Comments on TRAI Consultation Paper on Spectrum Related Issues

from

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Chapter 2: Current spectrum availability and requirement

(i) Should the 450 MHz or any other band be utilised particularly to meet the spectrum requirement of service providers using CDMA technology?

Comment: Spectrum allocation is best done for a service without specifying the technology. Of course, the band alloted must suit equipment availability, and the channeling plan, duplex spacing, method of sharing spectrum between operators (if any), and emission masks (if any), must suit the technologies operators would wish to deploy. Therefore, often there will be an underlying assumption about the technologies to be deployed in a band when deciding on its allotment. However, software-defined radios and re-configurable radios are fast becoming a reality, and one can expect increasingly rapid rollout of newer and more spectrally efficient technologies. One should not stand in the way of their deployment in bands already alloted, Therefore, it is best when alloting a band that only four spectrum-related characteristics are specified and not the technology to be used. These are: channeling plan (to the extent of minimum contiguous assignment to be made to an operator, as well as the downlink and uplink bands in the FDD case), duplex spacing, method of sharing spectrum between operators, and emission masks. Apart from these four spectrum-related characteristics, nations have often set aside certain bands for technologies based on national standards, or technologies with prescribed indigenisation levels/ indigenous technologies. This is done to meet certain national objectives as a matter of policy.

(ii) The consultation paper has discussed ITU method for assessment of spectrum requirement. Based upon the methodology submit your requirement of spectrum for next 5 years. While calculating the required spectrum, please give various assumptions and its basis.

(iii) Whether IMT 2000 band should be expanded to cover whole or part of 1710 – 1785 MHz band paired with 1805 – 1880 MHz?

Comment: In consonance with comments made for (i) above, it is best to give operators the maximum leeway in choosing the technology to be deployed. Thus, for example, if a 5+5 MHz contiguous assignment is made to an operator in this band, with 95 MHz duplex separation, the operator may deploy GSM/GPRS with twenty-five 200 kHz channels, or CDMA2000 with four 1.25 MHz channels or WCDMA with one 5 MHz channel. The uplink and downlink bands must be clearly specified irrespective of technology, and emission levels both within the assigned band (in this example 5 MHz) and outside it, must be specified. A band cannot be opened up for multiple technologies (true technology neutralily) without specifying these properly.

(iii) Should IMT 2000 spectrum be considered as extension of 2G mobile services and be treated in the same manner as 2G or should it be considered separately and provided to operators only for providing IMT 2000 services?

Comment: As mentioned for (i) above, spectrum should be alloted for a service, and the definition of the service(s) should be identical for both spectrum allocation and licensing. A licensee therefore knows explicitly which band is alloted for the services to be provided against the license. If this premise is accepted, this question can be re-posed as follows: *should spectrum be alloted separately for different services provided under a common license (e.g., data and voice services of IMT2000), or should we permit an operator to employ spectrum for various services as the market dictates*? We feel that one should let the market dictate how spectrum is to be used. The reason is that mobile voice service has become the cheapest technology for telephony, and in our country with a vast unmet telephony demand, there is no need to reserve spectrum for data services and prevent it from being used for voice services if market forces so dictate.

(v) Reorganisation of spot frequencies allotted to various service providers so as to ensure the availability of contiguous frequency band is desirable feature for efficient utilization of spectrum. Please suggest the ways and means to achieve it.

Comment : None.

(vi) Whether the band 1880 – 1900 MHz be made technology neutral for all BSOs/CMSPs/UASLs and be made available with the pair 1970 – 1990 MHz or should it be kept technology neutral but reserved for TDD operations only.

Comment : The allocation of 1880-1900 MHz (as per IND49) is for "microcellular WLL systems based on TDD access techniques, especially indigenously developed technologies, capable of co-existence with multiple operators in the frequency band 1880-1900 MHz on a case-by-case basis". It should be noted that the allocation ***is already technology neutral***, except that it specifically encourages the use of indigenous technologies by way of giving a fillip to technology development in India. As mentioned in the response (i) above, even while being technology neutral, it is imperative to specify the duplex type (here, TDD), method of sharing spectrum among operators (here, co-existence), channelisation (none, consistent with co-existence criterion), and emission characteristics (here, specified in qualitative terms as "micro-cellular"). Thus, it is clear that there is ***no need for any changes in the allocation of this band***. It is also worthwhile mentioning that this allocation has and continues to serve its purpose well. The indigenously developed corDECT technology has been deployed extensively all over the country by several operators for providing voice and data services very cost-effectively in urban and rural areas. The next-generation corDECT technology with bit-rates of 100 / 200 kbps per user, and 2 Mbps peak bit rate, is also to be deployed shortly.

Chapter 3 Technical efficiency of spectrum utilization

(vii) Please offer your comments on the methodology outlined in this Chapter for determining the efficient utilization of spectrum. Also provide your comments, if any, on the assumptions made.

Comment: (a) The definition of *M* in eq (2) of p. 19 used in the studies reported in Sec

3.2 is Erlangs, and the SUE then is measured in Erlangs / MHz / sq. km. The traffic is measured for a specified GoS, which implicitly assumes that call blocking is the primary service quality parameter. This is a voice-centric definition, and further, it does not account for call drop rate, an important parameter in cellular systems. Going forward, cellular systems are becoming multi-service voice and data communication systems, and the definitions of *M* and QOS have to change. There are several examples of system capacity (related to spectral efficiency) estimates for data services alone ["*WCDMA for UMTS*" by Holma and Toskala, Wiley, 2002] and for mixed voice and data services ["*GSM, GPRS and EDGE Performance*" by Halonen et al, Wiley 2003]. In some of these, the QoS parameter for a data service, for example, is the probability of supporting the minimum bit-rate negotiated by a user. Most of these estimates are based on simulations since simple analytical estimates are not accurate enough.

(b) Worst-case C/I figures obtained by purely geometric arguments, as in the table on p.22, are rarely used nowadays. They ignore the impact of typical terrain features, etc., and also do not account for interference averaging from techniques such as frequency hopping. This type of worst-case analysis leads to a conservative estimate of the capacity of cellular systems. More modern estimates rely on a combination of analytical models and simulations, followed by validation from field measurements. It should also be mentioned that the minimum C/I requirements specified are too conservative, being the values historically employed when voice was the only service and voice coders were more primitive. Today, with AMR voice coders, the C/I requirements are significantly lower. In the case of data services too, the use of turbo codes allows one to operate with near-zero C/I values, and link adaptation techniques make the use of a single C/I threshold simplistic.

(c) In Table 3.1, the assumption that the re-use factor with micro-cells is 1:3 is probably very approximate. More accurate results can be obtained based on simulation models.

(d) It is not clear why capacity ***decreases*** with increased spectrum availability in Fig. 3.3 for the case with 25% micro-coverage.

(e) Estimates of maximum cell density (sec 3.2.2.1.2) are best made from analytical/simulation results. These can be compared with the density achieved in practice till date in the field

(f) In interference-limited cellular deployments, GoS is not the only, and arguably not the most, important quality parameter (sec3.2.2.2). Probability of dropped calls (due to interference and unsuccessful handoffs) is equally, if not more, important. This has to be quantified, and can be done very well using multi-cell simulations.

(g) With the FoM as defined, the actual spectral efficiency exceeds the theoreticl efficiency in Figs. 3.6 – 3.9. This most probably indicates that the model employed to calculate the theoretical calculation is conservative.

It is clear that the definition of spectrum efficiency is an evolving one, particular in the context of multi-service platforms. Its estimation requires complex simulations, since most modern technologies employ several statistical techniques such as interference averaging by hopping, AMR codecs, link adaptation, adaptive antennas, etc. ["*Radio Resource Management for Wireless Networks*" by Zander and Kim, (Artech, 2001) is an example of a text-book that describes a methodology for simulating complex multi-service multi-cell networks]. In light of this, we feel that TRAI should have a mechanism for continuously assessing spectrum efficiency of various technologies and the methodologies involved. This could take the form of an expert committee which, in turn, draw extensively from expertise available in industry, academia, government, and international bodies. If the papers generated thus are subject to peer review and are

disseminated widely, they will stand scrutiny and become benchmarks not only in India, but also elsewhere in the world.

viii) Please provide your perception of the likely use of data services on cellular mobile systems and its likely impact on the required spectrum including the timeframe when such requirements would develop?

Comment : There are a number of applications involving data delivery, such as SMS, MMS, e-commerce, etc which are popular with mobile terminals. In all these cases, the revenue earned per bit delivered is much higher than for voice. In contrast, the revenue that can be earned for providing Internet access is much lower per bit delivered than for voice service. Thus, as long as there is pent-up demand for mobile voice services, and spectrum is insufficient to meet the demand, market forces will dictate the provision of voice service with the available spectrum (apart from the higher revenue-earning data services mentioned above). At the same time, there will be a large part of the population that will not have broadband access to the Internet due to non-availability of wireline connectivity. Fixed/nomadic/mobile broadband wireless technologies such as HSDPA/HDR/802.16 (and more to come) will therefore play an important role. An operator will need to provide at least 20 Mbps per sector with 1:1 re-use in order to meet the expectations. This calls for at least 10+10 MHz spectrum per operator to begin with.
Our expectation is that such deployment is likely to become feasible in 2006 in a big way.

Chapter 4 Spectrum Pricing

(ix) Is there a necessity to change from the existing revenue share method for determining the annual spectrum charge?
(x) If yes, what methodology should be used to determine spectrum pricing for existing and new operators? (Please refer table in Section 4.8)
(xi) In the event AIP is adopted as a means to price spectrum, would it be fair to choose GSM as a reference for determining the spectrum price?
(xii) Please provide your comments on the assumptions used in A.I.P.

(xiii) In case Auction methodology is used for pricing the spectrum, please give suggestions to ensure that spectrum pricing does not become very high and spectrum is available to those who need it.
(xiv) Should the new pricing methodology, if adopted, be applicable for the entire spectrum or should we continue with revenue share mechanism till 10 + 10 MHz, and apply the new method only for spectrum beyond this?

Comment : No comments for (ix) – (xiv).

(xv) What incentives be introduced through pricing to encourage rural coverage and / or using alternative frequency bands like 450 MHz?

Comment : Subscriber density is very low in rural areas, and wireless is the only cost-effiective technology option. At the same time spectrum is largely under-utlised in rural areas. Spectrum pricing must be such as to encourage operators to provide voice and broadband data services in rural areas. Revenue share is a reasonable way to ensure

that spectrum is priced based on ability to pay, which is low in rural areas. However, this approach, or any alternative that achieves the same effect, must apply to all subscriber services provided using wireless, irrespective of whether it is voice or Internet access. Currently revenue-share method of spectrum pricing is not available, for example, for Internet service providers. On the question of use of 450 MHz band, while it is a good band for rural coverage, the use of any available spectrum to provide rural services must be encouraged. There is no scarcity of spectrum in rural areas, and all available avenues, including utilisation of unused spectrum, should be explored for rapidly expanding rural coverage.

(xvi) Does M X C X W formulae for fixed wireless spectrum pricing need a revision? If so, suggest the values for M, C, W?

Comment: Spectrum assigned for fixed wireless subscriber ***access*** should be distinguished from spectrum assigned for fixed wireless ***backhaul***. Spectrum assigned for fixed wireless access, which is primarily for voice and Internet access wherever wireline does not / cannot reach, should be priced in a manner similar to spectrum assigned for mobile access, e.g., revenue sharing. The MCW formula should not be used in this case. Even when the formula is used for pricing spectrum assigned for backhaul, the pricing should be significantly lower for rural backhaul. There is nothing gained by pricing a renewable national resource out of reach of the rural populace and thereby leave it unused. Further, as in Brazil and some other countries, we could encourage use of un-crowded spectrum at high frequencies for backhaul by reducing the price as one goes to higher frequencies.

(xvii) Should there be different pricing levels for shared spectrum versus spectrum that is allocated with protection? How should this be determined?

Comment : If revenue-sharing is adopted, to some extent this is taken care of. However, use of technologies that permit sharing of spectrum lead to higher spectrum efficiency / utilisation, and their use should be rewarded. This will incentivise operators to share spectrum, as otherwise the preference is for protection. This could be done, by a lower revenue-percentage when spectrum is shared. If revenue sharing is not the basis, and spectrum is priced based on bandwidth assigned, obviously when spectrum is shared, the pricing must be for the amount of shared spectrum assigned divided by the number of operators sharing it.

Chapter 5 Spectrum allocation

(xviii) How much minimum spectrum (refer approach (I) and (II) in section 5.4) should each existing operator be provided? Give the basis for your comments.

(xix) At what stage the amount of spectrum allocation to new entrants be considered in the 800 MHz / 1800 MHz frequency bands?

Comment : No comments for (xviii) and (xix).

(xx) Should spectrum be allocated in a service and technology neutral manner?

Comment : This issue has been addressed already in several earlier comments, but is summarised again. Spectrum allocation should be defined for the same basket of

services as specified in a license, and beyond that, by and large, one should not rule on which spectrum should be used for what service. While being technology neutral, the four major spectral characteristics have to be specified for every allocation: duplex spacing (for FDD) including uplink and downlink bands, emission masks outside the assigned band, method of sharing spectrum between operators (if any), and minimum contiguous spectrum assignment to an operator.

(xxi) What should be the amount of cap on the spectrum assigned to each operator?

(xxii) What procedure for spectrum allocation be adopted for areas where there is no scarcity and in areas where there is scarcity?

(xxiii) Which competitive spectrum allocation procedure (Auction / Beauty Contest) be adopted in cases where there are scarcity?

(xxiv) Should we consider giving some spectrum in 900 MHz band to fourth CMSPs?

(xxv) Comments of stakeholders are invited on the minimum blocks such as 2 X 2.5 MHz / 2 X 5 MHz of additional spectrum to be allocated to existing service providers in situations where IMT 2000 band is opened as well as in situation where it is not opened. Additionally, comments are also invited on the minimum allocation to new entrants.

(xxvi) In the event that IMT 2000 spectrum is treated as continuum to 2G, should existing operators using spectrum below the specified benchmark be treated as those eligible for IMT 2000 spectrum?

Comment : No comments on (xxi) to (xxvi).