



**Allocation and Pricing for 2.3-2.4 GHz, 2.5-2.69 GHz, 3.3-3.6 GHz Bands
Response of Cisco Systems, Inc. to Consultation Paper no. 8/2008 of the
Telecom Regulatory Authority of India**

Cisco Systems, Inc. (“Cisco”) welcomes the opportunity to offer information and its views on the consultation questions posed by the TRAI for the development of wireless broadband services using spectrum in the 2 GHz and 3 GHz bands. Cisco strongly shares the TRAI’s view that the spectrum identified in this consultation has tremendous potential for enhancing the availability of broadband services throughout India. In these comments, we respond to those questions directed to wireless technologies and the relevant rules that will influence the choices that eventual licensees will need to make with respect to their networks.

Cisco is a global technology and services company, headquartered in San Jose, California, USA with a large and growing campus in Bangalore that serves as our globalization hub. Cisco currently employs more than 3,000 thousand people in India, including engineering staff that develop new technologies that Cisco sells worldwide. In late 2007, Cisco purchased Navini Networks, Inc., a Richardson, Texas, USA-based maker of WiMAX technology, also with a large engineering presence in Bangalore. Since our campus officially opened on October 30, 2007, construction of new buildings has advanced, and Cisco continues to build on its plan to make our staff in India a key part of our technology development initiatives going-forward. Cisco also supports 160 Networking Academies in India in cooperating with leading educational institutions throughout the country, has trained more than 75,000 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, etc. Our commitment to India, our Indian employees, partners, and customers remains strong, and we view our presence in India as an important part of Cisco’s future success. In addition, Cisco has actively advised governments around the world on spectrum policy with particular emphasis on governmental decision-making that will enhance the use of spectrum to deliver broadband services to citizens.

Cisco congratulates the TRAI on initiating this consultation promptly in response to the Department of Telecommunications recent decisions to refarm existing users to new frequencies. The bands that will become available for license include bands that are available globally and that utilize evolving technologies, such as WiMAX, that are



capable of delivering wide-area wireless broadband access services. By initiating this consultation, and by promptly making a significant amount of spectrum available for licensing, the TRAI has positioned India in the forefront of a new broadband era. Broadband access is no longer limited to the geographic reach of wired networks, which are difficult or impossible to build when end users are located at a distance from the network switching equipment. Using new wireless technologies, true broadband (multi-megabit throughput) can be placed within reach of any user within a few kilometers of a base station, depending upon the precise technology used and the frequencies utilized. Moreover, by ordering the utilization of spectrum that is available globally, network operators will be able to take advantage of global economies of scale, mass production of client devices, and efficient competition among vendors. This will greatly benefit Indian consumers.

If the DoT can offer spectrum to service providers in a way that optimizes the construction of wireless broadband networks, important benefits will flow to users, to the economy, and to the Indian government itself. As the TRAI has recognized, if broadband can be made generally available, opportunities for social inclusion among India's diverse populations will grow. Users will have new opportunities to interact using broadband technologies in ways that existing voice technologies will not allow. For example, while a cell phone can accommodate voice and the sending or receipt of a photograph, broadband wireless access can accommodate both Voice over IP and access to a collection of photographs, or even videos, that enrich the communication experience between users. In addition, broadband is a key enabler of national economic productivity. A number of occupations can be performed remotely, enabling rural populations to participate in India's economic success. Businesses can use broadband networks to develop e-commerce, or to improve the functioning of their supply chain. Even more importantly, businesses can use the power of broadband to more effectively collaborate across their component parts, using Web 2.0 tools, just as Cisco is doing from its Bangalore campus. Governments, too, benefit, by being able to deliver e-health, e-education and other social services across a broadband network to constituents that they could not reach in any other way.

But these benefits depend upon choices that the government must make. First and most importantly, the government must make a commitment to open spectrum for use by advanced technologies, even if that spectrum is currently in use. Migrating existing users of targeted spectrum is always a difficult task, but one that has to be undertaken with the energy and purpose commensurate to the goal of achieving the benefits of a society enabled by broadband technologies. As the consultation notes, the government has done a good job of identifying spectrum that can be utilized by global technologies and making a significant amount of spectrum available, but more needs to be done, particularly at 2.6 GHz, to clear spectrum for broadband access. Cisco urges the government to re-double its effort to clear spectrum in this band from its current government use, and in any band identified for use by IMT-2000 or Advanced IMT technologies.



Second, the rules governing the spectrum need to be written so that service providers can create sound business plans. Foremost among these rules is the amount of spectrum that will be available to the network provider. Capital markets and investors from whom money will be raised to build India's new networks need to know that sufficient spectrum will be available to generate revenues that will allow the network – with its base stations, backhaul, switching centers, and operation center – to operate profitably. Moreover, it does no good to create spectrum opportunities if robust and widespread networks are not built.

TRAI previously decided that spectrum made available by the Department of Telecommunications at 3.3-3.4 GHz and 3.4-3.6 GHz shall be allocated in contiguous blocks of 15 MHz. According to TRAI, this allows for 13 operators in each geographic region. In Cisco's view, while a 15 MHz allocation would allow for initiation of service, that amount of spectrum is insufficient to accommodate future growth in subscribers, given the likely applications that the network will support, except perhaps in rural areas where 15 MHz might be sufficient. Cisco recommends that a policy based on an initial 15 MHz sized allocation must be accompanied by a commitment from the government to free up sufficient spectrum to allow networks to grow to 30-40 MHz of spectrum. The government must commit to a reasonable timeline for the migration of governmental use of 2.6 GHz to other spectrum and/or the release of spectrum in other nearby bands with sufficient finality to allow operators to create business plans and attract the necessary capital investment for construction of broadband networks of sufficient size to accommodate urban areas.¹

The amount of spectrum named, while large relative to narrowband networks of the past, is largely a function of the technology that will be deployed and the uses to which a future mobile wireless network will be put. With respect to technology, these new networks will utilize Orthogonal Frequency Division Multiple Access (OFDMA) technology. OFDMA is the common basis underlying advanced broadband networks such as WiMAX, LTE and others. It is spectrally efficient, and it easily scales to wide bandwidths to deliver very high data rates. With respect to the uses of such networks, the overwhelming use case that will drive traffic on future broadband networks of all types is video. Media-rich content places greater demand on bandwidth. Video will be used in virtually every type of communication, from basic person-to-person communications, to business communications (e.g., meetings and advertising) and as a content service delivered to an end user. While bandwidth for download will continue to predominate for some time, upload bandwidth will become more important over the next 10 years, reflecting more and more user-generated content.

¹ To the extent the 15 MHz allocation decision has been made final, Cisco also strongly urges the Authority and the DoT to allow spectrum trading and/or secondary leasing of spectrum by a licensee to another entity to allow operators to amass sufficient spectrum to build robust broadband networks.



In a 2007 analysis, the WiMAX Forum calculated that a network operator would need capacity equivalent to 30-35 megabits per second per kilometer squared by 2015 to keep up with average user demands during periods of peak load.² To deliver this, the Forum calculated that a service provider needs a minimum of 30 and perhaps 40 MHz of spectrum using advanced antenna technology to improve the efficiency of its operation. This analysis assumed the network would be channelized into 10 MHz-wide channels. However, vendors such as Cisco today offer equipment that supports 5 MHz channelization, an architecture that will support more channels per base station.³ Cisco recommends that the TRAI consider the need to create a path forward to larger blocks of spectrum to support mobile broadband networks. India's large population concentrated in enormous urban centers, the growing demand for mobile technologies, and the likely uses of these technologies will quickly occupy a 15 MHz network. While a largely rural network may be able to suffice with 15 MHz, it is far preferable for most operators to be able to plan its network, and grow its business, based on a larger spectrum block.

Cisco also notes that the TRAI has initiated this consultation in order to establish spectrum for Broadband Wireless Access (BWA). In general, Cisco advocates that governments remain as neutral as possible on questions of what services spectrum can be utilized for, and on what technology can be deployed in the named bands. In Cisco's view, allocating large contiguous blocks of spectrum creates a natural market driver for the deployment of advanced services such as BWA. Capital markets will demand it of the winning bidders. However, if there is an overriding governmental interest in naming BWA, as there appears to be in the case of India, there is little harm done provided that the spectrum allocations are specified in a way to support BWA uses, as Cisco suggests below.

² <http://www.wimaxforum.org/technology/downloads/> "A Review of Spectrum Requirements Mobile WiMAX™ Equipment to Support Wireless Personal Broadband Services, September 2007.

³ In addition, in today's market, client devices utilizing 5 MHz channels tend to be less expensive than devices using 10 MHz channels.

Below are Cisco's responses to the key technology questions posed by the consultation document. In several cases, Cisco suggests areas where India's spectrum policies for these bands could be improved.

1. What should be the revised reserve price for the spectrum in the 3.3 -3.6 GHz band?

Cisco has no comment on this question.

2. What should be the eligibility conditions for bidding for spectrum in the bands of 2.3-2.4 GHz and 2.5 – 2.69 GHz?

Cisco has no comment on this question.

3. In the 2.3-2.4 GHz band, the maximum amount of spectrum which a licensee can bid for?

The Consultation document suggests that 40-50 MHz total will be available, and recommends bidders be able to acquire up to 15 MHz per licensee.

As an initial matter, it is worth noting that while the 2.3 GHz band has been identified by the ITU as an IMT-2000 band, it is not yet supported by the relevant standards bodies. While this is likely to be remedied over time in light of the availability of spectrum in several important markets, for the moment a network operator's ability to rely on competitive supply of its network components and client devices is less than if the band were fully supported. As a result, the business risk for deploying a network in this band is somewhat higher relative to a band supported by a standards organization and interoperability forum, where one might expect to see hundreds of vendors offering equipment.

If the band is to be utilized by "pre-standards" based technology, then in Cisco's view it is important to ensure that the licensee has sufficient spectrum to operate a robust broadband network. As stated in our introductory comments, if the government begins with licensed networks operating with 15 MHz of spectrum, networks will more quickly become capacity-constrained given the media-rich content that the network will be asked to deliver. In a rural area, 15 MHz might be minimally sufficient, given the lower population density, but 15 MHz of spectrum likely to become insufficient for urban areas. If 30 or 40 MHz cannot immediately be made available, then Cisco urges the government to commit today to a path forward where the remainder of the 2.6 GHz band can be cleared and/or other spectrum can be found to accommodate growth. It is vital that operators have a firm answer that will enable them to build a sound business plan and to attract capital investment.



4. In the 2.3-2.4 GHz band, the size of the spectrum blocks for bidding?

Spectrum blocks for bidding should minimally be 15 MHz.

5. In view of limited availability of spectrum in this band and possible conflict between the technologies using FDD and TDD modes, how the spectrum in 2.6 GHz band be allocated?

In Cisco's view, enlightened regulation should make any conflicts between FDD and TDD meaningless. Enlightened regulation would include no technology specification for this spectrum. It would also allow for spectrum trading and secondary leasing of spectrum to enable the market to rationalize spectrum holdings and uses. The most important matter for the TRAI to consider is to make available large blocks of spectrum for bidding, or at a minimum, decide and announce a path forward for the availability of additional spectrum in the future (see response to question 3). The rules should not prohibit TDD technologies from using paired spectrum.

6. In case the present available spectrum is allocated for BWA technologies using unpaired spectrum, then, will it be feasible in the future, from a technical and economic angle, to reform the allocated spectrum in the 2.6 GHz band in line with global practices?

Announcing in 2008 a future requirement to re-farm spectrum introduces unnecessary uncertainty with respect to those who might acquire spectrum now. The likely result is that there will be little interest in the band. In lieu of refarming, TRAI's rules should allow for spectrum trading and secondary leasing to allow the licensees to reconfigure the spectrum based on market place realities, such as demand and continued evolution in technology.

7. Unlike a number of other countries, a major portion of the spectrum in the 2.6 GHz band is yet to be got vacated by WPC. What measures can be taken to accelerate the process of vacation so that the Indian telecom sector is not at a disadvantage in relation to other countries?

This spectrum is critical if India is to achieve its goals for broadband development, because this spectrum facilitates broadband mobility. TRAI is therefore right to ask if there is a way to speed up refarming of the spectrum at 2.6 GHz. If the issue is cost to the government agency for re-deploying on different spectrum with different radio systems, the government should first determine the cost to the government agency. Based on the cost estimate, the government has two choices. First, allocate resources from general tax revenues to pay for the new governmental systems required or, as has been done in the US, require the winning bidder to pay for relocation. If the winning bidder(s) must pay, then there are two principles which must be observed. First, the size of the payment must be established before bidding



begins. Second, the amount cannot escalate. This ensures that the bidder knows the obligation prior to bidding.

8. What should be their reserve price for the purpose of auction for the spectrum in the 2.3 to 2.4 GHz and the 2.5-2.69 GHz?

Cisco has no comment on this question.

9. Is there a need for putting a maximum limit on the cumulative holding of spectrum acquired in these bands by a licensee and what should be that limit?

India's telecom sector is competitive, and needs to further evolve to allow companies to compete against each other in a national market. Risk of limiting future licensees to a low amount limits the ability of companies to extend their geographic reach with a robust broadband network. Risk of no limit is that a few of the strongest market participants buy the entire spectrum. In Cisco's view, the risk of a single buyer is low, given the build out requirements that will exist. For that reason, we would recommend a cumulative limit of no less than 45 MHz in any given geography. We also recommend that TRAI allow competitors to assemble a national footprint if they choose.

Respectfully submitted,

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Dated: 22 May 2008

