Telecom Regulatory Authority of India
New Delhi

National Broadband Plan

COMMENTS OF CISCO SYSTEMS (INDIA) PVT. LTD.

Cisco Systems, Inc. ("Cisco") welcomes the opportunity to offer its views on the consultation questions posed by the Telecom Regulatory Authority of India ("TRAI") concerning a national broadband plan for India.

Cisco commends TRAI for using the Consultation Paper to review the full panoply of issues that will need to be addressed in order to realize the great benefits of broadband for citizens throughout India, especially in rural areas. Cisco recommends that the Government of India embark on a major effort to bring broadband to more than half the population in five years. This effort will require a major investment in a nationwide fiber core network that will be open to all service providers.

Cisco is a global technology and services company, headquartered in San Jose, California, USA with a large and growing campus in Bangalore, Globalisation Centre East, that serves as our second global headquarters. Cisco's research and development centre in Bangalore is the largest such centre outside the USA. Cisco commenced operations in India in 1995 and today employs more than 6,000 people in India, including engineering staff that develop new technologies that Cisco sells worldwide. Since our campus officially opened in October 2007, construction of new buildings, including Cisco's smartest buildings worldwide has advanced, and Cisco continues to build on its plan to make our staff in India a key part of our technology development initiatives. Cisco also supports 163 Networking Academies with 17,580 students cross 23 states and union territories in India. In cooperation with leading educational institutions throughout the country, Cisco and its partners have trained more than 83,987 students in IP-based networking technologies. In addition to our direct investment in India, Cisco has established valued partnerships with other companies that lead the Indian economy, such as Infosys, Wipro, Tata, and others. Cisco has seven offices in the region - New Delhi, Mumbai, Bangalore, Chennai, Pune, Kolkata and Hyderabad. Cisco's commitment to India, and to its Indian employees, partners, and customers remains strong, and the company's India presence is seen as an important part of Cisco's future success.

The State of the Telecommunication Market

Broadband penetration in India remains very low, even as the mobile telecom market continues to experience phenomenal growth. The Consultation Paper indicates that as of March 2010, there are 8.75 million broadband connections in India, which represents approximately a 0.76% penetration rate. By comparison, China reports a broadband penetration rate of 7.7% as of 2009. In its *Consultation Paper on Overall*

Spectrum Policy last year, TRAI noted that the total subscriber base has increased from fewer than 40 million in 1997 to almost 430 million in 2009. Not surprisingly, as in other developing countries around the world, virtually all of that growth has been in wireless, which, according to the Consultation Paper, accounted for approximately 392 million subscribers and is continuing its rapid growth. Indeed, current demand projections anticipate that the mobile market in India will triple to more than 1.1 billion subscribers by 2015.

The growth in the mobile market is consistent with global patterns and reflects not just demand for voice services. Increasingly, the growth in traffic and in subscribership is driven by data, both in fixed and mobile markets, and increasingly by various video applications. In particular, the growth of global mobile data traffic will be extraordinary in the coming years. For example, Cisco Visual Networking Index (VNI) White Paper estimates that:

- Total global Internet traffic will quadruple between 2009 and 2014 and will equal 12 billion DVDs per month;
- Internet video is now one-third of all consumer Internet traffic;
- Global mobile data traffic will double every year through 2014;
- Global mobile data traffic will reach 3.5 exabytes per month in 2014;[1]
- Mobile broadband will drive over 80% of mobile data traffic by 2013;
- Mobile data traffic will reach one exabyte in half the time it took fixed traffic to do so;
- Almost 64% of the world's mobile data traffic will be video by 2013;
- Video websites YouTube and Hulu currently generate twice the traffic of the entire Internet backbone in 2000;
- Video will be nearly 50% of all traffic, fixed and mobile, by 2012;
- Business IP data, fixed and mobile, will grow at a 35% Compound Annual Growth Rate between 2007 and 2012 to 10,000 petabytes (or 10 exabytes) per month.[2]

The White Paper also notes that "multitasking and passive networking, the two key pillars of hyperconnectivity, are enabled by: (a) the growing penetration of high-speed broadband, (b) the expansion of digital screen surface area and resolution, (c) the proliferation of network-enabled devices, and (d) the increases in the power and speed of computing devices."

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[1] One exabyte equals one billion gigabytes.

[2] *Hyperconnectivity and the Approaching Zettabyte Era*, released June 2, 2010. The document can be accessed at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/VNI_Hyperconnectivity_WP.html.

These statistics serve to illustrate that the Government of India must urgently address the causes of its current low level of broadband penetration and in particular ensure that its backbone infrastructure has sufficient capacity to cope with the growing data traffic demand if India is to become a knowledge-based economy.

The Consultation Paper demonstrates that TRAI recognizes both the great economic and social benefits of broadband as well as the hurdles that India must overcome in order to promote broadband uptake. Cisco will not belabor these points here, but recommends to TRAI the analysis conducted on behalf of the Confederation of Indian Industry in September 2009,[3] which is very consistent with the findings and conclusions of TRAI's Consultation Paper.

Questions for Consultation

Realizing the strategic importance of broadband, the Government of India needs to take some significant steps to ensure that broadband proliferates in the country at an accelerated rate. A number of countries in the region, including South Korea, Malaysia, Singapore, Australia, and even governments in the Middle East, have long recognized that a vibrant broadband infrastructure paves the way for both social and economic development.

Cisco believes that the Government of India should commit itself to an ambitious program to build out infrastructure to more than 370,000 villages in order to serve 695 million citizens within five years. This objective was first articulated in the paper prepared for the Confederation of Indian Industry.

Cisco takes this opportunity to address many of the questions posed in the Consultation Paper.

CHAPTER 2: Broadband – Demand & Supply

5.1 What should be done to increase broadband demand? (Reference Para 2.23)

Much of the balance of Cisco's comments deals with the technical issues related to development of infrastructure for broadband. There are a number of factors identified in the Consultation Paper that are inhibiting demand for broadband – high prices, lack of local content, high cost of computers, etc. All of these are real and important factors. It is also essential that average consumers come to understand the value of broadband, that they learn how broadband can, for instance, increase educational opportunities for their children and provide health care for their families. The mobile industry began its phenomenal growth in India when average consumers began to recognize the value that

[3] *India 2009-2014: Broadband Roadmap for Inclusive Growth*, Confederation of Indian Industry, September 2009

the service brings to their lives. Cisco believes that this will be a key step in promoting broadband penetration as well. Consumers will, of course, also appreciate "killer apps," like VoIP[4] and even more important video, which increasingly is dominating the Internet and makes challenges like illiteracy or lack of local online content almost inconsequential, as content can be easily delivered visually and in the native language.

Fundamentally, however, no single factor is as important as the simple lack of infrastructure for broadband, especially in rural areas. In rural areas, most users will access broadband services away from their homes – at schools, cyber cafes, health clinics, and other community service centers. But as TRAI is well aware, fixed broadband infrastructure does not yet reach the vast majority of villages in rural India. While the mobile industry has made tremendous strides in bringing voice connectivity to the entire country, spectrum constraints make it impossible for the mobile industry to meet the growing broadband needs of the nation. Thus, the single most important thing that must be done to increase broadband demand is to build broadband infrastructure throughout India to ensure its availability country-wide. Once the infrastructure exists, content and applications will be developed to meet the needs of the second most populous nation in the world.

In short, Cisco believes that the way to increase broadband demand is to increase access to broadband. The growth of mobile data among Indian consumers shows that consumers already recognize the utility of broadband but most consumers currently have no alternative to mobile data. As TRAI has recognized in the Consultation Paper, fiber infrastructure beyond the district level is non-existent in most of the country and the cost of laying fiber is so high that no private company is willing to undertake the project at a national level. Existing DSL and cable television infrastructure is also limited and in any case would rely on fiber at the backend.

An ambitious program to develop the needed infrastructure will address most of the problem. The need for broadband – the unmet demand for broadband – exists. Issues related to useful applications and affordable devices for the Indian market are being addressed in the world market. For example, Cisco, along with other companies, is innovating Remote Health Presence and distance learning to meet the needs of the rural Indian market. Device manufacturers are increasingly developing devices like Cisco's Cius, Apple's iPad and a variety of Android based touch-screen devices that are easy to use and affordable. But the critical missing element in India is adequate broadband infrastructure to provide the needed connectivity for users and applications.

[4] Cisco filed comments supporting liberalization of VoIP in response to TRAI's consultation paper on the subject in June 2008.

Broadband will be increasingly vital to India as the country continues its rapid urbanization. To illustrate the point, the recent CII-Cisco-Booz report titled *Intelligent Urbanization – A roadmap for India* states that:

> As India urbanizes at this rapid pace, the demand for urban services is expected to grow exponentially. Our cities need to make substantial investments in physical infrastructure first and foremost meet the basic needs of its residents. This infrastructure deficit is seen across all aspects of urban services – be it housing, power, water, security, health, education, etc. We estimate that meeting these basic requirements will require in excess of USD 1 trillion of public investment over the next decade. As a contrast, JNNURM [Jawaharlal Nehru National Urban Renewal Mission] – laudable for being independent India's flagship urban renewal program – represents a corpus of USD 25 billion.

It will not be sufficient for India to invest in traditional infrastructure, such as roads, in order to address the challenges of urbanization. Road construction may be neither socially equitable nor environmentally sustainable as new roads often simply lead to increased traffic, which increases problems of congestion and pollution. Instead, the sheer magnitude of the challenge requires solutions that are more efficient, cheaper and holistic. Technology has proven to be the key – and perhaps the only – enabler of sustainable outcomes.

Both in India and around the world, technology is being leveraged to provide socially equitable, economically viable and environmentally sustainable solutions. Governments are utilizing technology to enhance the competitiveness of existing cities and investing in the creation of new "Connected Cities." One of the main recommendations of the above said report on *Intelligent Urbanization* is the creation of a robust broadband infrastructure that would provide connected education, healthcare, transportation, energy management, and physical safety and security for India's rapidly growing urban centers. There is ample evidence that there are enough "killer applications" that can be unleashed provided there is an adequate broadband infrastructure.

CHAPTER 3: National Broadband Network

5.7 What network topology do you perceive to support high speed broadband using evolving wireless technologies? (Reference Para 3.22)

The Consultation Paper demonstrates that the need for bandwidth is already large and will grow considerably as more broadband connections are added and as the volume of traffic per user (particularly video traffic) continues to grow.

For these reasons, Cisco recommends a hierarchical network topology that will have to rely heavily on fiber optic cable in the core network. If even relatively conservative estimates of demand are correct, then the prudent approach will be to construct a resilient fiber optic infrastructure that can grow to accommodate one to 10 gigabits per second (Gbps) or, in a few years, 40 Gbps to 100 Gbps optical signals over Dense Wavelength Division Multiplexed (DWDM) systems. Such a network will be able to support just about any demand growth that can be aggregated from any type of wireless and wireline access networks. It will also have the ability to support and aggregate multiple operators over a common managed fiber infrastructure. In addition, the network should be fully IPv6 capable at all points in the network and service providers should be required to deliver IPv6 mobile and fixed broadband services.

Cisco also recommends that the network architecture include an accompanying data center infrastructure to host and deliver the content that broadband users will access as well as Internet exchange points (such as the NIXI and potentially additional such exchanges). This will facilitate the movement of traffic over the network across multiple service providers and between India and international locations. Taking an end-to-end view of the network architecture at the outset will facilitate the coordination of technical and commercial issues across various infrastructure components. This will reduce the costs of service provision and will encourage broadband adoption by making service more affordable. Finally, the inclusion of data centers as part of the network will also ensure that efforts such as the Pimpri-Chinchwad project, designed to improve security and traffic monitoring, do not become islands of useless data.[5]

Cisco anticipates that the access network will include a range of wireless and wireline technologies. Wireless services and devices may be best suited for many consumers for economic reasons and because wireless service is already ubiquitous in India. Wireless access technologies will include 3G wireless, Broadband Wireless Access, LTE, WiMAX, and other technologies to come. In other parts of the country, primarily in urban areas, fiber optic (GPON and EPON), cable and various copper-based access technologies like xDSL will compete. At the same time, the newer wireless access technologies, particularly WiMAX and LTE, will be fully IP-based technologies from the outset, which will promote the technological convergence of wireless and wireline networks. These IP-based Next Generation Networks (both fixed and wireless) will be built on fiber-based core and aggregation networks that can flexibly provide bandwidth to wireless base stations as well as wireline access networks.

[5] This project allows local government to deliver citizen services to residents of the city of Pune and environs more efficiently through the use of a digital infrastructure.

5.8 What actions are required to ensure optimal utilization of existing copper network used to provide wireline telephone connections? (Reference Para 3.22)

Although there are more than 100 broadband providers in India, the Consultation Paper makes clear that the broadband market today is very highly concentrated. This is especially true of the DSL market, which is dominated by BSNL and MTNL. In order to increase the utilization of existing copper connections to provide DSL services, Cisco recommends that the Government increase competition in the DSL market by introducing Local Loop Unbundling. Unbundling has been effective in a number of markets in bringing down the costs of a broadband connection even when full facilities-based competition is either not permitted or is not technically or economically feasible. By increasing competition in the DSL market, the Government can make broadband more affordable for existing wireline subscribers.

Beyond this, however, Cisco recommends that the Government encourage the adoption of more robust technologies such as Fiber-to-the-Home and Cable (DOCSIS 3.0) for all new deployments. DSL has inherent limitations related to subscribers' proximity to the telephone company central office and bandwidth and may not be able to meet evolving broadband standards.

5.9 Do you see prominent role for fibre based technologies in access network in providing high speed broadband in next 5 years? What should be done to encourage such optical fibre to facilitate high speed broadband penetration? (Reference Para 3.22)

Cisco believes that fiber has a very important role to play in the access network, particularly for users who require high bandwidth services. These uses include video, enterprise collaboration, and other high-bandwidth cloud-based services. As we noted at the outset, Cisco's VNI forecasts that the current rapid rate of growth in demand for a variety of Internet video services will continue and even accelerate. The proliferation of video traffic will likely make fiber in the access network essential to both enterprise users and consumers. In addition, the availability of fiber in the access network will enable fiber-based wireline technologies like GPON and EPON to be adopted for the provision of multi-service, converged applications that require multimegabit bandwidths and predictable network performance, such as IPTV.

Moreover, high-bandwidth access networks will be needed to provide e-health and e-education services to rural India and to make these services a success. In this context, we note that the U.S. National Broadband Plan proposes to create a Connect America Fund that would shift up to USD 15.5 billion over the next decade from existing Universal Service Fund programs to support broadband deployment. The goal of the Fund would be to provide affordable access to voice and broadband services with an actual download speed of at least 4 megabits per second (Mbps). The Fund would also seek to ensure that every American community should have affordable access to at least

one Gbps broadband service to anchor institutions such as schools, hospitals and government buildings."[6]

Over time, as bandwidth demands continue to increase, fiber optics will be increasingly important in access networks (as well as the core network) serving both urban and rural customers. In the near term, wireless technologies will power the lightweight and quick deployment of access networks in order to hasten broadband adoption, especially in areas that are more expensive or more difficult to serve with fiber.

While Fiber to the Kerb is necessary, it is important to remember, however, that fiber should not be the only technology deployed in the network, especially in the last mile. In many countries, fiber competes with DSL and with cable television networks. Indeed, in the United States in particular, cable is a leading provider of broadband services especially in the residential market (cable also serves the enterprise market as well). This competition among different platforms promotes technical innovation, reduces prices, and provides consumers with expanded choice and, for all of these reasons, increases broadband penetration.

The Government can take several actions that will allow cable television to flourish as a broadband access technology in India. First, like other access technologies, cable needs access to rights of way on terms that are both affordable and efficient. Requirements to negotiate with multiple jurisdictions and overly-complicated permitting processes will hinder a cable operator's acquisition of rights of way and, hence will hinder its ability to provide broadband access to the public. Cable is a capital intensive business and must be allowed access to capital on fair and reasonable terms. Further, cable, as a provider of voice service, must be allowed to interconnect to the Public Switched Telephone Network on the same terms as other providers of voice service and without the need for additional licensing.

5.11 Is non-availability of optical fibre from districts/cities to villages one of the bottlenecks for effective backhaul connectivity and impacts roll out of broadband services in rural areas? (Reference Para 3.39)

Undoubtedly the creation of a core fiber network will be necessary for a future-proof, high-bandwidth transmission fabric throughout the nation. The lack of such a network between cities and villages is certainly one of the bottlenecks that impede the rollout of rural broadband.

As the Consultation Paper demonstrates, the cost per megabit of fiber is lower than other transmission media, and this in itself will be important to promote broadband acceptance, given that price is a major consideration for many consumers and even for communities. But perhaps more important than price, the native bandwidth supported by

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[6] The U.S. National Broadband Plan is available at http://www.broadband.gov/plan/.

fiber is higher than any other existing technology. Fiber can already provide 40 Gbps of throughput per wavelength in a DWDM transmission system, and this will increase to at least 100 Gbps in the future. The applications that will be important in rural India, such as e-health and e-education, will require higher bandwidth per node than urban users will need. For these applications to succeed, India must have healthy fiber capillarity – that is, fiber extending deep into the access and middle-mile network, not just in the core

backbone network. Indeed, as noted above, even in rural areas wireless base stations can be connected to fiber aggregation networks that will give wireless subscribers in rural areas flexible bandwidth for both voice and data services.

5.12 If so, is there a need to create national optical fibre network extending upto villages? (Reference Para 3.39)

Cisco strongly recommends the creation of a national fiber network that will extend to villages throughout India. This core network should be considered to be a critical national asset, like roads or the electric grid, that will be essential to economic and social development in the 21st Century. In the words of the U.S. National Broadband Plan, "Broadband is the great infrastructure challenge of the early 21st century. Like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge." Accordingly, the Government should regard creation of this network as a top economic development priority. Indeed, construction of the national fiber network should be undertaken in conjunction with other infrastructure projects. When roads or railways are constructed, improved or extended, ducts and fiber cables should also be installed to make these more traditional infrastructure projects exponentially more valuable.

5.13 In order to create National optical fibre core network extending upto villages, do you think a specialized agency can leverage on various government schemes as discussed in para B? (Reference Para 3.39)

There are a variety of potential models for the structure of a network operator that could be adopted to deploy the national fiber core network, and each model has its advantages and disadvantages. The model that is adopted must take advantage of the best of both private and public models and Cisco is working with the Confederation of Indian Industry on a report that examines the pros and cons of various models. This report will be submitted in the near future. Cisco recommends the following principles to guide the decision of the appropriate model of a national fiber core network:

- The network will be a key public asset, akin to roads, railroads, and the electrical grid, that will be vital to the economic development of the nation, social development, and public safety. Construction of the network will be a massive financial undertaking. For these reasons, the Government must be prepared to take a leading role in financing the construction of the network.

- Because resource maximization is critical, the model should ensure optimal leveraging of existing infrastructure.
- The model should combine the best of Public and Private sector: Government leadership in funding, ensuring the larger public good, getting approvals on issues such as right of way; and Private sector leadership in execution and sustainability.
- The Government has wisely recognized that a competitive, privately managed telecom network, subject to appropriate regulatory oversight, is the best model for the development of a modern telecom market. India has enjoyed tremendous growth in penetration since the market was liberalized, and the growth of the telecom market, through private enterprise, has helped to fuel economic growth overall.
- The network should be operated on a non-discriminatory basis. Whatever the ownership structure of the network, all telecom operators must have the right to access the network on reasonable terms and be able to interconnect with all other operators. This will require that all transactions are conducted on an arms-length basis.

With these principles in mind, Cisco believes that the creation of a specialized agency may be the most effective way to create a national fiber core network. Indeed, it may be the only way to achieve this objective within a reasonable time. No single private sector entity is likely to have the incentive to build a national fiber core network, yet all industry participants (as well as consumers, of course) will benefit from it. As the Consultation Paper discusses, the National Rural Road Development Agency has estimated the need for more than 11 lakh km of road construction to provide every village of more than 500 inhabitants with one good, all-weather road. During road construction, fiber optic cable should also be laid, under the management of an appropriate specialized agency. Moreover, Cisco believes that the construction of such a network would be an excellent use for Universal Service Obligation funds. Similarly, USO funds should be used to support Fiber-to-the-Kerb buildouts.

The foregoing observations demonstrate the need for government financial support for the construction of the network. Moreover, given the substantial public benefits to be derived from construction of the network, this is clearly a project that deserves the government's financial backing.

At the same time, however, government may not be particularly well-suited to own and operate a telecom network. Therefore, Cisco recommends that any specialized agency or corporation established to own and operate the network be led by the private

sector with clearly spelt out roll out obligations. All operators should be invited to participate in the ownership and management of the network, rather than allowing any single operator to control this vital public asset.[7]

All telecom operators should have the right to use to network on a fair and non-discriminatory basis, and for this reason among others, a specialized agency with an arms-length relationship to all operators is likely to be needed to ensure non-discriminatory access.

5.14 Among the various options discussed in Para 3.35 to 3.37, what framework do you suggest for National Fibre Agency for creating optical fibre network extending upto village level and why? (Reference Para 3.39)

As discussed above, Cisco believes that a specialized agency may be best positioned to leverage other government programs and USO funds in the construction of the national fiber core network as well as private sector expertise in its operation and maintenance. This will ensure that all service providers are given fair and nondiscriminatory access to the network.

5.15 What precautions should be taken while planning and executing such optical fibre network extending upto villages so that such networks can be used as national resource in future? What is suitable time frame to rollout such project? (Reference Para 3.39)

Cisco recommends that the Government commit to covering 80 percent of the villages to be achieved within 3 years and 100 percent of the villages within 5 years. This is an ambitious goal, but it is in line with the recommendations of the Confederation of Indian Industry and will help to achieve the CII's goal of making broadband available to 695 million citizens within 5 years. Bringing fiber to these villages, even just to Community Service Centers, will provide enormous benefits to residents of rural areas and will greatly stimulate broadband uptake, just as telephone kiosks helped to make the telephone commonplace in rural India.

[7] The traditional consortium arrangement under which submarine cables have typically been constructed and operated may provide a useful analogy for the operation of a specialized agency to operate the national fiber core network. Specifically, in the case of submarine cables, many operators invest in the construction and maintenance of the cable. The cable is then operated by a Management Committee comprised of representatives of the various investors. In this case, the Government could participate in the Management Committee in an observer capacity to ensure non-discrimination and other regulatory objectives.

This project will be a massive undertaking, and will require that the agency tasked with building and operating the network be adequately staffed and fully empowered to carry out the project. In the design phase, the agency should consult broadly with the telecom industry and with other relevant stakeholders. The responsibilities of the agency must be clearly delineated in advance of construction of the network. These

responsibilities should include not only technical aspects of the project but also legal and financial rights and obligations of all parties involved in the project.

It is also advisable to establish at the outset of the project what the rights of service providers will be to use the network and to interconnect their existing infrastructure to the core network. This should include both the commercial and operational aspects of service provider interconnection. In order to protect the rights of all users and ultimately of the public, the Government must ensure that the agency it establishes has adequate authority to monitor the management of the network, to guarantee non-discriminatory access and to resolve any disputes. Finally, given the very large scale of the proposed project, it may be advisable to develop a phased plan for network rollout in order to ensure that the network is completed on time.

CHAPTER 4: Regulatory Challenges and Future Approach

5.16 Is there a need to define fixed and mobile broadband separately? If yes, what should be important considerations for finalizing new definitions? (Reference Para 4.18)

Cisco believes that it is advisable to define broadband separately for fixed and mobile networks. The bandwidth available even on advanced wireless networks is far less than on fixed networks. Other factors, such as provisioning, maintenance, and Quality of Service (QOS) are all different depending on the type of access network the service provider uses. We would assume, of course, that all networks, fixed and wireless, will have access to the same national fiber core network and that, therefore, differences in performance should be principally related to differences in the access network. Cisco also believes that in general a competitive market will be the most efficient method of promoting the interests of consumers and ensuring good behavior on the part of all market participants. Nevertheless, TRAI must have the power to clearly spell out what conduct will be deemed anti-competitive and to enforce appropriate competition rules.

5.17 Is present broadband definition too conservative to support bandwidth intensive applications? If so, what should be the minimum speed of broadband connection? (Reference Para 4.18)

Cisco believes that the current definition of broadband is far too conservative. As the Consultation Paper notes, users creating and sharing more content will require more

bandwidth. In countries around the world, broadband speeds are far in excess of the standard of 256 kilobits per second (Kbps) in the Indian definition. Japan, Korea, Hong Kong and Singapore are already providing broadband networks that provide download speeds of 50 Mbps-1 Gbps and even nations with less robust broadband infrastructure are achieving multimegabit speeds. These speeds will increasingly be seen as essential to a quality broadband experience as Internet traffic becomes more and more heavily

weighted toward video. In addition, the applications that can transform life in rural India for millions of citizens – such as e-health and e-education – will require enormous bandwidth.

For these reasons, Cisco believes that the minimum broadband target that TRAI should adopt to meet today's application demands is actual download speeds of at least 2 Mbps and actual upload speeds of at least one Mbps, and strive in short order towards higher speeds that will be enabled by a fiber infrastructure. Indeed, TRAI should bear in mind that other countries in the region, notably South Korea, are already providing much higher speeds than this, with networks that provide 1 Gbps to the home with a contention ratio of 100-200. TRAI should establish its broadband definition with regard to international norms.

Of course, TRAI must also bear in mind that whatever definition of broadband it adopts today, demand for bandwidth will continue to grow and will very likely exceed the standard that TRAI adopts now. In particular in community anchor institutions, like hospitals and schools, the applications that are needed to transform India into a knowledge-based economy will require multimegabit speeds in the near term and may require gigabit speeds in the not too distant future. Therefore, it is essential that, whatever definition TRAI may adopt, the definition of broadband must not serve as a ceiling, but only a floor. Thus, the national fiber core network must be designed to be future proof so that service providers will be able to continue to meet growing demand for bandwidth.

5.19 Does the broadband sector lack competition? If so, how can competition be enhanced in broadband sector? (Reference Para 4.42)

As the Consultation Paper demonstrates, although there are more than 100 service providers currently providing broadband, approximately 70% of broadband connections are provided by just two companies and more than 89% of connections are provided by five companies. The broadband market in India, then, is highly concentrated and in part for that reason has performed poorly.

Broadband competition will be enhanced if all service providers have access to a national core network on reasonable, non-discriminatory terms. One model for ensuring non-discriminatory access that has been used in other countries in Asia is to establish an independent backbone provider that would sell access to all service providers, including the state-owned incumbent. The backbone provider would not be permitted to enter the

retail market itself and thus would have no incentive to favor its own service provider or anyother service provider.

5.20 Do you think high broadband usage charge is hindrance in growth of broadband? If yes, what steps do you suggest to make it more affordable? (Reference Para 4.42)

Plainly, high prices deter many consumers from subscribing to broadband services. As the Consultation Paper observes, current prices for broadband (particularly when combined with the cost of a computer) are simply not affordable for many consumers, especially in rural areas.

The Government needs to take measures to reduce the cost to providers supplying broadband connections. In some cases, the Government may need to cover the cost of infrastructure in areas that are especially high cost or have low income potential. Most important, access to a national core network on reasonable, non-discriminatory terms will lower costs for providers. Likewise, access to international bandwidth at reasonable prices as well as more domestic content hosting will make broadband services more affordable. Finally, TRAI should encourage more infrastructure sharing and more competition in the broadband market in order to bring down prices for consumers.

Even then, however, the Government will likely need to provide subsidies for the capital expenditure of some users or even for entire communities where the cost of service provision is high. These subsidies should be designed to be transparent and competitively neutral and should probably be provided through existing universal service mechanisms.

5.21 Do you think simple and flat monthly broadband tariff plans will enhance broadband acceptability and usage? (Reference Para 4.42)

Cisco believes that it is likely that simple, flat tariffs will encourage broadband subscribership. At the same time, service providers should retain the flexibility to introduce a variety of pricing plans to meet the needs of their customers. Moreover, as the market becomes truly competitive, service providers should be given still more pricing flexibility.

5.24 How can utilization of International Internet bandwidth be made more efficient in present situation? (Reference Para 4.42)

First, utilization of international Internet bandwidth can be made more efficient by using less of it. The more content that is hosted domestically, the less need there will be to use international bandwidth. This can be achieved both by producing and hosting more content locally and by encouraging providers to mirror the content of popular foreign websites so that domestic consumers will access the content within India. Carrier hotels and other managed infrastructure facilities located near submarine cable landing stations would help facilitate this.

Second, there are bottlenecks in the international market as there are in the domestic market. Indian service providers would benefit from the establishment of "fat" international backbone networks and settlement free international peering arrangements. The establishment of new cable landing stations, carrier hotels and additional Internet exchanges would also help to reduce backhaul charges for service providers and make the utilization of international bandwidth more efficient.

5.29 Do you think that bad quality of broadband connection is impacting the performance of bandwidth hungry applications and hence crippling the broadband growth? If so, please suggest remedial actions. (Reference Para 4.59)

Certainly, poor quality of service, from whatever cause, will reduce consumers' incentives to subscribe to broadband service. Consumers do not know and typically do not care what the cause of poor performance is – they just know that service is poor. One approach to both improving service quality and to reassuring consumers would be to institute Service Level Agreements so that consumers know what to expect and have a standard that they can hold the service provider to.

5.32 What measures are required to encourage development of content in Indian vernacular languages? (Reference Para 4.68)

The rapid growth of the Indian mobile market has created a base of more than 400 million customers. Applications are already being developed for this market, including in the Indian vernacular. This customer base, and this growing suite of applications, provides a logical platform on which to base the creation of applications and other content for the Indian broadband market. Existing mobile applications and content can be enhanced for viewing on a computer. Indeed, as we have noted above, the Indian market is especially well-suited to video content. Increasingly, video can be easily created and is accessible to the entire population, even the illiterate or semi-literate population. Of course, video is essential to services such as telemedicine and education.

In addition, as cloud-based services take on a new level of acceptance amongst users, software and application developers – small and large – will require information and communication technology (ICT) infrastructure to develop and deliver new applications. The creation of multi-tenanted, pay-per-use cloud computing infrastructure that is hosted and managed by service providers and made accessible via the Internet and

broadband networks will certainly play an important role in the entrepreneurial segment to develop vernacular content and applications with minimal up-front cost.

Conclusion

The Broadband Policy of 2004 established a goal of 20 million broadband connections by 2010. At present, India has just 8.75 million broadband connections. As TRAI recognizes, broadband is increasingly essential to economic development in the 21st Century, and the low penetration rates, slow download speeds, and high prices for broadband will seriously impede India's effort to become a knowledge-based economy.

The Consultation Paper has identified the main problems that are holding India back from achieving its broadband goals. Cisco recommends that TRAI endorse an ambitious plan, to build a nationwide fiber core network that will spur the establishment of hundreds of millions of broadband connections in the next five years. Cisco appreciates the opportunity to share its views on these important issues and stands ready to work with TRAI and other stakeholders to continue to move these issues forward.

Respectfully submitted,

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