RADIO RESOURCE MANAGEMENT IN HIGHLY POPULATED DEVELOPING COUNTRIES

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ABSTRACT

In highly populated developing countries like India, the efficient management of radio spectrum poses several unique challenges and calls for unique solutions that are customized to meet the specific economic needs of the each particular country. Efficient spectrum use can be ensured through a number of measures that are and should be adopted by all countries and more especially by countries that are confronted with huge tele density objectives and a constraint on spectrum availability. Since the Indian Government too, has identified mobile /wireless as the primary platform to achieve the country's telecom objectives, the various measures through which efficient spectrum use can be ensured, within this framework, are discussed in this contribution.

INTRODUCTION

World over, telecom is acknowledged to be a critical infrastructure sector. Growth and development of telecom services has a direct and significant impact on the efficiency, competitiveness and growth of every other sector of the economy. International studies have shown a direct relationship between growth in tele-density and its impact on economic growth. In fact, it is generally accepted that for every 1% increase in tele-density, there is a 3% increase in the rate of growth of Gross Domestic Product (GDP).

Within telecom, it is the mobile infrastructure that has demonstrated itself to be the most conducive medium to rapidly and economically deliver the benefits of communications and connectivity in developing economies. Cellular mobile telephony is uniquely suited to bridge the digital divide and bring modern telecommunications services to chronically underserved communities. While, setting up a fixed line infrastructure is a costly and time-consuming task, cellular networks are cheaper to set up and faster to deploy and thus represent the optimal solution to expeditiously reaching the power and benefits of telecommunications to remote and rural areas in developing countries.

As a result of the above advantages, it is increasingly being realized that developing nations can best realize their desired tele density and associated socio-economic objectives through the mobile route. Mobile can thus become an effective tool for developing economies; not only to bridge the urban-rural digital divide in their own countries, but also to catch up with other developed nations that have achieved significant maturity in their telecoms environment.

Thus, developing economies are increasingly adopting the wirefree characteristic to pursue their telecom objectives. As a result, the requirement for spectrum has increased dramatically in such countries and Governments are finding it difficult to keep pace with the spectrum demands of service providers. There is therefore, in these countries, a definite case for managing their available spectrum resources in the most optimal and efficient manner.

The Indian Government too, has identified mobile /wireless as the primary platform to increase tele density and achieve the country's telecom objectives. The mobile-fixed cross over has already taken place in India in October 2004. Of the present telecom subscriber base of 102 million, over 55 million subscribers are mobile subscribers. Going forward too, it is expected that the mobile industry will contribute at least 180-200 million subscribers to the Government's target of 250 million telecom subscribers by December 2007.

It is estimated by experts that the efficient management of spectrum contributed USD 771 billion to the US economy in 2001 and 20 billion pounds sterling in the United Kingdom. These numbers can give some idea of the value of efficient spectrum management for developing economies, especially those that have both a large geographical footprint as well as a sizeable population.

The Paper will discuss the various measures through which efficient spectrum use can be ensured. These include:

1. Harmonized Spectrum Use
2. Transparent & Fair Assignment of Spectrum
3. Spectrum Pricing
4. The Role of 3G

HARMONIZED SPECTRUM USE

Spectrum harmonization is an important aspect of spectrum efficiency in global radio communications. To avoid interference amongst systems, not only the frequency bands, but also the direction of transmission (i.e., from base station to mobile and from mobile to base station) must be harmonized. Global harmonization of spectrum also offers an opportunity and an incentive for manufacturers to develop and engage in the production of large volumes of low cost telecom equipment. Use of globally harmonized common spectrum, as identified by ITU-R, will lead to:

a. Interference-free operations
b. Optimal utilization of spectrum (no wastage by guard bands etc),
c. Facilitation of Global roaming
d. Availing of the benefits of the economies of scale of globally available standard equipment, etc

In this connection it is important to note the recommendations made by the ITU Regional Working Group on Private Sector Issues, which met on April 26-27, 2004 in New Delhi. The recommendations of the Group, which were consensually agreed between all stakeholders, including representatives from several Asia Pacific and other countries are as under:

a. "Harmonized frequency allocation is essential for facilitating global roaming, economies of scale, wide competitions and benefits to the end-users.
b. Consistency in identifying global spectrum for specified services also provides regulatory certainty for operators, investors, manufacturers and administrators and facilitates development of global standards.
c. Long-term spectrum plans should consider ITU-R globally harmonized spectrum use as well as the technological evolution paths of different wireless systems in a given market. The adequate accommodation of these requirements in national spectrum allocation should aim to give operators certainty in their long-term plans and strategies.
d. ITU has identified certain bands for the IMT 2000 / 3G applications, without precluding the use of these bands for other wireless applications. It was pointed out by the ITU expert that the thrust of the ITU Recommendations was achieving global harmonization of spectrum use and that the same should be implemented."

It is therefore clear that use of the ITU-R identified globally harmonized spectrum increases the equipment commonality, facilitates global roaming and brings benefits of economies of scale for the consumers. Lack of harmonization could prevent countries from enjoying the benefits of a quasi-global large-scale production of common equipment. It is thus important for developing countries such as India, to integrate themselves with the global community and also deploy the ITU-R globally harmonized frequency bands to achieve their connectivity targets in the most optimal, cost efficient and effective manner.

TRANSPARENT AND FAIR ASSIGNMENT OF SPECTRUM

Internationally, the general practice is that cellular operators are indicated/allotted the total spectrum that would be made available to them right at the time of issuing the cellular licenses. This gives operators the flexibility to design their networks in the most optimal manner so as to maximize the efficiency of this scarce resource. One time upfront allocation of spectrum also ensures capex saving resulting in increased affordability of service for consumers.

However, whilst it would be desirable for mobile operators to get their entire spectrum allocated at one-go at the time of signing of their license agreements, practical constraints on availability of spectrum because of say, use of spectrum by other users, etc. often means that service providers get additional spectrum in small tranches. This has also been the case in India, where due to constraints on availability, the operators were given an initial assignment of only 2x4.4MHz in the 900MHz band.

Under such circumstances, it is very important to lay down a clear roadmap regarding the availability of spectrum for service providers in the short, medium and long term and also lay down a similar roadmap for the vacation of spectrum

by existing users. Such measures will ease the pressure on the Government of having to allocate spectrum at one go and simultaneously also facilitate efficient network planning and design for service providers.

Also, to ensure equity and fairness to all service providers, it is important to have a fair and transparent queuing arrangement for assignment of additional spectrum. In India, the queuing mechanism is such that it is linked to subscriber numbers (as a rough approximation of erlang capacity) and the achievement of pre-defined subscriber targets triggers of eligibility for the next round of spectrum assignments.

The Government first adopted the subscriber-linked spectrum assignment approach when it was considering the additional spectrum requirements of the GSM operators. Indian GSM operators were initially assigned only 2x4.4 MHz (in case of the 900MHz band) / 2x6.2 MHz (in case of the 1800MHz band) spectrum. However, with the explosive growth of mobile services in the country, especially after 1999 when the country moved over to a more beneficial revenue share license fee regime, it was becoming fast apparent that operators would need significantly more spectrum than their initial assignments to cater to their growing subscriber base. In fact the Compound Annual Growth Rate (CAGR) for GSM subscribers from 1999-2004 was in the region of around 95% per annum.

Thus, to examine and consider the demand for additional spectrum by GSM operators, the Government constituted a Technical Committee. The Committee examined the current utilization of assigned bandwidth by the GSM operators as also analyzed the network design practices followed by the GSM operators. For the study of the network design practices, the traffic densities in Most Dense Areas (MDAs), Dense Traffic Areas (DTAs) and Normal Traffic Areas (NTAs) were calculated by using two carriers for in-building solutions and reuse pattern of BCCH as 5/15. The inter-site distances for the MDA were taken at 750-900 meters. The maximum traffic density handling capability in an MDA taking 85% efficiency came to 87.13 Erlang /square kilometer for 2x6.2MHz; 135.33 Erlang/square kilometer for 2x8 MHz and 197.09 Erlang /square kilometer for 2x10MHz. The maximum traffic density in DTAs and NTAs was taken as 25% and 10% respectively of the traffic density in an MDA. The total traffic handling capacity of a city/service area was then calculated by a summation of the traffic handling capacity of the MDA, DTA and NTA of the city/service area. The erlang capacity was then translated into number of subscribers assuming an average traffic of 35mE/subscriber. Based on the above calculations, the Committee decided that a bandwidth of 2x6.2 MHz, 2x8 MHz and 2x10Mhz is sufficient to serve 0.5, 1 and 1.5 million subscribers respectively. The Committee also decided that taking into account the lead time required for planning, coordination, equipment procurement and implementation, etc, the service provider may apply for additional spectrum after reaching 80% of the subscriber base possible within the already assigned spectrum. Based on the Report of the Technical Committee the Government laid down the following roadmap for assignment of additional spectrum to GSM operators:

	Subscriber Base (in Millions)	**Assigned Spectrum**
Step 1	Initial Assignment	2 x 4.4 / 2 x 6.2 MHz
Step 2	0.5	2 x 8 MHz
Step 3	1.0	2 x 10 MHz
Step 4	1.5	2 x 15 MHz #

Beyond 2x10MHz will be given in chunks of 2x2MHz

SPECTRUM PRICING

Spectrum pricing in developing countries has to be undertaken keeping in mind the particular environment inasmuch as the Governments in these countries have to balance the twin objectives of accessibility and affordability of services as well as achieve a speedy increase in tele-density.

Whilst there are a number of options used for spectrum pricing and there can be no one perfect model, it is important to identify the principles, which should be adopted to serve as guidelines on how this resource should be optimally priced for efficient utilization. In the case of developing countries where affordability is the key criterion to ensure the spread of service, it is very important that the pricing of spectrum does not increase the cost of service and thus hinder the growth of the sector.

In India, the Government is following the principle of an entry fee for spectrum (which at present is bundled along with the license) plus spectrum usage charges which are paid annually as a percentage of revenues. India follows a customized version of AIP (Administered Incentive Pricing) whereunder additional spectrum assignments entail the payment of a higher percentage of revenues as usage charges. This mechanism of requiring service providers to pay a higher percentage of their revenues on a higher revenue base, is not only a simple and transparent approach, but it also

acts as an effective measure to ensure that service providers optimally utilize their existing assignments before seeking additional spectrum. The spectrum usage charges for GSM operators are as below:

	Assigned Spectrum	Spectrum Usage Charges per annum (as a % of Adjusted Gross Revenues)
Initial Assignment	2x4.4 MHz	2%
Step 2	2x6.2 MHz	3%
Step 3	2x10 MHz	4%
Step 4	2x12.5 MHz	5%
Step 5	2x15 MHz	6%

While in principle, the stepped approach is a good one as it is fair, simple, transparent and easy to administer and also ensures the efficient use of spectrum, in the interests of sustained affordability of service, there is a requirement to set a cap on the spectrum usage charges. It is felt that an overall cap for spectrum usage charges may be set at 2% of revenues and within this, a stepped approach may be adopted by prescribing increments of 0.2 or 0.25%, for increased levels of spectrum allocation.

THE ROLE OF 3G SERVICES

It is a well known fact that 3G spectrum can deliver 4-5 times the voice capacity of 2G spectrum. In markets that are driven by affordability, 3G can serve as an ideal platform to deliver low cost voice telephony to the consumers. 3G can thus be an extremely effective tool for developing economies in driving penetration in where price of service is the key factor for encouraging increased subscriber take-up. 3G can also prove to be a crucial tool in undertaking social initiatives of Governments such as delivering E-Education, Tele medicine, etc especially in rural markets, which would help to mainstream rural markets with the rest of the population. For the reasons outlined above, expeditious introduction of 3G services is both relevant and important for developing countries. However, the success of 3G in developing economies will primarily be determined by the affordability of the service. If 3G spectrum is awarded through bidding or by levying huge upfront costs, the huge benefits that 3G can offer will be lost as the service would be beyond the reach of the common man. It is also equally important that when 3G is introduced in developing countries, it should be allowed as an overlay network, so that 3G offerings are determined by the demands of the market and not by any rollout obligations stipulated by the Government.

The Indian Government has already decided in principle to introduce 3G services in the country. 3G will be offered in the international consensus band of 2.1GHz identified by ITU for IMT-2000 and also earmarked by the National Frequency Allocation Plan 2002 (Spectrum Policy Document). The incumbent PTTs have already initiated some measures in this regard in the form of a pilot project and floating a tender for 3G. The private operators are also very bullish on 3G as all the private GSM operators have already applied for 3G spectrum. In fact the largest private GSM operator has already announced its intentions to invest USD 1 billion in 3G. It is expected that the introduction of 3G will serve as a catalyst in accelerating the growth of mobile telephony in India and will help achieve the connectivity objectives of the Government.

CONCLUSION

It is clear from the above that efficient and optimal utilization and management of radio resources is a crucial factor in highly populated developing economies and administrations have to adopt a number of steps to ensure the achievement of the twin objectives of affordability and access. Use of globally harmonized spectrum; adoption of fair, transparent and objective spectrum assignment criteria; innovative pricing measures that ensure both efficiency of utilization and affordability of service are some of the measures that have been adopted by the Indian Government to facilitate the achievement of its aggressive telecom objectives. In addition, the expeditious introduction of 3G services in the 2.1GHz international consensus IMT-2000 band identified by ITU in WARC-92 and it is expected that launch of 3G will play a significant role in accelerating growth and increasing tele density.