result of the integration of its measurement tools into common consumer software and hardware products, M-Lab collects QoS measurements from nearly every country in the world at a substantial volume. Currently this sample includes over 51,000 measurements from 31,000 unique IP addresses in India on a monthly basis.² This dataset has already been used by civil society organizations and academic institutions to document application-specific throttling and monitor changes in quality of service over time in India.³ The large-scale deployment of measurement infrastructure planned by M-Lab represents a commitment to further contribute usable tools and data to the Indian public on broadband access. The

¹ M-Lab has also developed its own open source consumer-facing toolkits, such as browser extensions and web portals to provide easy measurements in the browser and on mobile devices, e.g.: <https://speed.measurementlab.net>

² M-Lab does not collect demographic data in its tools, so it cannot assert whether a panel of testers is representative of any particular experiment design. Instead M-Lab has sought to improve overall confidence in the dataset through increasing the number of integrations to widen the population of users. Pursuing integration into consumer premises equipment and media applications has also reduced the percentage of tests that could be the result of sampling biases of consumers that have issues with their connection.

³ Network Neutrality: “ISPs slam brakes on BitTorrent speeds”

<http://www.thehindu.com/sci-tech/technology/internet/isps-slam-brakes-on-bittorrent-speeds/article3751310.ece>
Quality of Service: Analysis of Impartial Quality Measurements on Indian Broadband Connections, 2016 Twenty

Second National Conference on Communication (NCC), March 2016

<http://www.measurementlab.net/publications/2016-Prasad-et-al.pdf>

number of measurements collected from Indian users is anticipated to increase multifold in the coming months with planned measurement partnerships, which will follow our deployment of servers.

M-Lab's measurement infrastructure supports a global range of national broadband measurement initiatives, including the FCC's Measuring Broadband America, and programs in Greece, Austria, Cyprus, New Zealand and Thailand. These regulators and national Internet authorities rely on M-Lab for accurate and open data on the quality of their citizens' broadband access.⁴ Measurement Lab believes that transparency regimes should seek to maximize disclosures to the general public.⁵ In that effort, M-Lab provides regulators, researchers and consumers with a rich set of free tools to conduct independent assessments of broadband access using transparent and objective methodologies hosted on well-tested platforms.

These hosted measurement experiments currently include:⁶

- Performance: Network Diagnostic Tool (NDT), BISmark, and Mobiperf
- Network Neutrality: Neubot (MeasurementKit)

The platform does include measurements of application-specific performance pertinent to *Question 7*, such as the throttling of streaming media or blocking of services. The network neutrality tools hosted on M-Lab measure discrimination through a comparative assessment of throughput and reachability. Some differences exist in the methods used between tools, and the full experiments are documented by their maintainers.⁷ Generally these first establish a baseline through measuring the performance of a control protocol (such as VPN, HTTP, or a raw TCP stream), which is not believed to be the subject of discrimination or prioritization. This baseline is compared against a subsequent test using protocols (e.g. streaming video, Bittorrent, etc.) or packet captures from applications of interest.⁸ Both tests are conducted against the same M-Lab servers in order to limit the possibility that other factors, such as network paths or servers, have tainted the results.⁹ Where performance between tests departs consistently

⁴Additionally, the M-Lab's data and tools has been used local governments (such as the city of Seattle), quasi-governmental institutions (government-sponsored Internet exchanges), and other initiatives (E.C.'s Mapping of Broadband Services in Europe) in order to demonstrate the impact of infrastructure improvements on consumer access. After the E.U.'s Net Neutrality Rules identified the need for NRA's to provide measurement tools to consumers, M-Lab began to provide a portal for NDT to fit the needs of the Dutch ACM and is currently engaged in discussions with other European regulators about extending this work elsewhere. These partnerships have had the additional benefit of fostering the development of a toolkit that is oriented to the needs of NRAs:

<https://github.com/opentechinstitute/piecewise>

⁵ While broadband labeling under Question 9 tend to be outside of the scope of M-Lab's domain, the Open Technology Institute, a partner in M-Lab, did discuss this issue at length in its August 2015 paper "Empowering Consumer Choice Through Standardized Disclosure"

<https://www.newamerica.org/oti/blog/empowering-consumer-choice-through-standardized-disclosure/>

⁶ <http://www.measurementlab.net/tests/>

⁷ <https://nexa.polito.it/neubot>

⁸ While it is not currently hosted on Measurement Lab, another project worth note is "Differentiation Detector" based out of Northeastern University: <http://dd.meddle.mobi>

⁹ The experiments and datasets made available by M-Lab conduct tests against the platform's servers. M-Lab does not provide tools that measure the responsiveness of other remote services, such as measuring the load time of a particular website or application. Certain tools that conduct measurements against the M-Lab platform, such as

and meaningfully, potential application-specific throttling or prioritization is flagged. We would be happy to elaborate further on the details of these tests and future plans for their development.

TRAI notes concerns about external factors influencing crowdsourced datasets and software-based measurement systems. Concerns about the home networks and user devices leading to false reports is most applicable to QoS measurements, where the user is comparing an anticipated external value (e.g. the speed that they have paid for) against measured results. This differs somewhat from network neutrality measurements hosted by M-Lab, which look for deviations based specifically on protocol, thus comparing two measured results that share the same environment. However, this concern reinforces the importance of using common toolkits that are widely available and that produce reproducible measurements. Increasing the amount of people contributing measurements decreases the reliance on any specific measurement or user. M-Lab has never relied on single measurements and instead focuses on establishing that the same pattern of discrimination can be seen across a large and diverse population. Additionally, simply collecting information on the environment of the user can provide some level of accountability on whether the test could be affected by device-specific issues. For this reason, M-Lab tests generally also collect a minimal amount of descriptive information on the device, browser, and operating system being used during the measurement.

For both QoS and network neutrality tests, M-Lab has pursued a strategy of collecting measurements from as wide of a population as possible and repeatedly over time. This has led to the model of partnering with companies, such as router manufacturers and file-sharing software, to integrate M-Lab's measurements into popular platforms. One important initiative, MeasurementKit,¹⁰ hosted in the Nexa Center for Internet & Society at the Polytechnic University of Turin, builds on the experiences of the network neutrality measurement tool Neubot. MeasurementKit provides a library for device manufacturers and software developers to integrate open measurements tools into deployed applications and hardware. A third party can use MeasurementKit to conduct tests against M-Lab for their use purposes without having to understand the intimate technical details about how the system works. Importantly, MeasurementKit is also designed to be modular to easily support new tests and accept contributions from the open source community. For example, MeasurementKit would provide TRAI the ability to integrate network neutrality measurements into its own successful MySpeed application in order to provide a central location for users to turn to and a platform for further growth.

In practice network neutrality measurement is a complex field of ongoing development with continued research opportunities due to the different potential discrimination issues that could arise. In October 2014, Measurement Lab released a report entitled "ISP Interconnection and its Impact on Consumer Internet Performance," the product of a two-year collaborative effort using our extensive measurement dataset to understand how interconnection arrangements impact end-user access in the United States.¹¹

SamKnows, may also conduct performance measurements of application responsiveness, but this is done independently and not recorded through M-Lab. This limitation on outside data was put into place due to concerns about privacy, reliability, integrity, reproducibility, and openness of such approaches.

¹⁰ <https://measurement-kit.github.io/>

¹¹ "ISP Interconnection and its Impact on Consumer Internet Performance," Measurement Lab, http://www.measurementlab.net/static/observatory/M-Lab_Interconnection_Study_US.pdf

Through comparative analysis across the country, and amongst a diverse set of Internet access providers, we were able to demonstrate significant degradation in consumer broadband service over an extended period – degradation associated with disputes related to the business relationships between providers. This report has since contributed to a stronger public discourse on the role of the business relationships at the core of the Internet, and has been cited in regulatory filings by a breadth of parties.¹² Thus not only is it necessary to account for protocol-specific throttling, but also the interconnection arrangements between networks that could become degraded. This is why new M-Lab deployments, such as those planned in India, have moved beyond one site per city, to include several installations connected to different networks. Performance measurements that provide data on the impact of congestion between access providers and other network segments promises to be the most thorough and scalable approach to interconnection transparency in the long term.

In addition to measurement, TRAI identifies the question of how to formulate a proactive monitoring approach that is inclusive of the public’s experience. Collection of information from users and of information provided by third parties are all valuable perspectives, however, single measurements with improvised methods as commonly have flaws or are not easily reproducible.¹³ There is no toolkit that will definitively monitor all possible network neutrality issues. However, TRAI can support and promote the improvement of specific measurements within open source tools, such as the MeasurementKit library. It is especially well positioned to promote those tool’s development to fit the needs of Indian users based on its unique perspective. TRAI could convene discussions or workshops that would inform an overall strategic plan for inclusive broadband measurements and future developments. These sessions could include regulators, community leaders, academic researchers, and the private sector, in order to identify information gaps and opportunities for cross-sector collaboration to improve the reliability and extensiveness of its tools.

In summary, to safeguard the open Internet, the monitoring and disclosure mechanisms provided by TRAI should ideally:

- promote the availability of user-facing measurement tools for analyzing Internet access performance and network neutrality on mobile and wireline connections;
- respond to changes in which applications are potentially subject to discrimination, accommodate new research questions, and be deployed to wide user bases;
- include interconnection congestion and other sources of performance degradation relevant to end-to-end accessibility of broadband Internet users within monitoring mechanisms; and,

Commercial disputes between network providers are not unique to the United States. European member states individually have already intervened in interconnection issues through regulatory reporting mechanisms and merger agreement conditions, and BEREC acknowledged the need of regulators to consider interconnection arrangements in its Draft Guidelines.

¹² See: Letter of National Cable & Telecommunications Association in GN Docket No. 14-28. Page 3, January 21, 2015, <http://apps.fcc.gov/ecfs/document/view?id=60001014982>; Letter of COMPTEL, Level 3, Cogent and Netflix in GN Docket No. 14-28. Page 3, January 13, 2015, <http://apps.fcc.gov/ecfs/comment/view?id=60001008405>

¹³ When interconnection disputes led to degraded access to Netflix, a number of Internet users used a comparisons between direct access and connecting over a VPN to suggest the problem was application-specific throttling. These experiments were incorrect.

- provide publicly-available datasets, open-source software and open methodologies.

M-Lab is committed to being a strong partner in monitoring broadband access in India. M-Lab's presence in diverse networks and geographies will bolster the ability of researchers and regulators to use our tools and data to identify issues specific to a given market, and monitor the continued development of connectivity across India. Furthermore, M-Lab's infrastructure is provided through an open partnership that could be a foundation of further developments outside of the current experiments hosted on the platform and support TRAI's existing initiatives.

We appreciate the opportunity to submit comments and would be happy respond in depth to any further questions from TRAI.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Collin Anderson', with a long horizontal flourish extending to the right.

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