

Position Paper

Rationale for Spectrum Neutrality between CDMA and GSM Operators in India

Submission by

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QUALCOMM appreciates the opportunity to submit this “Position Paper on the Rationale for Spectrum Neutrality for CDMA and GSM Operators in India” as the regulatory authorities analyze the broad range of issues involved in the allocation, assignment and award of spectrum, a scarce national resource, whose management is of utmost importance to India’s advancement and economic growth.

The purpose of this position paper is to present compelling arguments for the regulatory bodies to consider awarding spectrum in a neutral manner that provides equal opportunity for all mobile operators. That is, regulatory entities should focus on developing fair guidelines and should not use operators’ technology choice as a factor when awarding spectrum. Furthermore, this paper discusses the benefits of awarding equivalent spectrum to CDMA operators to bring them to par with GSM operators, so that CDMA operators are not disadvantaged in any manner and to enable them to grow their networks to offer voice and advanced data services for consumers. Finally, this paper focuses on the issues of equality in spectrum allocation and technology neutrality, and their effects on economic growth opportunities and social and technological benefits for the country. QUALCOMM believes that these issues are of paramount importance as the regulator sets its spectrum policies.

Equal Opportunity in Spectrum Allocation

It is of critical importance for the regulator to create a level playing field for wireless operators in India in order to promote further investment in the country. The current spectrum allocation for CDMA operators in India varies from 2.5 to 5 MHz compared with 4.4 to 10 MHz for GSM operators (one-way). For CDMA operators this amount is not enough even to support the minimum capacity projections required over the next two years for voice services only. At the very minimum, the CDMA operators should have access to the same amount of spectrum as GSM operators, provided that the former adopt similar regulatory conditions and pay the fee required for full mobility. The amount of spectrum assigned should be independent of the technology chosen by the operator, and consequently, it will not be necessary for the regulator to determine the efficiency of either technology in order to allocate spectrum. Indeed, evolutions in each technology change the efficiency over time, making efficiency determination an ongoing and probably impossible task. Further, efficiency improvements should not be discouraged nor delayed by a game of maximizing frequency assignment. The same regulatory environment should apply to all mobile service providers and their success or failure should be based solely on marketplace factors. That is, the ability of the service provider to offer quality service in their designated service areas at a competitive price.

Today, the Government’s rationale for awarding spectrum is that since spectrum is a limited resource, it should be assigned based on need and in small blocks according to the technology used by the operator and once certain subscriber targets are met. Awarding spectrum on a piece-meal and ad hoc basis results in various inefficiencies, including the need for operators to use more guard bands than usual due to the lack of contiguous spectrum. Since guard bands do not support traffic, more guard bands lead to waste of spectrum. Non-contiguous spectrum assignments also make network planning difficult because network planning tools are not designed to work with sites with short distances. Not being able to have a reliable network plan prevents

operators from making long term business plans, which in turn directly impacts investor confidence and interest in wireless concerns. Further, given the complexities and ever-changing nature of mobile network technologies, the government is not in the best position to determine the need of each operator. Instead, the regulator should establish a level playing field to enable operators to have equal opportunity and freedom to leverage the strengths of their chosen technologies and networks to their full potential. Ideally, operators should be assigned larger blocks of contiguous spectrum, at least 10 + 10 MHz or 20 + 20 MHz, if the total allocation of spectrum permits. Larger blocks of spectrum provide an operator with increased flexibility for the provision of services and permit the operator to better meet the needs of its subscribers. It would also encourage the operators to seek ways to become more efficient.

The regulator can provide guidelines and set qualifying criteria prior to issuing spectrum in order to ensure its efficient use. The operators should not be allowed to occupy unused spectrum longer than the predefined period of time, and there should be automatic withdrawal of spectrum in case of non-compliance with spectrum utilization requirements. In order to dissuade spectrum hoarding, the regulator can set an appropriate spectrum cap. Any allocation of spectrum beyond the cap should be based on a pre-defined set of rules.

Technology Neutrality

Technology neutrality is another important consideration in allocating spectrum. To be considered technology-neutral, the regulatory agency must maintain policies and incentives that are agnostic in terms of the technology used to provide the service. The ultimate test is whether a service provider has the freedom and flexibility to select the technology that makes the best commercial sense without interference from governments, and to benefit from any available incentives (i.e. receiving additional spectrum) to the same degree regardless of the technology used.

QUALCOMM believes that the rationale that since CDMA is more spectrally efficient than GSM, then the CDMA operators do not need, and therefore should not be awarded as much spectrum as GSM operators, is seriously flawed. Whereas it is true that CDMA is more spectrally efficient than GSM, in dense urban areas this benefit can not be fully realized by simply adding more sites given inadequate spectrum. In any cellular wireless network having a large number of sites, decreasing the average site to site distance less than some minimum will result in increased interference between sites, degrading both the capacity and the quality of the network. In the case of CDMA, where all sites use a common frequency, a practical minimum average inter-site spacing is about 500 meters. In the case of GSM, which employs frequency reuse, only the cells that use the same frequency need to be considered as interferers, and thus the overall cell density of a GSM network can be greater than that of a CDMA network. This is not to say that individual CDMA cells cannot be spaced less than 500 meters in a final network design (available site locations are never uniformly spaced). However, the global density in dense areas should not be greater than about 5 cells/sq km, which will bring the average inter-site spacing to less than about 500 meters. Therefore, this minimum spacing may be restated as a density limit,

which in the case of an efficient hexagonal-like arrangement is approximately 5 cells/sq km.

Table 1 demonstrates that given 5 MHz of spectrum (4 carriers) to serve 60,000 subscribers/sq km in a dense urban area (for the given usage assumptions) an operator would need 10 sites/sq km. This is twice the density limit recommended. Using the maximum recommended 5 sites per square kilometer and having a cell capacity of 1,500 subscribers per carrier, an operator would need 8 carriers (10*10 MHz) to support the assumed subscriber base of 60,000/sq km. We would also like to point out that among all the global CDMA operators with large scale deployments, we cannot find any examples where cell density ever reached a maximum of 5 sites per square kilometer. The highest value that we can find is less than 2 sites per square kilometer.

Table 1 – Spectrum Requirements Based on Peak Subscriber Densities in Metro Areas in the Year 2005

	CDMA2000 1X
Macro Cells (3 sectors)	
Spectrum Width (One-way) MHz	5
Number of CDMA carriers (5/1.25) *	4
#Erlangs per sector - per carrier (at 80% load factor)	20
Total Capacity per carrier per cell (20*3) - Erlangs	60
Total Capacity per cell site (60*4) - Erlangs	240
Traffic per sub - milli Erlangs (assumption)	40
#Subs per cell - (240/.04)	6,000
#Urban Subs per sq km (assumption)	60,000
#Required Sites per sq km - for 5 MHz spectrum	10
Maximum Recommended Sites per sq km	5
# Urban subs per available site (60000/5)	12,000
# Subs per cell per carrier (60/.04)	1,500
Required Carriers per Cell (12000/1500)	8
Additional Spectrum Requirement (MHz, 8*1.25-5)	5

* Note: Assumes guard band is outside the allocated 5 MHz

As it may be seen from the above table, the current spectrum allocation is inadequate to satisfy the demand even for voice services alone. Hence in order to maintain a reasonable grade of service, it is important that operators are allocated adequate spectrum.

As we note in the next section, CDMA2000 offers further benefits by helping operators provide high speed data services to the consumers. However, these benefits can only be realized if adequate spectrum is first provided for voice based services and then for data services.

Additional Benefits of CDMA2000 and High Speed Wireless Data

For the same amount of spectrum with the same traffic assumptions, a CDMA2000 1X network requires less number of cell sites than a GSM network. However, the network capital expense per subscriber (excluding site acquisition) is approximately the same for both technologies because GSM base stations are cheaper than CDMA2000 base stations. CDMA2000 1X is much more capable than GSM. CDMA2000 networks can be upgraded to CDMA2000 1xEV-DO (Evolution-Data Optimized) if CDMA operators have enough spectrum. 1xEV-DO technology is optimized for high speed data and can bring advanced services to a wider range of users; including meeting important social needs such as providing high speed Internet connectivity to clinics, schools, libraries, governments, and other priority users while also meeting the needs of business users and enabling consumer multi-media applications. In addition to accessing the Internet directly with wireless handsets or personal digital assistants, 1xEV-DO-capable PCMCIA cards for laptops and wireless modems for traditional desktop computers are also available for Internet connectivity. Verizon Wireless, the largest wireless operator in the United States with approximately 37 million subscribers, recently announced its intentions to deploy wireless *BroadbandAccess*, a nationwide high speed wireless data network based on 1xEV-DO. Wireless *BroadbandAccess* will provide high data rate services and applications to consumers in the United States.

When considering the nationwide rollout of voice and data networks, wireless networks have the added advantages of cost efficiency and speed of deployment over wire line systems. Operators' capital investments are often lower for wireless systems – both in the short term and in the long term. The operations and maintenance costs are significantly diminished in a wireless system due to centralized, automated control of the network. Lower capital and operational expenses result in a lower cost of service which makes wireless services more affordable for the average consumer. Network deployment speed is another crucial factor to consider in assessing a wireless access technology. A shorter deployment period means lower capital cost and faster access to service revenue. Wireless networks are also faster and cheaper to expand to meet subscriber demand than wire line networks. In rural areas, wire line network capital costs may be prohibitive due to significantly fewer users in a specific coverage area, forcing operators to consider a wireless solution. In India's densely populated cities, demand is growing so quickly that fixed lines cannot be installed fast enough.

In such situations, wireless systems, such as those based on CDMA2000, are a cost-effective and flexible solution with myriad advantages. Additionally, many areas of India lack the wire line infrastructure required to develop a traditional broadband network, therefore, wireless solutions will have a competitive edge, serving as the primary, if not the only, means for Internet access. To meet demand in a timely and cost-effective manner, operators must examine wireless technologies that provide high speed data transmission without the expense of installing and maintaining traditional broadband networks, such as DSL. However, to allow wireless voice and high speed wireless data networks to flourish, the government of India must release additional spectrum for mobile operators.

Conclusion

The current allocation of spectrum is inadequate to serve the demand for voice services. Hence the regulator should allocate adequate spectrum so that operators can provide a reasonable grade of service. With CDMA2000 1X and 1xEV-DO, operators have the opportunity to offer superior quality high speed data services in addition to providing affordable voice services. In order to provide quality services, CDMA operators need adequate spectrum (10 + 10 MHz) in contiguous blocks of 5 MHz each: 5 MHz in the 800 MHz band and an additional 5 MHz in the proposed 1900 MHz band. The growth of data services will spur economic expansion in the country, specifically stimulating growth in the software industry. Opportunities are also being created for India to leverage its highly skilled software workforce to become a dominating player in the development of data applications for the world market.

All of the aforementioned points highlight the importance of the regulator taking steps to facilitate economic growth by releasing additional spectrum for all operators regardless of technology. The first step should be to award additional spectrum for the newly mobile [CDMA] operators to bring them on an equal footing with the incumbent [GSM] mobile operators. This will enable CDMA operators to grow their networks to meet the public need for affordable and high quality voice and data services. The next step will be to release additional spectrum for all mobile operators to grow their networks on an equal opportunity basis.

All mobile operators will need additional spectrum to expand their networks in order to meet the growth in consumer demand and to help the government meet its targeted teledensity of 100 million mobile subscribers by 2005. This goal will only be met if the operators have adequate financial, technical and natural resources in addition to a stable and reasonable regulatory and spectrum policy. A fair spectrum policy allows operators opportunities and promotes growth in technical innovation for the benefit of the general public, government and telecommunications industry. Under such a scenario, everyone wins: the general public, government, and the operators. Economic equilibrium is achieved by giving operators freedom and equal opportunity. Based on the size and population of the country and the forecasted demand of 100 million subscribers by 2005, large operators with a nationwide footprint should have a minimum of 10 + 10 MHz of spectrum. Annex I includes a partial list of international CDMA operators who have deployed CDMA2000 including operators in densely populated developing countries. It shows that almost all of them have been assigned a minimum of 10 + 10 MHz of spectrum.

In conclusion, it is important to acknowledge that releasing spectrum for mobile operators will not only result in subsequent growth in the wireless telecommunications industry, but will have even wider implications. For example, it can also lead to opportunities for growth in the telecommunications manufacturing base in the country which does not exist today. Manufacturing of telecom equipment domestically is only possible if there is enough of a consumer base to justify a large investment to set up a handset or an infrastructure factory. By allowing mobile operators to grow their networks without any roadblocks like lack of spectrum, the government can help expand the telecom industry and make the manufacturing of telecom equipment feasible in country. China has become one of the leading manufacturers of telecom equipment in recent years due to growing demand in-

country for handsets and infrastructure. Growth in telecom industry could also promote the growth in telecom service areas in both high tech and support services. Due to its large population of an English speaking highly educated work force, India will have the opportunity to develop capabilities not only to sustain its own telecom industry but to also support telecom companies around the globe. All these factors can lead to increased economic growth from a larger manufacturing base, service sector and imports.

QUALCOMM appreciates the opportunity to submit this position paper. QUALCOMM (www.qualcomm.com) is one of the world's leaders in developing, delivering, and enabling innovative digital wireless communications products and services based on its digital technologies. Since its founding in 1985, QUALCOMM has developed products and services based on its code division multiple access ("CDMA") technology, which QUALCOMM has licensed to over 100 leading manufacturers of wireless communications infrastructure equipment and handsets around the world. QUALCOMM has developed chipsets, system software, satellite-based products, and wireless data products, all based on one or more variants of CDMA.

ANNEX 1

Various Commercial CDMA2000 Systems in Bands Above 800 MHz

Country	Operator	Date-Commercial Service	Frequency Bands	Amount of Spectrum**
Korea	SK Telecom	Oct. 1, 2000	800 MHz	25 + 25 MHz
Korea	LG Telecom	May 1, 2001	1800 MHz	10 + 10 MHz
Korea	KT Freetel	May 2, 2001	1800 MHz	10 + 10 MHz
Brazil	Telesp	Dec. 10, 2001	800 MHz	12.5 + 12.5 MHz
USA	Leap Wireless	Jan. 17, 2002	1900 MHz	15 + 15 MHz
USA	Verizon Wireless	Jan. 28, 2002	800 and 1900 MHz	15 + 15 MHz
USA	MetroPCS	Feb. 1, 2002	1900 MHz	5 + 5 MHz
Canada	Bell Mobility	Feb. 12, 2002	800 and 1900 MHz	15 + 15 MHz
Japan	KDDI	Apr. 1, 2002	800 MHz	15 + 15 MHz
Puerto Rico	Centennial Wireless	Apr. 4, 2002	1900 MHz	15 + 15 MHz
Brazil	Telefonica Celular	Apr. 16, 2002	800 MHz	10 + 10 MHz
Canada	Telus Mobility	June 3, 2002	800 and 1900 MHz	15 + 15 MHz
New Zealand	Telecom N.Z.	July 22, 2002	800 MHz	12.5 + 12.5 MHz
Chile	Smartcom PCS	July 26, 2002	1900 MHz	15 + 15 MHz
USA	Sprint PCS	August 8, 2002	1900 MHz	15 + 15 MHz
Moldova	Interdnestrcom	Sept. 30, 2002	800 MHz	12.5 + 12.5 MHz
Israel	Pele-Phone	Oct. 1, 2002	800 MHz	12.5 + 12.5 MHz
India	TataTeleservices	Nov. 7, 2002	800 MHz	5 + 5 MHz
Venezuela	Telcel	Nov. 13, 2002	800 MHz	12.5 + 12.5 MHz

* Note that not all operators have nationwide licenses and that spectrum holdings may vary slightly depending on region/license area. What is listed here represents operators' general spectrum holdings in majority of their license areas.

Venezuela	Movilnet	Nov. 20, 2002	800 MHz	12.5 + 12.5 MHz
Indonesia	Telecom Flexi	Dec. 1, 2002	800 MHz	10 + 10 MHz
Australia	Telstra	Dec. 1, 2002	800 MHz	12.5 + 12.5 MHz
Ecuador	Bell South	Dec. 3, 2002	800 MHz	12.5 + 12.5 MHz
Panama	Bell South	Dec. 3, 2002	800 MHz	12.5 + 12.5 MHz
Mexico	IUSACELL**	Jan. 24, 2003	800 and 1900 MHz	10 + 10 MHz
Thailand	Hutchison CAT	Feb. 27, 2003	800 MHz	12.5 + 12.5 MHz
Nicaragua	BellSouth	Mar. 26, 2003	800 MHz	10 + 10 MHz
Dominican Republic	Centennial Dominicana	Mar. 27, 2003	1900 MHz	15 + 15 MHz
China	China Unicom	Mar. 28, 2003	800 MHz	10 + 10 MHz
Columbia	BellSouth	April 15, 2003	800 MHz	12.5 + 12.5 MHz
Brazil	Giro (Vesper)	May 01, 2003	800 MHz	10 + 10 MHz
India	Reliance Infocomm	May 1, 2003	800 MHz	5 + 5 MHz
India	MTNL	May 19, 2003	800 MHz	5 + 5 MHz
Guatemala	BellSouth	May 20, 2003	1900 MHz	15 + 15 MHz
Guatemala	PCS	Jul. 15, 2003	1900 MHz	15 + 15 MHz
Taiwan	APBW	Jul. 29, 2003	800 MHz	20 + 20 MHz
Chile	BellSouth	Aug. 11, 2003	1900 MHz	15 + 15 MHz
Russia	MCC	Nov. 1, 2003	450 MHz	12.5 + 12.5 MHz
Peru	Telefonica Moviles	Dec. 1, 2003	800 MHz	12.5 + 12.5 MHz
Ecuador	Telecsa	Dec. 2, 2003	1900 MHz	15 + 15 MHz
Dominican Republic	CODETEL	Dec. 3, 2003	1900 MHz	15 + 15 MHz
Peru	Bell South	Dec. 5, 2003	800 MHz	10 + 10 MHz
Indonesia	Mobile8	Dec. 24, 2003	800 MHz	10 + 10 MHz
Kazakhstan	Datacom	Dec. 9, 2003	800 MHz	12.5 + 12.5 MHz
Argentina	Movicom (Bell South)	Dec. 15, 2003	1900 MHz	10 + 10 MHz

** In Mexico, Unefon and IUSACELL are now under the same operating control. Unefon, a CDMA (IS-95A operator) has 15 + 15 MHz of spectrum but has not yet launched CDMA2000 so we chose not to include the combined spectrum holdings at this time. IUSACELL has 12.5 +12.5 MHz of spectrum in Regions 5 to 9 in the 850 MHz band and 5 + 5 MHz in Regions 1 and 4 in the 1900 MHz band (CDMA)