RESPONSE TO CONSULTATION PAPER ON SPECTRUM RELATED ISSUES

RELIANCE INFOCOMM LTD.

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C O N T E N T S

PREFACE

We sincerely thank the TRAI for starting the discussion / consultation on this most crucial issue of spectrum allocation, spectrum efficiency and spectrum pricing because the spectrum requirements are increasing due to more and more wireless applications in the telecommunication field.

We also congratulate the Regulator for having brought out a very comprehensive consultation paper bringing out all the relevant issues, which need to be debated and considered in order to have appropriate spectrum policy in India.

We have prepared our response to the issues raised in the consultation paper and our response /report is divided into three parts.

Part – I	Gives the Executive Summary
Part–II	Explains the Complete Background of All the Relevant Issues
Part-III	Pointwise Response to the Questions Raised in the Consultation Paper

We would be happy to provide any additional information, which may be required by the Authority.

Reliance Infocomm Limited

PART - I

EXECUTIVE SUMMARY

Spectrum allocation:

(a). Spectacular growth of mobile services in India after the introduction of wireless telephony based on CDMA technology. Wireless telecom likely to overtake the landline connections in India in this year itself.

(b). The present allocation of spectrum is unequal and also insufficient to meet the requirements of growth in future as well as to meet the growing requirements of broadband data services. Minimum requirement of spectrum is 15 + 15MHz to 20 + 20 MHz to each mobile operators in line with the international standards.

(c). The allocation of spectrum should be technology and service neutral.

(d). Spectrum allocation should be contiguous and allotted in one lot for better planning of network , instead of piecemeal allocation.

(e). Level playing field i.e., no preference for any technology, all technologies should be equally treated in terms of spectrum allocation. Both the CDMA and GSM are mobile technologies and the operators using both technologies have paid same entry fee and are paying same license fee with similar roll out obligations after migration to unified access license and hence the need to remove the anomaly of difference in frequency allocation.

(f). Spectrum allocation should be appropriate (suitable in terms of ready availability of handsets and infrastructure). These should be available from multiple vendors from different countries to avoid dependence on any vendor or any region.

(g). There is no single spectrum band, which can be called IMT2000 band since ITU recommendation No. M.1036-2 has identified eight different bands or their combinations to be used for ITM2000. ITU permits flexibility in the use of bands for different applications.

(h). There are large number of countries where both GSM and CDMA technologies are operative. However, there are countries where GSM system is working in 800/900/1800/1900 MHz and in no country CDMA systems are working in all these bands. The CDMA systems on the other hand are working in 800 or 1900 OR 800 and 1900 MHz band only. Even in Korea, the CDMA systems are working in 800 or 1800 MHz but not 800 and 1800 MHz band.

(i). The requirements for guard bands and filters cannot be the ground for not allocating 1900 MHz band for CDMA operators because guard bands are required

not only between two different frequencies but also between the two operators using the same frequency band.

(j). The ideal band to meet the spectrum requirements of service providers using CDMA technology is USPCS band but the 450 MHz band could be allowed as a complement/ supplement to the 1900 MHz band but not as a substitute.

(k). The whole of PCS1800 band (1710-1785 p/w 1805-1880 MHz) should be expanded to cover IMT2000 as the same has been recognized as IMT2000 band by WRC2000.

(l). In India, the licenses are technology neutral and the licensees are permitted to provide voice and data services. There is nothing called IMT2000 spectrum since ITU has recommended different bands for IMT2000 and hence IMT2000 service has to be considered extension of 2G service as no separate licenses are required for 3G services.

(m). Reorganization/refarming of spot frequencies is required to allot continuous frequency band to the service providers. And avoid wastage in guard bands.

(n). Since we propose technology neutral approach, the band 1880-1900 MHz should be technology neutral and should be available for FDD operations also.

(o). There is a growing requirement of data services. This is provided as per the USO guidelines and broadband policy recommended by the TRAI. The requirements for mobile data services are increasing, particularly in the CDMA networks. And this growth for wireless data requirements will need additional spectrum of at least 5+5 MHz in addition to 15+15 MHz as minimum requirement.

(p). The spectrum allocation procedure should be to allow the allocation of spectrum upto 15+15 MHz to the existing operators. The regulator need not determine the efficiency of either technology in order to allocate spectrum. The spectrum should be allocated in a service/ technology neutral manner.

(q). We ideally would not recommend any cap on spectrum allocation but since the market in India is yet not fully matured and the anti competition regulations/legislations in India are not, in their present form, in a position to control the anti competitive behavior (hoarding of spectrum to jeopardize competition), we propose a cap and there should be a provision for a periodic review as and when required. Moreover, there is no need to evolve any new method of spectrum allocation, whether there is a scarcity or not, in any area.

(r). As regards the competitive spectrum allocation procedure (auction/beauty contests), any method, which gives equal spectrum for all service providers and initial allocation of 15+15 MHz as per international standards and which does not differentiate between technologies, is suitable for spectrum allocation.

(s). In areas where segments of 900 MHz band are available even after meeting the requirements of first three GSM operators, is such areas, 5 MHz downlink (889-894 MHz) of 900 MHz band should be utilized for pairing with 844-849 MHz and may be allocated to the CDMA operators.

(t). Spectrum trading should be de-linked from the current consultation process and should be separately considered since trading has been permitted in matured markets and it involves larger implications and a deeper study.

(u). In the Indian context, there may not be a separate specific service to be called IMT2000 service for which any special license is required. However, since the requirement for wireless data in the form of High Multimedia Messaging (HIMM) and other real time video gaming services are going to increase using mobile devises, the combined cap to include such data services should be 20+20 MHz.

(v). Keeping in view the principles above we suggest the following spectrum allocation:

1) 1710-1755 MHz p/w 1805-1850 MHz (2 x 45 MHz) for GSM
2) 1850-1880 MHz p/w 1930-1960 MHz (2 x 30 MHz) for CDMA (B3)
3) 1900-1910 MHz p/w 1980-1990 MHz (2 x 10 MHz) for CDMA (B3)
4) 1755-1805 MHz p/w 2110-2160 MHz (2 x 50 MHz) for 3G as per ITU-R (B5) Recommendation M.1036-2. to be equally shared between GSM and CDMA.
5) 452.5-457.5 MHz p/w 462.5-467.5 (2x5 MHz) for CDMA

(In terms of policy we are in favour of technology neutral approach for spectrum allocation but to bring in parity with the GSM spectrum allocation we have suggested the 450 MHz to be earmarked for CDMA based operators)

Spectrum efficiency :

(w). Technical and spectrum efficiency should not be interchangeably used since trade-off between technical (cost) and spectrum (resource) efficiency is important. TRAI should use market principles and allocation processes to ensure maximum efficiency of networks. The Regulator should consider methods of encouraging efficient use of spectrum rather than aiming to measure or determine what is efficient because there is no single metric, which can be specified for measuring spectrum efficiency. If at all, one measure is to be used it should be erlangs/MHz and not erlangs/MHz/KM.

Spectrum pricing :

(x). Spectrum and capital are substitutes in wireless systems. Additional spectrum means that an operator can install fewer base stations to get the same capacity and quality of service. Service providers will use their spectrum in order to minimize the capital expenditure needed to provide the service. Hence it is important that the spectrum is priced in a manner, which will induce the operators to first invest in up gradation and optimal utilization of their networks before they seek additional spectrum.

(y). While deciding about the pricing policy for spectrum, raising government revenues should not be the objective at all. The objective should be to provide efficient and affordable service to the masses. The price should be based on recovery of cost of administration or managing spectrum. Auctioning is not suitable in the present Indian context.

(z). Since spectrum pricing at higher level, will lead to increase in the cost of service and will be against the national objective of NTP'99 to provide affordable services. Administration cost recovery basis for spectrum pricing upto the initial entitlement of 15+15 MHz and market driven efficiency based AIP beyond 15+15 MHz is recommended.

Charges	Spectrum to existing operators upto 2x15 MHz.(spectrum entitlement as a part of licence).	Additional spectrum to existing operators beyond 2x15 MHz.	New entrants
One time entry fee	NIL	NIL	Same as paid by existing licensees to ensure level playing field.
Annual charges	Minimum charges based on recovering the cost of administering spectrum on charge per MHz basis.	Charge per MHz to be arrived at on the basis of AIP method which can also ensure spectrum efficiency based on market mechanism.	Same as proposed for the existing licensees to ensure level playing field

(aa). For encouraging the coverage in rural areas, special discounts like deducting the revenue obtained from services from such areas from the gross revenue for the purpose of calculating annual license fee, exemptions of excise/custom duty on

the equipment used in such areas and no annual charges for use of 450 MHz in rural areas etc are suggested.

(bb). There is a need for change of the formula for payment of royalty charges for the basic (Unified Access) licensees for terrestrial links. Ideally, we should suggest this charge also to be based the cost of cost of administration recovery method. However, due to the reasons stated in answer to question (xvi)) we propose:

?? migration to royalty charges based on proposed percentage basis of AGR to be in line with the similar charges for the cellular operators.

?? Allocation of frequency spots for the entire circle, again in line with the cellular operators, instead of town-wise allocations as at present.

PART - II

TRAI CONSULTATION PAPER NO 11/2004 ON SPECTRUM ISSUES

BACKGROUND

1.0 There has been an unprecedented growth in wireless services in the country in the recent past. The number of wireless subscribers is growing at the rate of more than 1.5 million per month.

1.1 The teledensity has increased from about 2 per hundred up to the year 2000 to more than 7 per hundred today. The growth since 1995, when the first mobile was launched, was 12.6 million till the end of 2002-03 and in the next one year or so more than 21 million mobile subscribers have been added. **In policy terms it means achieving the teledensity targets of NTP'99** (i.e., 7 per hundred by 2005) much ahead of time.

1.2 This unparalleled growth in wireless subscriber base has been attained after the introduction of wireless telephony based on CDMA technology. Apart from introducing state –of- the- art technology, CDMA operators also introduced an element of competition in the market leading to the fall in tariffs and increased demand. Mobile phone is no longer the preserve of the elite class of the society. It has become a necessity and the increasing use by the masses is the only way of empowerment of the ordinary people in the country. It has in fact become a mass movement.

1.3 The coming years would witness further expansion in mobile services to rural areas as well and the next target would be to raise rural teledensity which will provide access to millions living in rural areas across the country. **CDMA as an established mobile technology will play a crucial role in this development.**

1.4 Another important area in providing rural access would be the rollout of internet dhabas / PTICS in rural areas which will help provide information to the masses. It is here that CDMA which is proven for its broadband capabilities will be extensively used because of the low cost in rollout of wireless broadband to connect the rural areas.

FUTURE PROJECTIONS

2.0 As a first goal, further exponential growth in wireless telecom services is expected in the coming years surpassing the NTP '99 teledensity target of 15% before 2010. It is expected that mobile telephones would overtake landline connections in India in 2004. Thereafter more growth is expected in wireless telephones rather the landline. The growth projections are shown below:

YEAR	FIXED (Millions)	MOBILE (Millions)
2002	39.4	10.5
2003	40.7	28.9
2004	42.1	56.5
2005	50.6	85.0
2007	57.9	122.0

Source: Gartner Report – Telecom Summit '2004

2.1 The Association of Unified Telecom Service Providers of India (AUSPI), erstwhile ABTO, had submitted its projections of demand in August '2003 for the then basic service operators (since migrated to the Unified Access license in Nov 2003) to DOT Committee for considering effective utilization of and additional requirement for spectrum. The table below gives those projections .

PROJECTIONS OF DEMAND - ABTO (now AUSPI) ESTIMATE

(Figures in Million)

Quarterly	Jul-Sept '03	Oct-Dec '03	Jan-mar '04	April-Jun '04	Jul-Sept '04	Oct-Dec '04	Jan-mar '05	April-Jun '05	Jul-Sept '05	Oct-Dec '05
No of Subscribers	5.4	5.9	6.4	7.1	7.5	8.1	8.6	9.2	9.7	10.3

2.2 These projections were given to the DOT in August'2003 and the actual figures today show that the projections have almost come true.

2.3 In addition to the above, with the introduction of mobile /wireless service based on CDMA technology, there is increasing competition and this competition will grow further and the demand for wireless services, which will include increasingly data services, is likely to increase on account of the ability of the UASL licensees to provide a bouquet of services through one window providing convenience to the subscribers. Therefore, there is a need for a fresh look at the requirements of frequency for the CDMA operators.

PRESENT ALLOCATION OF SPECTRUM

3.0 The present allocation of spectrum is governed by the respective license conditions and the NFAP provisions and is tabulated below:

824-844 p/w 869-889	CDMA(WLL-M)	2 x 20 MHz
890-925 p/w 935-960	GSM Cellular Mobile	2 x 25 MHz
1710-1785 p/w 1805-1880	GSM-1800 (DCS 1800)	2 x 75MHz
1880-1900	corDECT (TDD)	20 MHz
1920-1980 p/w 2110-2170	Allocation for IMT 2000 in future	2 x 60MHz

3.1 From the table it is seen that only 20+20 MHz total spectrum has been earmarked for the CDMA operators, which means in all 14 carriers and not even four carriers can be allocated to the UASL licensees where four operators are operating.

3.2 Theoretically, it may be stated that DCS 1800 band has been earmarked both for GSM and CDMA technologies as per IND-48 (India footnote in NFAP). However, practically this allocation is suitable only for GSM operations because of non-availability of the compatible handsets and equipment in this band (DCS-1800) for CDMA operations.

3.3 In view of the above the CDMA operators are unable to expand their networks, and will not be able to make full use of the technology by providing high speed data services to the subscribers unless appropriate spectrum is earmarked/ allocated to the CDMA operators.

REQUIREMENT OF ADDITIONAL SPECTRUM

4.0 Spectrum is an important resource for any wireless mobile operator to build large networks with economies of scale and in a short time. It is well known in cellular based mobile technologies, that a given capacity can be served most economically with largest spectrum made available to an operator. Lack of spectrum will throttle any mobile business and wherever large networks have been built, they invariably had access to large chunks of spectrum.

4.1 The CDMA operators also plan to provide high speed data networks/broadband services in the near future. The projected growth in both voice and data services should be facilitated by earmarking the adequate bandwidth for the CDMA operators. The present 5 + 5 MHz cap per operator on CDMA is not capable of meeting the growing requirements of voice and data services

4.2 Data is becoming an increasing traffic load in CDMA networks which drives spectrum requirements. As could be seen by the popularity of various options on mobile phones including data requirements, the subscribers are increasingly using these services and the therefore the radio resources are taken away from voice for data significantly. CDMA 2000 1X sites provide for voice+data services from the same sites on the same carriers using the available radio resources over the air.

4.3 At each site the air capacity available is being shared by voice and data with neither getting full resource, although fortunately to some extent, the busy hour voice and data loads are not concurrent. However **to increasingly cater to data services, an operator is better off by dedicating carriers to data only and separating voice carriers**. This would result in a more efficient use of the spectrum in terms both erlangs per sector for voice and Kbps of data throughput per sector.

4.4 However to do that, the CDMA operator needs dedicated carriers for data, specially beyond the current 4 carriers which could serve voice only. India has embarked

on a rapid program of bridging the "digital divide" and the only way to do this is to provision ubiquitous data services to all.

4.5 For data services (for which CDMA is the best platform) which we intend to provide shortly, cannot be managed in the present 5+5 MHz allocation as separate radio carriers will be required for CDMA 2000 1X EVDO implementation. It is important to highlight at this stage that CDMA services introduced on a country- wide basis since last year have attracted over 8 million subscribers. This shows the tremendous growth potential that exists for the same.

TECHNOLOGY NEUTRALITY & DEVELOPMENT OF NEW APPLICATIONS

5.0 There is a lot of discussion on the introduction of new applications being developed under different technologies in the world. As we know the licensees in India are technology neutral and the scope of service under the license includes both voice and/or non-voice messages over the Licensee's network in the service area and includes provision of all types of services except those, which require a separate license. **The Licenses do not indicate the speed at which the non-voice message/data can be transmitted.**

5.1 It is also brought out here that in our country the first two cellular licenses in Metro districts and circles mentioned only the carriage of 'message" without specifically mentioning 'Voice & Non-Voice messages. Only the 4th Cellular License specified in the scope of service to include 'Voice & Non-Voice' messages.

5.2 All the basic services licenses issued in 1997, in 2001 and now the Unified Access License specifies the SERVICE as carriage of 'Voice & Non-Voice' messages. Still the first three GSM operators are planning / providing GPRS / EDGE services which are not 'Voice Messages'. The **idea here is not to say as to why the GSM operators are providing such services**. Our contention is that whatever services/applications any technology is capable of providing, should be permitted and should not be denied to the consumers only because any license condition does/does not specifically permit / prohibit it. **Benefits of technology must go to the consumers whether it is one technology or the other.**

5.3 The present access licenses granted to the operators permit them to provide all services whether voice or data. In future when new applications (4G) will come, these will also be provided under the existing license since the license is not required to be amended every time there is an additional application which is invented and which is possible to be provided under the existing network.

5.4 The only issue for consideration can be as to whether the new applications can be provided with the same spectrum or additional spectrum is required or whether the same bandwidth can be used for providing any additional applications, which might be developed by the technology developers for use in the networks in future.

PRINCIPLES OF SPECTRUM ALLOCATION

6.0 While every one believes and propagates the efficient utilization of valuable spectrum resources, the spectrum allocation procedures have differed from regulator to regulator depending upon the requirements in each country. However, there are some fundamental principles which need to be followed in the matters of spectrum allocation and these are:

- ?? All the operators should have adequate spectrum (in line with international standards)
- ?? Spectrum allocation should be technology and service neutral.
- ?? Spectrum allocation should be contiguous and allotted in one chunk, instead of piecemeal allocation, for better planning of network.
- ?? Level playing field i.e., no preference for any technology, all technologies should be equally treated in terms of bandwidth allocation.
- ?? Spectrum allocation should be appropriate (suitable in terms of ready availability of handsets and infrastructure)
- ?? These should be available from multiple vendors from different countries to avoid dependence on any vendor or any region.
- ?? Indian service providers are not to be put on the mercy of any specific vendor or country.
- ?? Frequency bands not to be earmarked with a hope that in future some vendor may develop the equipment/ infrastructure/multi- mode handsets.
- ?? International practices to be followed while earmarking/allocating spectrum

6.1 The above principles have been considered and followed by the WPC so far while allocating spectrum for different services, because though the licenses are technology neutral for providing the services as defined in the license agreement, yet the licenses do specify frequency allocations that have resulted in the deployment of particular technologies in different bands: CDMA in the 800 MHz band and GSM in the 900 MHz.

ADEQUATE SPECTRUM ALLOCATION AS PER INTERNATIONAL STANDARDS

7.0 Particularly, the allocation of spectrum for any mobile technology has to be in line with international standards and norms. CDMA networks are designed to carry higher traffic to include voice and data requiring far larger spectrum bandwidth. As may be seen from the Table given at Annex-1 that, in all the major countries where CDMA2000 technology is being used for providing mobile services, the spectrum allocated to the operators is varying from 10 +10 MHz to 20 +20 MHz except Hong Kong where Hutchison has been allocated 7.5 MHz. In contrast in India, CDMA operators are allotted only 2.5+2.5 MHz initially which is abysmally low and further this allocation has a cap of 5+5 MHz.

7.1 Our requirement is that the allocations being made to CDMA operators in India move closer towards international averages and CDMA operators are also allocated at least 15+15 MHz spectrum, at least on par with GSM operators.

7.2 This will bring about greater efficiency and better effective utilization, which adds significant economic value to both consumers as well as government. Operators could build cheaper networks with adequate spectrum rather than constrained to add cells at each expansion of capacity. Quality of services would also significantly improve since there would be lesser congestion in the networks and fuller utilization of existing resources.

7.3 It is important to note that the USA and Europe enjoyed high teledensities (typically more than 50 lines per 100 population) through extensive terrestrial wired networks prior to the introduction of mobile systems; the development of mobile networks has therefore supplemented the capacity of terrestrial wired networks. In contrast, teledensity has been much lower in India (7 lines per 100 population), and the demand for wired connectivity has not been satisfied. Mobile networks have been instrumental in increasing teledensity and will continue to do so for the foreseeable future**. It is vital therefore that sufficient spectrum is made available to serve this demand for connectivity: as a minimum, 2 x 15 MHz should be made available for each operator.**

ALLOCATION IN SMALL BLOCKS – INEFFICIENT WAY OF ALLOCATION OF SPECTRUM

8.0 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 further allocation is made only when 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. Moreover, in no country, the spectrum has been allocated on the basis of subscriber numbers.

8.1 Ideally, operators should be assigned larger blocks of contiguous spectrum, at least 15 + 15 MHz to 20 + 20 MHz. 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. **Allocation of adequate spectrum to the mobile operators will help them to:**

- ?? Plan their network more economically and efficiently
- ?? Provide better coverage in remote and inaccessible areas
- ?? Make it affordable for the subscriber
- ?? Provide voice, data and multimedia services comparable with international standards.

APPROPRIATE SPECTRUM

9.0 All technologies have to grow and it should be the endeavor of the Government and the Regulatory Authorities to ensure that the growth of any technology is not hampered due to the lack of the adequate spectrum. While ensuring adequate spectrum for the different technologies, it has also to be ensured that the **spectrum allocated for different technologies is appropriate.**

9.1 Appropriateness of spectrum would mean that it should be in line with the international practices so that the operators do not face the problems relating to the availability of handsets and equipment which are compatible with the existing networks and those of networks in the international market. The operators should also not be left at the mercy of one or two vendors in the world market otherwise cost effectiveness will be lost.

9.2 The most important rationale in the forward looking changes brought about by the government in its telecom policies has been that the benefits of technology should not be denied to the subscribers. **In order to ensure that all the benefits of a technology are made available to the consumers at affordable rates** it is essential that all the operators using different technologies should be allocated adequate and appropriate spectrum. They should not be hampered by inadequate amounts or inappropriate allocations of spectrum while competitors with a different technology are granted better access to spectrum resources.

LEVEL PLAYING FIELD - SIMILAR SPECTRUM FOR MOBILE TECHNOLOGIES

10.0 Both, GSM and CDMA are mobile technologies: Both basic and cellular operators are providing fully mobile services in the country. Both the GSM technology, being used by the cellular operators and the CDMA technology, being used by the Unified Access Service providers are fully mobile technologies capable of providing exactly similar mobile services in the country.

10.1 Both have paid same entry fee and paying same license fee: The entry fee paid by the basic service operators has been brought at par with the entry fee paid by the 4th

cellular operator in each circle. The license fee in the form of revenue share is the same for both types of mobile operators. In fact the license fee for the first three GSM licensees has been reduced and they are paying less license fee than the Basic licensees migrated to the UASL.

10.2 Difference in frequency allocation: Despite having paid the similar amount of entry fee and now paying the same license fee, the allocation of frequency is, however, different for both types of mobile operators. The mobile service operators providing service based on GSM technology are allocated 4.4 + 4.4 MHz initially and it goes up to 10 + 10 MHz (spectrum upto 15+15 MHz has also been earmarked). However, the mobile operators providing service based on CDMA technology are allocated 2.5+2.5 MHz initially and the maximum allocation is limited to 5+5 MHz on completion of given roll out obligations.

10.3 Remove this anomaly: This anomaly needs to be rectified and similar /same spectrum needs to be allocated to all the technologies for the wireless service in India keeping in mind the level playing field conditions so popularly pronounced by the regulator and propagated by the wireless services using other technologies.

10.4 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. The amount of spectrum assigned should be independent of the technology chosen by the operator, and consequently, there is no need for the regulator to determine the efficiency of either technology in order to allocate spectrum. The same regulatory environment should apply to all mobile service providers and their success or failure should be based solely on marketplace factors.

CONTIGUOUS SPECTRUM ALLOCATION

11.0 Apart from the requirement of equal and additional spectrum for both the mobile technologies, it is also essential that the spectrum **should be allocated in one chunk and contiguous instead of allocating spectrum in small chunks and on different spots**. The contiguous and one time allocation helps in avoiding the wastage of scarce and valuable spectrum through requirements of guard bands. It also helps in better planning for purchase of equipment at reasonable prices. This ultimately helps in making the services available to the subscribers at affordable rates.

11.1 Non-Contiguous Allocation Is Inefficient and Anti-Competitive : Allocation of non-contiguous frequency bands to a single operator is inefficient, simply because of the need for each operator to set a guard band between them and the adjacent operator to avoid adjacent channel interference. Consequently, the interleaving of different service

providers leads to an inefficient utilization of spectrum and loss of quality of service to subscribers.

11.2 As is shown in Figure 1, the interleaving of service providers' frequency allocations leads to a wastage of spectrum, and might be anti-competitive if any one service provider (example Service Provider 3 in Figure 1) is allocated a contiguous band.

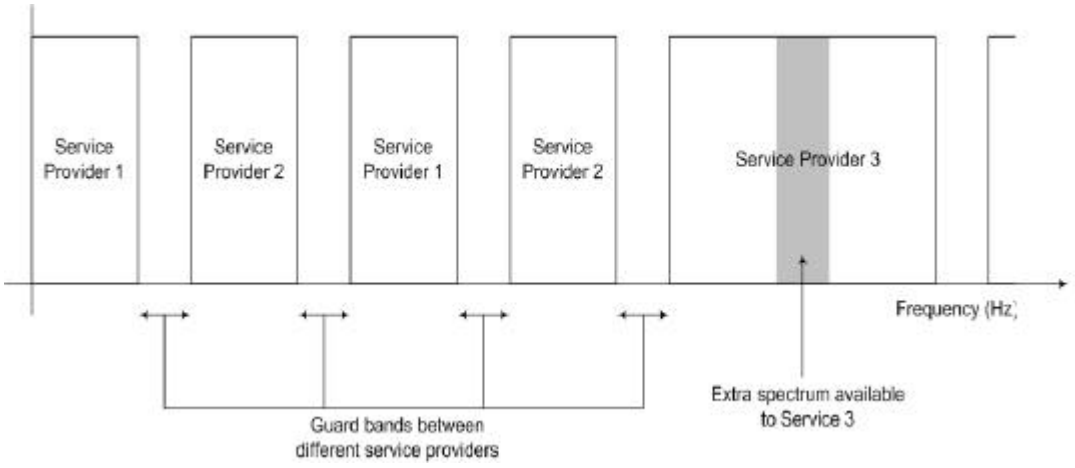

Figure 1

11.3 If we look to the future, it might be possible for new wireless technologies to use guard bands and temporarily available spectrum for multiple alternate services[1]. However, at this time, with the constraints on technology, the TRAI's intention to achieve contiguous allocation is a step in the right direction.

11.4 As is explained in the Consultation Paper, the current allocation for wireless telephony services is as follows:

WLL(M) and CDMA	824-844 p/w 869-889 MHz
GSM 1, 2, 3	890-915 p/w 935-960 MHz
GSM 4 and additional 1, 2, 3	1710-1785 p/w 1805-1880 MHz

11.5 Within these broader allocations, the operators are assigned their frequencies in such a manner that guard bands are used between the different operators using same or different technology, of which would be saved if service allocations were made contiguous. This automatically will provide operators with space for additional carriers.

11.6 It is clear that reorganization of spot frequencies allocated to various service providers to create contiguous bands is desirable. The immediate question is how to achieve this goal.

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[1] Horne, W. D., *Adaptive Spectrum Access: Using the Full Spectrum Space*, Telecommunications Policy Research Conference, 2003. Available at http://intel.si.umich.edu/tprc/papers/2003/225/Adaptive_Spectrum_Horne.pdf

Reorganization Strategies: Swapping

Inter-Operator Unregulated Swapping

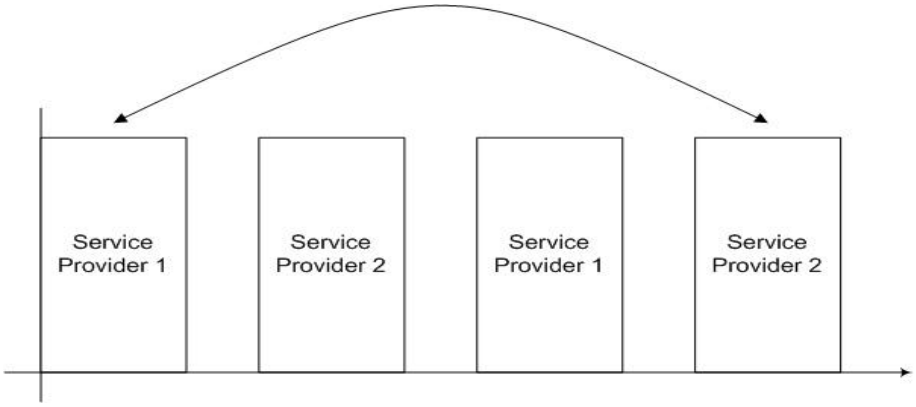

Figure 2

11.7 In this case, the operators will exchange allocated bands of spectrum, as they deem necessary. This is a costless transaction for the regulator and has no transaction costs. As a result, impact upon subscribers will be minimal. The only possible impact will be costs of reorganization of network operations by the operator. However, this cost will not be a barrier to the success of this swap because of the increased efficiencies availed by the service provider because they are moving towards a contiguous spectrum band.

11.8 However, for this system to work, the following conditions will have to be met in every single swap for each individual operator:

Value of old bandwidth ? Value of new bandwidth (1)
Gain in spectrum in Hertz > Width of one channel in Hertz (2)

11.9 There is a game that can be played between two operators who use different technologies. Consider a GSM and CDMA operator swap spectrum. In this case, while the GSM operator can fit n carriers in the additional spectrum it gains, the CDMA operator can fit m carriers in its additional spectrum. In most cases, n ? m, and as a result, the perceived benefits in terms of revenue to each operator are different. Thus, the operator who loses the game might not cooperate in the swap. Embedding this by modifying (1) condition in (3) below,

Value of new spectrum to operator 1 = Value of new spectrum to operator 2 (3)

11.10 Finally, we need multi-party cooperation for highly interleaved spectrum bands. In such a case, operators could again play games to prevent other parties from benefiting from swaps.

11.11 The inter-operator swapping mechanism can work for the reorganization of spectrum in order to create contiguous bands. However, the market might indulge in game playing and even though the costs of the technique are low, non-cooperation by all concerned players might lead to continuation of inefficiencies to some extent.

11.12 **Regulator Imposed Swaps :** The regulator can also force the swapping of spectrum between operators. In this process, diktat replaces market forces present in the previous system. However, this reduces uncertainty due to game playing. The regulator will have to be careful to ensure that no operator loses out in a swap and simultaneously ensure the maximum benefits to the public as well as in the efficient use of spectrum.

11.13 The problem with this system is that it depends heavily on how the regulator values spectrum allocated before swapping. If the valuations are incorrect, the swap might result in a biased result, or in litigation. The regulator in this system will have non-zero, positive costs, while the service providers will have similar costs to the unregulated swap system described earlier. The chance of litigation in this system is also higher, and as such, the costs of this system are greater than the inter-operator swapping system.

11.14 **Regulator-Managed Inter-Operator Swapping** : In this system, all operators submit their valuation of their spectrum allocation, and in order to ensure a correct valuation the regulator depends on service providers to provide their valuations. The best option is to pursue a standard method (analogous to those used for spectrum requirements e.g. ITU-R M.1390) and ask service providers to calculate the value of every band of spectrum they possess. For example, the metric could be a function of the subscribers served in that band, or the traffic carried by that band. This is only indicative – the actual function used will be complex to calculate.

11.15 Once the interested operators submit their valuations, the regulator coordinates the swapping of spectrum in order to best utilize spectrum, and to fit within the conditions of the inter-operator swap, (1) and (2) above. The regulator must allow 'all-or-none' swaps by any one operator. For example, if operator X wants to swap only 1 of *n* possible bands, it is not allowed to participate. This ends games that prevent other operators from creating contiguous bands. The regulator should be wise in swapping and displace the least number of operators from their current allocations while simultaneously creating the maximum number of contiguous bands. Since it is in the benefit of every service provider to operate in a contiguous band all will participate. As a result, the risk of litigation is reduced, and the benefits to service providers are maintained. There are some administrative costs, but these less than in the second system described above.

To formalize the system, we can present it as:

Maximize the number of contiguous spectrum bands (I)

subject to

Minimum number of swaps between operators (4)
Value of old bandwidth ? Value of new bandwidth (5)
Gain in spectrum in Hertz > Width of one channel in Hertz (6)
where (6) and (7) apply to each operator.

11.16 **Technical Feasibility of Swapping :** In order to achieve any of the above system objectives, irrespective of choice of method, we must establish the technical feasibility of the process. This means that if contiguous bands are to be allocated, there should be minimum interference due to the reorganization, and that it should not disturb any present non-wireless telephony allocations. The following conditions embed these concerns for the formal problem (I) defined above.

Minimize the amount of interference in the reorganized spectrum (7)

Minimize the relocation of spectrum allocated to other services (8)

The satisfaction of these conditions will minimize the cost due to technical reasons in any of the methods described before.

SPECTRUM ALLOCATION LINKED TO AVAILABILITY OF HANDSETS AND INFRASTRUCTURE

12.0 While earmarking spectrum for CDMA operations, it should be ensured that the allocation is made in the band in which the compatible handsets and equipment are available from multiple vendors from different countries so that the CDMA operators in India are not left to the mercy of one vendor or one or two vendors from the same country to develop new equipment in new frequency bands.

12.1 Also it should be ensured that the spectrum is earmarked based on the availability of the compatible equipment **today** instead of allocating spectrum with an attached condition that some vendor may develop the system based on this spectrum **in future** due to huge demand in India or in other words locking the spectrum allocation to one technology**.** As an example although the 1800 MHz was made available to CDMA over the 2 years, no CDMA operator could use this band because of lack of CDMA handsets and infrastructure in this band. So although the government insists that there is technology neutrality of implementing the technology of choice, the spectrum allocation in reality locked the development of wireless services to GSM.

12.2 **Such futuristic allocation on the assumption of vendors developing the system will not be helpful because such systems may or may not develop** and the CDMA operators will be left in the lurch waiting for such vendors whereas the demand for additional spectrum for growth is available today.

CORELATION BETWEEN SPECTRUM EFFICIENCY AND SPECTRUM ALLOCATION

13.0 The ground for allocation of lesser frequency for CDMA operators is that CDMA technology is spectrally more efficient than the GSM technology. **While it is true that CDMA is the latest and spectrally more efficient technology but it is not correct that the CDMA operators "need" less spectrum.** The regulator has to allocate spectrum based on what each operator has paid as license fees and not on what the technology he has adopted. Moreover, technologically also the cell density constraints in CDMA technology require more spectrum to increase capacity and maintain the quality of service.

13.1 **Cell density constraints in CDMA:** There is another aspect to spectrum requirement. In a given area, the operator using GSM technology can increase capacity or coverage of the network by adding more number of BTS sites but the CDMA operator with less available spectrum is constrained because he may not be able to put more number of BTS sites, beyond a certain figure because of inter site interference problems. A GSM operator may put BTS sites at a distance of 150 meters or less resulting in a higher cell density by changing the frequency re-use patterns while CDMA already uses frequency re-use and cannot put BTS sites at a distance of less than 500 Mts. Therefore, allocating less spectrum to the CDMA operators on the grounds of using efficient technology may not be justified on technological grounds as well as on the grounds of level playing field.

USE OF DCS 1800 FOR CDMA IN INDIA?.

14.0 A needless controversy has been raised in certain quarters recently that CDMA operators in India should be allocated additional spectrum only in DCS1800 MHz band as per the NFAP'2002 provisions. **Their main arguments are:**

- ?? The provisions of NFAP-2002 should be adhered and no changes should be made in that.
- ?? New allocation to the CDMA operators in other bands should be considered only when the NFAP-2002 allocated band of 1800 is exhausted.
- ?? 1800 MHz band for CDMA operators is being used in Korea.
- ?? In case the handsets or equipments is not available in 1800 MHz band immediately, and if this band is allocated to the CDMA operators, some vendors develop the equipment/ infrastructure/handsets to meet the requirements of CDMA operators in India.
- ?? Allocation in 1900 MHz band for CDMA would disturb IMT-2000 band which is approved by the ITU;
- ?? co-existence of IMT2000 band and PCS 1900 band will cause interference problem;
- ?? block the growth of WCDMA and hence 3G services by GSM operators.

14.1 **In this regard it is stated that these issues have been raised only with a purpose to block the growth of CDMA operations in India rather than any other purpose either technical or economic. The arguments are replied point wise as follows:**

Applicability of NFAP 2002 provisions

15.0 Another point raised by some groups is that once a provision has been made in NFAP '2002 for allocation of additional spectrum for basic services (CDMA), the NFAP provisions should be adhered to. It has been argued that the allocations made in the NFAP'2002 after due consideration need not be changed now.

15.1 This **argument does not hold ground because i**t has been repeatedly indicated in this regard that the NFAP contains a provision for review every two years in line with the Radio Regulations of ITU (Point no: 10 of Introduction –NFAP'2002). If there has to be no change in the NFAP provisions on any ground at any time and the document is to be treated as **permanent** forever then such review provision would not have been made in the NFAP in line with Radio Regulations of ITU.

15.2 The very rationale of revision is to take note of the developments which have taken place in the intervening period in the field of technology, deployment of different networks, actual use of different bands, problems which might have been faced while implementing earlier allocation, new application developed during the period etc. Changes in the NFAP cannot be blocked on the ground that some provisions were made in the earlier NFAP after due considerations and hence should not be changed now. In fact the changes in technology has overwhelming implications on how spectrum for different services is allocated and how the difference services could co-exist with out mutual interference.

15.3 Briefly, the NFAP is revised every two years is to examine:

- ?? Whether there are technical developments needing to have a re-look on earlier reservation.
- ?? Whether the earmarked frequency has been utilized.
- ?? Whether any bandwidth can be reallocated to ensure utilization, if not yet used and better utilization if being used but not efficiently.
- ?? Whether the earlier earmarking meets the new criteria of utilization or efficient use.
- ?? Whether the reallocation can be made to accommodate new developments like availability of equipment, terminals so that spectrum does not get locked to one technology.

15.4 Therefore the argument of existing provision of NFAP '2002 to be the ground for not considering any changes is not relevant at all.

Presently DCS 1800 Band not used by any CDMA operator in any country of the world.

16.0 Presently, DCS 1800 band has not been used by any CDMA operator in the world. We cannot reinvent the wheel for Indian requirements. The list of countries where

CDMA based systems are operating is given below. It has been claimed in certain quarters that CDMA based infrastructure is available from a few vendors. If the compatible handsets and network infrastructure equipment were available in DCS1800 MHz band, it is surprising as to why no operator in the world in any country so far used DCS1800 MHz band for operating CDMA systems. [Korea has developed its own Korea PCS band, which is 1750-1780 p/w1840-1870 MHz band. This band however is not the same as the standard DCS1800 MHz band.]

16.1 From the table given at Annex-2 it is clear that in most countries where CDMA technology is used, the frequency allocation is either in "800 MHz or 1900 MHz" OR "800 MHz and 1900 MHz" except Korea *(The Korea case is explained in detail below.)* The 1900 MHz allocation referred to here is also known as the USPCS band and is the allocation of 1850-1910 MHz paired with 1930-1990 MHz.

USE OF DCS 1800 BY KOREA

17.0 **KOREA PCS BAND:** Korean example is an exception and needs to be understood in detail as outlined below:

(i) Korea is using Korea PCS Band which is 1750-1780 MHz p/w 1840-1870 MHz. This band however **is not the same as standard DCS 1800 band** which is 1710-1785 MHz p/w 1805-1880 MHz.

(ii) Korean PCS has a FDD spacing of 90 MHz instead of 95 MHz as is available in normal DCS 1800. This duplex spacing has an important impact on the availability of handsets and infrastructure and that is why even ITU has stated that the administrations may use different band pairings but the duplex separation should not be disturbed.

(iii) There maybe one or two vendors making equipment and handsets in the 1800 Korean PCS band specific to Korean needs but none are making equipment and handsets in the DCS 1800 band.

(iv) There are no dual mode/multimode terminals in 800/KPCS or 800/KPCS/USPCS even after 8 years or more in Korean CDMA implementation in 1800 MHz band.

(v) Korean PCS is 30 + 30 MHz (1750-1780 p/w 1840-1870 MHz) whereas DCS 1800 is 75 +75 MHz (1710-1785 MHz p/w 1805-1880 MHz).

(vi) In Korea, out of the three operators, one operator is using 800 MHz band for CDMA operations and the other two operators are using 1800 MHz Korea PCS band and there is no inter-operator of mixed band of 800 and 1800 MHz.

(vii) Thus, the situation in Korea is "800 MHz OR 1800 MHz" and not "800 MHz AND 1800 MHz".

(viii) Therefore. Korean example is not applicable in the areas where the same operator has to work in 800 MHz and 1800 MHz band.

17.1 For allocation of frequency for CDMA operations, there are 3 questions, which are relevant specially with reference to the DCS 1800 MHz band.

Q.1) Do we have multiple vendors from different countries making handsets and equipment in 1800 MHz band?

Ans: We do not have multiple vendors from different countries if we are considering the standard DCS 1800 band .**The Korean PCS band (1750-1780/1840-1870 MHz)is not the same as standard DCS1800 band.** KPCS has a FDD spacing of 90 MHz instead of 95 MHz spacing. Except Korea no other country has used 1800 MHz band for providing mobile services based on CDMA technology. There are no dual mode/multimode terminals 800/KPCS or 800/KPCS/USPCS even after 8 years or more in Korean CDMA implementation.

Q.2) Do we have multiple vendors from different countries making equipment and handsets in 1900 MHz band?

Ans: There are lots of vendors in 1900 MHz (US-PCS) for terminals as well as Infrastructure. In almost all countries of the world where CDMA systems are deployed the frequency used is 800 MHz and 1900 MHz. That is why there are large number of vendors making equipment and handsets compatible with 800 and 1900 MHz band. The equipment is available from multiple vendors from different countries.

Q.3) If the CDMA frequency is allocated in 1800 band, what is the roaming possibilities?

Ans: None, as no country has CDMA in the DCS 1800 MHz band. As already said the **Korean PCS is not the same as DCS 1800 band** for roaming in Korea.

FUTURISTIC ALLOCATION --NEITHER EFFICIENT NOR APPROPRIATE

18.0 To say that if this band (DCS 1800) is allocated to the CDMA operators, some vendors will develop the equipment/ infrastructure/handsets to meet the requirements of CDMA operators in India is ridiculous to say the least. Is it proposed that CDMA operators in India should remain at the mercy of some vendor who may develop the compatible handsets and infrastructure in future or will the CDMA operators have the cost competitiveness and advantage of economies of scale in future in such a scenario? China has equally strong market and have they followed such an approach?

18.1 The most natural way to allow the growth of state of the art technology is to ensured that the spectrum is earmarked based on the availability of the compatible

equipment **today** instead of allocating spectrum with an attached condition that some vendor may develop the system based on this spectrum **in future** due to huge demand in India or in other words locking the spectrum allocation to one technology**.** Further, although the 1800 MHz was made available to CDMA over the 2 years, no CDMA operator could use this band because of lack of CDMA handsets and infrastructure in this band . We profess the technology neutrality of implementing the technology of choice, still the spectrum allocation in reality will lock the development of wireless services to GSM.

18.2 **Such futuristic allocation on the assumption of vendors developing the system will not be helpful because such systems may or may not develop** and the CDMA operators will be left in the lurch waiting for such vendors whereas the demand for additional spectrum for growth is available today.

LICENSE PROVISIONS

19.0 It may also be pointed out here that the license agreement issued for Basic operators in '2001 contains a provision, which is totally opposite to what certain quarters have been claiming about allocation of DCS 1800 for CDMA operations. The relevant clause in the Basic Service License is reproduced below:

> *" 32.5 For wireless operations in SUBSCRIBER access network, the frequencies shall be allocated by WPC from the designated bands prescribed in National Frequency Allocation Plan – 2000 (NFAP 2000) in coordination with various users. However,* ***the frequency in GSM band of 890-915 MHz paired with 935-960 MHz and 1710-1785 MHz paired with 1805-1880 MHz will not be allocated under any circumstances to the LICENSEE……..****" (emphasis added)*

19.1 In November '2003 TRAI gave its recommendations on the issue of Unified Access License permitting migration of the Basic Service Operators to Unified Access License and stated that there is no change in the spectrum allocation procedure as a part of the migration process. The relevant clause of the TRAI recommendations is reproduced below:

> *" 7.31 Service Providers migrating to Unified Access Licensing Regime will continue to provide wireless services in the already allocated/contracted spectrum and no additional spectrum would be allocated only because of migration.* ***There shall be no change in the spectrum allocation procedure as a part of migration process."*** *(emphasis added)*

19.2 The TRAI recommendations were accepted by the government and the guidelines for Unified Access License were issued in November '2003. The guidelines also reflected the same recommendations of TRAI and it was provided that the Unified Access Licensees would migrate with the existing allocated/ contracted spectrum.

19.3 **The gist of the above two provisions is that there was no change in the spectrum allocation procedure on account of the migration to the Unified Access license.**

19.4 Therefore, the basic service license itself states that DCS 1800 MHz band can not be allocated the Basic licensees since it was known that this band is not useful for the basic service licensees providing service based on CDMA technology and it is strange that now some quarters still desire that additional requirements of CDMA should be met from the DCS 1800 MHz band.

IMT 2000 AND ITU RECOMMENDATIONS

20.0 It is being stated in some quarters that WARC 92 identified the IMT 2000 band as 1920-1980 p/w 2110-2170 and in the interest of harmonisation this band should not be disturbed. In this regard it is stated that that WARC 92 recommendations are very old and the CDMA technology had not even been commercially deployed at that time. Large changes have taken place in the technology front in the last 12 years and new technologies/ concepts have been developed, and it is to take into account of these changes that the new ITU recommendations No. M.1036-2 clearly permits flexibility and use of different bands for 3G (IMT2000**). Moreover, the whole band 1710-1785 p/w 1805-1880 MHz was identified as an IMT-2000 band in WRC-2000.**

20.1 The idea here is not to say that the recommendations of ITU become irrelevant over a period but to say that with the changing technologies the earlier recommendations are modified also and that is why the ITU has now permitted flexibility. The administration is now free to implement all or parts of this frequency band arrangements. The only condition applicable is that if the administrator wishes to implement only the parts of IMT2000 frequency arrangement, **the channel pairing should be consistent with duplex frequency separations of the full frequency arrangements**. This in itself indicates the possibility of using only a part of the IMT2000 band or any of the bands prescribed by the ITU recommendation No. M.1036-2. There is no one frequency arrangement, which cannot be touched or changed.

20.2 The ITU has mandated that International Mobile Telecommunications – 2000 (IMT-2000) systems which are being continuously enhanced in line with market and technology trends will operate in the frequency bands identified in the Radio Regulations (RR) as intended for use on a worldwide basis by administrations wishing to implement IMT-2000, noting (in accordance with RR No. 5.388) that **identification of these bands does not establish priority in the RR and does not preclude use of the bands for any other services to which these bands are allocated.** Also, some administrations may deploy IMT-2000 systems in bands other than those bands identified in the RR.

20.3 Thus, the ITU has permitted flexibility to different administrations for allocation of different bands and even for IMT - 2000; they identified different bands in the ITU-R Recommendation M.1036-2.

20.4 While determining the principles and practical use of spectrum, the recommendation (ITU-R M.1036-2) states that while the RR identifies the bands as intended for use on a worldwide basis by administrations wishing to implement IMT-2000, **but it also states that by taking into account various provisions, regulations, flexibility should be afforded to administration's evolution/migration plan.**

20.5 Based on these considerations the ITU-R M.1036-2 has made the following recommendations for frequency arrangements for IMT-2000:

TABLE 1

Paired frequency arrangements in the band 806-960 MHz

Frequency arrangements	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station Transmitter (MHz)	Duplex Separation (MHz)
A1	824-849	20	869-894	45
A2	880-915	10	925-960	45

TABLE 2

Frequency arrangements in the band 1710-2200 MHz

Frequency arrangements	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station Transmitter (MHz)	Duplex separation (MHz)	Un-paired spectrum (e.g. for TDD) (MHz)
B1	1920-1980	130	2110-2170	190	1880-1920; 2110-2025
B2	1710-1785	20	1805-1880	95	None
B3	1850-1910	20	1930-1990	80	1910-1930
B4 (harmonized with B1 and B2)	1710-1785 1920-1980	20 130	1805-1880 2110-2170	95 100	1900-1920; 2110-2025
B5 (harmonized with B3 and parts of B1 and B2)	1850-1910 1710-1755 1755-1805	20 50 305	1930-1990 1805-1850 2110-2160	80 95 355	1910-1930
B6 (harmonized with B3 and parts of B1 and B2)	1850-1910 1710-1770	20 340	1930-1990 2110-2170	80 400	1910-1930

20.6 An important note at the end of these tables indicates that ITU permits the administrations to implement all or parts of these frequency arrangements. The only condition applied is that if the administrations wish to implement only part of an IMT-2000 frequency arrangement, the channel pairing should be consistent with the duplex frequency separations of the full frequency arrangement. This in itself indicates the possibility of using only a part of the IMT-2000 band **and hence there is no one frequency arrangement, which cannot be touched or changed.** The "UMTS" band (B1 in table 2) and the "1900" MHz band (B3 in table 2) or any other band plan in this table must be considered equal in this sense.

What is clear from this is that:

- ITU permits flexibility in the use of bands for different applications.
- The identification of the bands does not establish priority in the RR
- The identification of the bands does not preclude use of the bands for any other service to which these bands are allocated.
- Administrations are free to deploy IMT-2000 systems in bands other than those, which are identified in the RR.
- The identification of bands is not an allocation to a particular technology or set of technologies nor is it an allocation to a new service.
- Instead the identification is a recommendation to administrations to consider using these frequencies for IMT-2000.

CO-EXISTENCE OF GSM AND CDMA

21.0 There are large number of countries where both GSM and CDMA technologies are co-existing and working smoothly as can be seen from the table given at Annex-3.

21.1 What is clear from this table is that there are large number of countries where both GSM and CDMA technologies are operative. However, it is interesting to note that in the countries where 800 and 1900 MHz band were initially allocated, both GSM and CDMA were allowed to be deployed. In countries where only 900 and 1800 MHz was allocated, only GSM was allowed (Europe and elsewhere in Asia). Therefore, in order to allow for the introduction of CDMA, other bands (800 and 1900 MHz) were opened up.

21.2 What is clear from this table is also that there are countries where, GSM is working in 900, 1800 and 1900 MHz and hence with tri-band handset international roaming is permissible. **However, there is no country, including Korea, where 800 and 1800 MHz has been deployed for CDMA.** There is no tri-band handsets in 800, 1800 and 1900 MHz and hence the roaming of CDMA subscribers will not be possible in the countries, where CDMA operators are granted frequency in 800 and 1800 MHz band. The roaming is possible only in those countries, where 800 and 1900 MHz is allocated for CDMA operations.

LONG TERM SOLUTION

22.0 Though it has been indicated in various forums and is accepted as international norm that allocation of frequency should be technology neutral. This is what is accepted and recommended in the Indian context also that we should have technology neutral approach. However, it is also a fact that given the peculiar situation that we are in, due to the licensing provisions and due to the legacy of GSM networks having started earlier, the allocations in the National Frequency Allocation Plan tend to be service specific. 800 MHz band has been earmarked for CDMA operations. 900 and 1800 MHz has been earmarked for GSM operations.

22.1 The frequency band of 1880-1900 MHz has been specifically earmarked for micro-cellular technology – corDECT. Thus, despite our claims for technology neutrality, we are still following the spectrum allocation, which is technology specific. At this stage, the CDMA and the GSM operators are operating in their respective bands. Similarly corDECT operators are operating in the frequency band of 1880-1900 MHz.

22.2 In view of these ground realities, it has been stated above that for the growth of mobile services in India, all technologies should be allowed to grow and no technology should be allowed to suffer on account of lack of adequate spectrum. In the paras above it has therefore been suggested, that the allocation for CDMA operators should be adequate and appropriate. It has also been suggested above that, there should be a level playing field between various mobile operators because they have paid the same entry fee, same license fee and same charges for spectrum allocation.

22.3 In keeping with the above principles of level playing field, adequacy of spectrum, allowing growth of all technologies **the following allocation is suggested to be incorporated in the Spectrum Policy:**

1) **1710-1755 MHz p/w 1805-1850 MHz (2 x 45 MHz) for GSM**
2) **1850-1880 MHz p/w 1930-1960 MHz (2 x 30 MHz) for CDMA (B3)**
3) **1900-1910 MHz p/w 1980-1990 MHz (2 x 10 MHz) for CDMA (B3)**
4) **1755-1805 MHz p/w 2110-2160 MHz (2 x 50 MHz) for 3G as per ITU-R (B5) Recommendation M.1036-2. to be equally shared between GSM and CDMA.**
5) **452.5-457.5 MHz p/w 462.5-467.5 (2x5 MHz) for CDMA**

(In terms of policy we are in favour of technology neutral approach for spectrum allocation but to bring in parity with the GSM spectrum allocation we have suggested the 450 MHz to be earmarked for CDMA based operators)

With this proposed allocation the situation will be as follows:

The existing allocation for GSM is 25 + 25 MHz.
The existing allocation for CDMA is 20 + 20 MHz.

Total allocation of spectrum for GSM (existing plus the now proposed allocation) = 25 + 45 MHz = 70 MHz.

Total allocation of spectrum for CDMA (existing plus the now proposed allocation) = 20 + 45 = 65 MHz.

Total allocation for 3G = 50 + 50 MHz, to be equally divided between GSM and CDMA.

The above suggestions are :

- ?? In line with the ITU recommendations for selecting any of the given bands for 3G services.
- ?? In line with international standards and appropriate spectrum is allocated to all the mobile service operators.
- ?? Ensure level playing field between the GSM and CDMA operators.
- ?? Provide adequate bandwidth for the growth of mobile services in the country.
- ?? Ensure the most efficient and optimal utilization of spectrum.
- ?? equal opportunity for growth of all technologies – no one technology to be allowed to grow at the cost of other;
- ?? technology neutral approach adopted by the Government.

SPECTRUM EFFICIENCY AND SPECTRUM UTILIZATION

Spectrum is a valuable public resource and it is important when it is put to use, it is done so in the most efficient manner based on the requirements of each country .

The conventional wisdom is that market based mechanisms for spectrum valuation will automatically ensure an efficient utilization of spectrum. The buyer who pays the highest value for the spectrum will naturally ensure that it is utilized most efficiently.

However the key factor to note is that the market-based mechanism will ensure "economic efficiency". It is not necessary that the mechanism may ensure "technical efficiency". The highest bidder could use the acquired spectrum to provide a service, which wastes spectrum resulting in high price to the subscribers. Thus it could lead to an outcome where wireless service is available only to a small percentage of the population.

In a country like India, which has low teledensity, it is important to ensure that the benefits of wireless technology reach the masses.

There are three key issues relating to spectrum efficiency in this context:

(i) Subscriber or Erlangs per MHz per square Km is a representation of spectrum efficiency in a technical sense, but the spectrum regulator should be more concerned in encouraging the operator who uses efficient technologies by allocating more spectrum rather than using that argument to allocate less spectrum

(ii) Price of a unit of spectrum should be independent of the wireless technology

(iii) In wireless systems spectrum and capital are substitutes to some degree; Operators will lobby for more spectrum if it is free or cheaper than their network costs.

22.4 **Spectrum utilization and spectrum efficiency are complex issues**. They encompass the realms of technology and economics and both need to be examined together.

22.5 At the risk of oversimplification, but in order to demystify the issues, they are illustrated through an analogy to an object, which we frequently use in our daily life: *building lifts*.

22.6 **Subscriber per MHz is a flawed representation of spectrum efficiency** : Lift capacity is generally visualised in terms of number of people. However if some children were to take the lift, it is natural that more number than the 'capacity' of the lift can use it without any problem. This is because the true capacity of the lift is in terms of the total weight it can carry (i.e. in KGs). Therefore lift capacity stated by number of people is a handy proxy for capacity used by the common person but it is not a technically correct measure.

22.7 Similarly subscribers per MHz are a handy proxy for spectrum utilisation but it is not the technically correct measure. Spectrum provides bandwidth and bandwidth is utilised when subscribers talk. **Hence it is not the number of subscribers but how much do those subscribers talk, which is important**. To reiterate, it is the total minutes of usage by the Subscriber base in the spectrum band, which is the right metric for spectrum efficiency.

Capacity		**Correct Metric**		**Handy Proxy (incorrect matrix of capacity)**		
Lift capacity	=	Total load (in kgs)	=	No of persons	x	Weight per person
Spectrum capacity	=	Total load (in minutes)	=	No of subscribers	x	Minutes of usage per Subscriber

22.8 As all the people in world do not have the same weight, all mobile subscribers do not talk for the same time. Hence, if MOU per sub is different for different wireless operators, subscriber/MHz will give an incorrect picture of the efficiency of spectrum utilisation. The following example will clearly illustrate the anomaly. Assume that two wireless operators are allocated 2Mhz each.

Operator	**Spectrum (1)**	**Subscribers (2)**	**Minutes of usage per sub (3)**	**Total minutes (4=2 x 3)**	**Subscriber per MHz (5= 2 / 1)**	**Minutes per MHz (6= 4 / 1)**
A	2 MHz	10	20	200	5	100
B	2 MHz	10	50	500	5	**250**

22.9 As it is evident, operator A appears to be equally efficient as operator B, if we use the matrix of *Subscriber per MHz*. In reality, it is operator B who is more efficient, which is apparent from the *Minutes per MHz* matrix.

1900 MHz ALLOCATION FOR CDMA & ISSUE OF INTERFERENCE AND HARMONISATION

23.0 From the discussion above it is seen that the CDMA operators in India need additional spectrum in 1900 MHz band. However, the questions of interference with the UMTS band and the need for Guard Band as well as harmonisation has been raised in certain quarters.

23.1 **Interference :** First and foremost the band plans proposed by us do not create the interference issues raised in certain quarters and hence our proposal is more appropriate and any apprehensions are unfounded. Still while we cannot wish away the technical requirement of studying interference issues and recognising the need for guard band as well as harmonisation, this however cannot be the ground for denying adequate spectrum for growth of any technology.

23.2 Moreover, it is to be noted that guard bands for PCS1900 MHz (1850-1910 MHz p/w 1930-1990 MHz) and the so called IMT2000 core band (1920-1980 MHz p/w 2110-2170 MHz) set-up are not huge and since the interference and blocking potential is almost the same as TDD/FDD clash at the bottom of the band.

23.3 It may also be considered whether introduction of filters can be a ground for not considering the requirements of CDMA operators? The filters have been used even in 800 and 900 MHz bands but that has not prevented the government to allocate the frequencies in 800 and 900 MHz bands to the CDMA and GSM operators.

23.4 While studying the interference problems certain assumptions are made which are critical in developing any argument. Such assumptions may or may not reflect the performance of today's CDMA equipment or the market situation.

23.5 **The choice is between the following two situations :**

(i) Blocking the growth of CDMA in India beyond 5+5 MHz i.e. no more spectrum to CDMA operators at all.

Or

(ii) Introduction of internationally deployed 1900 MHz band for CDMA operators adjacent to the so called core band which requires guard band, additional cost to the operators, due to tight additional filters.

23.6 **Harmonisation :** As regards harmonisation we say that spectrum harmonization is acceptable but at the same time, it cannot be ignored that requirements of various systems have to be considered in the appropriate bands and no one technology can be allowed to suffer because of the need for harmonization. Moreover, harmonization is being insisted by the propagated in the name of ITU and the ITU itself has also said that different administrations can use all or parts of the frequency arrangements given by ITU-R recommendation No. M.1036.2. Therefore, harmonization cannot be the only criteria for allocation of spectrum for different service providers using different

technologies. It cannot be anybody's case that harmonization purpose will be served better if incompatible bands of 800 MHz AND 1800 MHz are allocated to the CDMA operators whereas the natural process all over the world is 800 AND 1900 MHz band.

23.7 **Guard Bands :** It is also stated that mixed use of PCS 1900 and IMT 2000 leads to inefficient use of available spectrum in terms of large guard-band. This issue is totally irrelevant. The proposal suggested above separates the allocation for GSM and CDMA in such way that the allocations are different for different service providers.

23.8 In any case, the guard-band is inescapable not only between two different bands but also two different operators, even within the same band. Therefore, it is not possible to avoid the use of guard-band or other protective measures like filters as has been done in the case of present allocation between GSM and CDMA in 800 and 1900 MHz bands. But this cannot be a ground for not allocating 1900 MHz band for CDMA operators.

23.9 Moreover guard bands are required not only between two different frequencies but between the two operators in the same frequency band also. Reduction in the frequency due to guard bands can not be the ground for denying the 1900 MHz bands for CDMA because then this would apply to all the GSM and CDMA operators among themselves also.

23.10 **Development of infrastructure :** Another logic which has been given is that when the USA opened the 1900 MHz band to the GSM operations, the GSM infrastructure providers made available the infrastructure as well as handsets to suite the needs of the US markets and if the 1800 MHz band is opened up for CDMA in India, the vendors will make the infrastructure and handsets available for the Indian market also.

This logic is strange:

- ??firstly because the concerned section has failed to mention the length of time it took for GSM operators in the USA to get the GSM networks in place.
- ??Secondly **the proponents of this approach admit that the handsets and infrastructure are not available today in this 1800MHz and for the CDMA.**
- ??Thirdly such an approach will leave the Indian CDMA operators at the mercy of those vendors who may come up to develop such India specific infrastructure and handsets, which is against all commercial norms.

23.11 Keeping in mind the Indian market with very low ARPU, unlike US market, India today cannot afford expensive infrastructure and handsets specifically designed for it. One has to consider the development time and the cost of developing Infrastructure and handsets in a unique band. Moreover, this would mean that the CDMA operators would not be able to grow either their networks or their subscriber base or give full benefits of technology to the public till some vendors are able to develop the handsets and infrastructure to suit Indian needs. This logic is therefore totally invalid and not acceptable. Even WPC has repeatedly stated that they prefer multi vendors from multi-

regions for the handset and infrastructure availability to take advantage of economies of scale, required to maintain low cost of service.

SPECTRUM PRICING

Objectives of Spectrum Pricing

24.0 While it is true that fee is generally applicable for the right to use radio spectrum for promoting efficient use of this scarce resource, however it is not possible to accept the rationale as stated inn TRAI consultation paper that one of the objectives of pricing policy is raising government revenues. No policy document of the government, whether NTP'94 or NTP'99 have mentioned the fee to be obtained from the private service providers is for raising government revenues. In fact the basic policy objective in the case of telecom services has been to increase the teledensity levels, to provide telecommunication services in rural and remote areas and to provide affordable services to the consumers. Therefore, while deciding about the pricing policy for spectrum, raising government revenues should not be the objective at all.

Methodology for Spectrum Pricing

24.1 Out of the various methodologies mentioned for pricing spectrum it has been indicated in the consultation paper that where the aim is to ensure efficient use of radio spectrum, then one of the two methods i.e. Auctions or Administrative Incentive Pricing (AIP) is generally used. As is explained in paras below both these methods may not be useful and appropriate in the present Indian context.

Present Pricing Policy and Need for Change

24.2 Since the operators in India have not paid any entry fee specially for spectrum but have paid one time entry fee for getting the license it is rightly pointed out in the consultation paper that it is very difficult to assess the amount that has been paid by the operators at the time of issue of license for spectrum alone.

24.3 The current pricing regime based on revenue share is of course simple, understandable and accountable but has the disadvantage for the efficient operators (in terms of revenue) even within the same technology, as stated by the TRAI in its consultation paper. In view of this the TRAI has opined that the fee structure needs to be changed from the present revenue sharing to the fee based on amount of spectrum assigned. This logic of the regulator is relevant that there should be a change in the pricing policy for spectrum and entry fee be kept separate from the annual license fee.

Spectrum Pricing Policy for India

24.4 From 1994 onwards the government has issued licensees for providing mobile services in India starting with Metro areas and spreading to other parts of the country over a period of time. In each service area, barring a few exceptions, there are six to seven mobile operators providing mobile services using different technologies – GSM or CDMA. In terms of the competition this is a fairly competitive structure and there is less likely hood of the new operators coming in, though theoretically this possibility is not ruled out. The existing operators using any technology have made huge investments in the infrastructure and may need additional spectrum for expansion of their networks. Therefore any pricing policy to be considered should take into account the requirements of additional spectrum for the existing operators in such a manner that no additional burden is put on them which would lead to making the service more costly and this will be against the basic objective as laid down in NTP'94 and NTP'99 of providing affordable service to the masses.

Auctioning Spectrum –Indian context

24.5 Auctioning of the spectrum has been used in different parts of the world where it is the spectrum, which has been licensed for providing any mobile services or for providing specific 3G services. Additionally auction has been adopted as an approach for allocation of spectrum when the spectrum is initially allocated for providing the service and not when 6 / 7 operators are already operating the service and each has already been allocated spectrum, though to a different extent and differing degrees. Considering the option of Auction midway may lead to a situation that one or two operators may grab larger amount of spectrum by offering large amounts and the others are left without any additional spectrum.

24.6 Another important issue is that we can adopt process of auction only for a product/resource, which is readily available and can be given immediately after the auction and after the selected bidder makes the payment as per the auction procedure. Since we are dealing with a product / resource which is scarce in nature and is not readily available, and since this aspect is known to the bidders, whether auction will result in any serious bidding is questionable. The fact that the bidders are aware of the immediate non-availability of the spectrum may also lead to spurious kind of bidding where the bidders may quote astronomical figures in the knowledge that they do not have to pay anything immediately but will be able to block the spectrum for the serious players for the future. All the theories and points in favor of auctioning the spectrum would have been acceptable incase we had the spectrum readily available, which in fact is not the case.

24.7 Therefore, the option of auctioning spectrum in the present Indian context may not be the appropriate methodology for fixing the price for spectrum or as a method of spectrum allocation.

Administrative Incentive Pricing (AIP):

24.8 It is stated in the consultation paper that AIP is used in a situation where the demand for spectrum exceeds the supply. This is the situation in India for all types of wireless services. Therefore, AIP seems to be the appropriate method for spectrum pricing. However, the more pertinent question is of fixing the AIP. Theoretically speaking, the solution proposed in the consultation paper that of basing the value of spectrum on "Second Best" technology is appropriate since this provides users of that technology with an incentive to use it in the most efficient manner while avoiding to penalize users of more efficient technology.

24.9 Another aspect to be kept in mind is the investment decision making for a particular technology when AIP is used for pricing the spectrum. In normal circumstances the spectrum pricing can influence the decision for choosing any technology. However, in the current Indian context this theory may also not be applicable because the **decisions about the technology have already been taken and it is highly unlikely that any operator would like to switchover from one technology to another because of the spectrum pricing for a particular technology.**

24.10 The methodologies proposed in the consultation paper is theoretical in the sense that the assumptions used are not practical in the current scenario. Using base level of capacity and a number of sites to provide coverage in urban and rural areas or urban or total population, reasonable but equal market share for all the service providers etc are theoretical assumptions which can not be applied in the real world specifically in the current Indian Context.

Price of spectrum should be independent of the wireless technology

24.11 We shall take forward our analogy of building lifts to illustrate the above statement. Assume two buildings have lifts, which have same power consumption. Building A has an older lift, which has lesser capacity. Building B has a newer and expensive, but energy efficient lift and hence has more capacity for the same power consumption. But the differences in lifts do not mean that building B pays more for its power because its lift has more capacity. The electrical company will charge both the buildings the same rate for consumption of power.

24.12 Similarly different wireless technologies provide different amount of capacity for the same amount of spectrum. This does not mean that spectrum should be priced differently for different technologies. Spectrum pricing should be independent of the wireless technology.

Spectrum and capital are substitutes in wireless systems

24.13 We shall continue with our analogy of building lifts to illustrate the above relationship. Assume that power is free or inexpensive to Building A. Under such circumstances, the residents of the building will have no incentive to invest on maintenance of their lift so that it functions optimally. Over a period of time, due to lack of maintenance, the lift will degrade and consume more power. In this scenario, the

residents of Building A are able to save on cost of lift maintenance by drawing more power which is free or inexpensive.

24.14 If power is properly priced, then the residents of Building A have an incentive to invest in maintenance of their lift so that it functions optimally and does not use excess power.

24.15 In Wireless business, spectrum is akin to electrical power. If it is free or inexpensive, operators will seek more spectrum and save on costs of network upgradation and maintenance. Additional spectrum means that an operator can install fewer base stations to get the same capacity and quality of service. Service providers will use their spectrum in order to minimize the capital expenditure needed to provide their service.

24.16 **Hence it is important the spectrum is priced in a manner, which will induce operators to first invest in upgradation and optimal utilisation of their network before they seek additional spectrum.**

SPECTRUM CHARGES AND PROCESSING FOR OTHER TERRESTRIAL WIRELESS LINKS

25.0 TRAI has raised an important issue regarding the high spectrum royalty charges and the structure of charge determination. Before responding to the specific question on the formula for the royalty charges, we would like to draw the attention of the Authority to the disparities in the existing allocation and the charges paid by the cellular operators and the basic (Unified Access) licensees. We would therefore, like to respond as follows:

25.1 UASLs who apply for microwave links are allocated frequency spots on town-wise basis for a particular circle whereas CMSPs are allocated the frequency spot for the entire circle. Since the UASL operators are to be treated at par with the 4th Cellular licensees, and keeping in view the level playing field, it is essential that we should be allocated frequency spots for the entire circle instead of town-wise allocations.

25.2 In addition to the above, there exists a variation in the microwave royalty charges and license fee payable to WPC Wing. This is summarized in the following table:

UASL (erstwhile BSO)		CMSP	
Royalty Charges	R = M x W x C where M = Fixed multiplier W = Weighting factor C = No. of RF channels	**Spectrum Charges* for MW access networks (10 GHz and beyond)**	Bandwidth upto: ✍ Circle: 112 MHz ✍ Metro: 224 MHz @ 0.25% of AGR p.a. Additional allocation: ✍ Circle: 28 MHz ✍ Metro: 56 MHz @ 0.05% of AGR p.a.
License Fee	L = 1000 x N where N = No of Base stations (transmission towers for MW)	**Spectrum Charges* for MW backbone networks (below 10 GHz)**	Bandwidth upto: ✍ 56 MHz @ 0.1% of AGR p.a. ✍ For every additional 28 MHz @ 0.05% of AGR p.a.
* Spectrum charges include the royalty charges for spectrum usages and license fee for the fixed stations in MW access links.			

25.3 Ideally, we would suggest that the price/charge for microwave links should also be based on the cost recovery method, but in view of the reasons stated above it is only appropriate that the spectrum charges by the UAS licensees be first brought in line with the 4th CMSP's payment terms. Since we are proposing the new method for royalty calculation in line with what is being paid by the cellular operators, there is no rationale for proposing any different values for the M,C,W.

PART - III

POINT WISE RESPONSE TO TRAI CONSULLTATION PAPER NO.11/2004 ON SPECTRUM ISSUES

CHAPTER 2 : Current spectrum availability and requirement

Question: (i)

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

Response:

There are four band options, which can be considered for meeting the requirements of service providers using CDMA technology. The band options are:

(a) 800 MHz band
(b) 1800 MHz band
(c) 1900 MHz band
(d) 450 MHz band.

(a) In the 800 MHz band there is only 20 + 20 MHz bandwidth available (824 – 844 MHz paired with 869-889 MHz) in India. Due to 3/4 CDMA operators in each circle, this bandwidth is inadequate.

(b) 1800 MHz band has not been used by any CDMA operators in the world, except Korea and is not useful for meeting the spectrum requirements of CDMA operators. (The details of Korean PCS band and how it is different from DCS 1800 and their non-applicability is explained in detail in Annex-4).

(c) 1900 MHz band is the most used band for CDMA operations in the world. The 1900 MHz allocation referred to here is also known as the USPCS band and is the allocation of 1850-1910 MHz paired with 1930-1990 MHz. Due to the worldwide usage of 800 and 1900 MHz band for CDMA operations, there is easy availability of compatible handsets and infrastructure from multiple vendors. The CDMA operators have wide choice of selecting the vendors and handsets suppliers. Multiplicity of vendors also leads to comparative cost structure and the operators are able to obtain handsets/infrastructure at competitive prices to provide affordable service to the subscribers. The economies of scale for infrastructure equipment in the 1900 MHz PCS band and the availability of dual band 800/1900 MHz handsets make the PCS band preferable now to any other frequency band option.

With over 40 countries utilizing CDMA in the 800 MHz and/or PCS 1900 MHz frequency (Annex-2), dual band 800/1900 MHz phones can take advantage of international roaming. The ten most populated countries in the world have CDMA systems operating in either or both the 800 and 1900 MHz PCS bands. Further, multi-band, multi-mode GSM/CDMA phones have been introduced into the markets that operate on 900/1800/1900 MHz for GSM and 800/1900 MHz for CDMA.

(d) As regards the 450 MHz band it is stated that there are many advantages to utilizing the 450 MHz band for wireless systems especially in rural areas. Because of lower band operation, systems would be well-suited for coverage of large areas with fewer base stations than would be necessary at higher frequencies and could provide operators with a means to fulfill universal service obligations and also to ensure that the advanced mobile services will be available to the largest possible proportion of users. There is commercially available CDMA2000 equipment from some vendors for use in the 450 MHz band (in particular: 452.5-457.475 MHz paired with 462.5-467.475 MHz) and operators in few countries are offering commercial service today in this band. The list of the countries is given at Annex-6.

However, there is no dual-band (450/800) or tri-band (450/800/1900) handsets for the 450 MHz and 800/1900 MHz bands, and hence roaming opportunities are limited. Further, the amount of spectrum available at 450 MHz as specified in the CDMA2000 standard where currently equipment is available is slightly less than 2 x 5 MHz, which would not enable all operators to receive sufficient spectrum in this band. Only 2 FAs could be used in a 5 + 5 MHz spectrum allocation.

Suggestion :

In view of the above we suggest that USPCS band of 1900 MHz should be the first choice for additional spectrum to meet the requirements of CDMA operators and consideration of the 450 MHz band as a complement for the 1900 MHz for rural and high cost areas. We suggest TRAI **not to consider the 450 MHz band as a substitute for the 1900 MHz PCS band for meeting the requirements of CDMA operators in India.**

Question:(ii)
The consultation paper has discussed ITU method for assessment of spectrum requirement. Based upon the methodology submit your requirement of spectrum, please give various assumptions and its basis.

Response:

Analysis made on the basis of methodology suggested by the TRAI (ITU-R,M.1390) indicates the spectrum requirement of around 15+15 MHz for Reliance Infocomm.

Suggestion : 15+15 MHz should be allocated immediately

Question: (iii)

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

Response:

It is stated in this regard that the relevant provision in NFAP (IND 51) speaks of IMT '2000 requirements in frequency bands 1885-2025 paired with 2110 –2200 to be coordinated with existing users. Of course it is also stated in the said note that initially the coordination will be for 1920-1980 MHz p/w 2110-2170 MHz (FDD mode) and 2010-2025 MHz (TDD mode) depending on the market needs and availability. What this provision clearly explains is that the IMT-2000 allocation was not limited to 1920-1980 MHz p/w 2110-2170 MHz only. Moreover, The entire band 1710-1785 p/w 1805-1880 has been identified as IMT –2000 band by WRC-2000

To ensure level playing field between GSM and CDMA technology, the spectrum allocation should be so arranged that both these technologies get equal opportunity to grow. The ITU recommendations No. ITU-R M.1036-2 (as recorded by the TRAI in its consultation paper in para 2.3) permits the flexibility for administration to choose any band in 806-960 MHz band or 1710-2200 MHz for IMT2000.

The B5 band plan of the ITU-R recommendations can be earmarked for 3G operators in India, allocating equal spectrum for GSM and CDMA in the band 1755-1805 MHz paired with 2110-2160 MHz. This will ensure the level playing field between the GSM and the CDMA operators as well as will be in line with the provisions of adequate bandwidth for growth of mobile services in the country. The complete band plan and rationale for the same has been explained in response to other points in this document.

Suggestions:

We suggest that band plan for IMT -2000 should be expanded to cover the entire of 1710-1785 MHz band paired with 1805-1880 MHz. The entire band 1710-1785 p/w 1805-1880 has been identified as IMT –2000 band by WRC-2000

Question: (iv)

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?

Response:

In the case of the Indian context, the licenses are technology neutral. All licenses include provision of data services in the scope of services, without specifying the speed at which the data is to be transmitted, whether it is the basic license, cellular license or unified access licenses. In this context, 3G services should continue to be a part of the 2G services and no separate license is to be given. Since ITU permits flexibility for use of different bands for IMT2000 (3G services), there is no specific 'core band' for such a service.

The issue of spectrum allocation should not be linked to the issue of considering 3G as a continuation of 2G. Though, 3G services may be treated as a continuation of 2G, but for the purposes of spectrum allocation, IMT2000 may be considered in the band plan B5 (1755-1805 MHz paired with 2110-2160 MHz) under the ITU-R recommendation No. ITU-R M.1036-2.

It is essential to recognize that no one particular band can be referred to as the IMT-2000 band as the ITU has identified several bands for IMT-2000 and outlined a variety of specific band pairings for IMT-2000 under ITU-R Recommendation 1036-2. In fact, all the bands currently used by mobile providers in India have been identified by the ITU in Radio Regulation Footnotes 5.388, 5.317A, and 5.384A for possible use by IMT-2000 systems. Thus, it is inappropriate to identify a specific band for "IMT-2000" technologies and/or services.

We have suggested the classification of the entire 1710-1785 MHz paired with 1805-1880 MHz for IMT 2000 services in response to question no (iii) above. Internationally, the IMT 2000 includes 1710-1885 MHz. India should follow this definition as it will free spectrum from the currently defined 2G uses and make it available for 3G services as suggested in the ITU recommendations.

In Europe, discussions are on about the potential to deploy W-CDMA technology in the 900 and 1800 MHz frequency bands while in Region 2, deployment of W-CDMA systems will be in the 800 and 1900 MHz PCS bands. In Japan, NTT DoCoMo has indicated it will deploy WCDMA in the Japanese 800 MHz band. These particular examples of existing and future IMT-2000 technology deployments in the 800 MHz, 900 MHz, 1800 MHz DCS and 1900 MHz PCS bands show that it is crucial not to associate one particular band as an "IMT-2000" band.

We do not support defining frequency bands for specific services or technologies. In the United States for example, the Federal Communications Commission allows for the provision of advanced wireless services utilizing a variety of mobile technology systems, including TDMA, GSM, CDMA, CDMA2000, GSM/GPRS/EDGE, and WCDMA/HSDPA, or whatever technology or standard that may evolve in the marketplace. The current competition in Indian mobile market will automatically drive every technology service provider to 3G-like services even in the current bands.

With the technology and service-neutral regulations as outlined under the Unified License Regime, operators already offer 3G services in their existing bands (EDGE in 1800 MHz and CDMA 2000 1X in 800 MHz both termed as IMT-2000 technologies) and also offer a variety of services not specific to 2G or 3G technologies.

In the USA, the Federal Communications Commission (FCC) and National Telecommunications and Information Administration (NTIA) undertook a study to locate alternate bands for 3G operations, because GSM operators use the 1900 MHz band. The NTIA report found 45+45 MHz of spectrum for 3G services in the 1710-1755 MHz and 2110-2170 MHz bands.[2] The FCC found that the 2500-2690 MHz band were usable for 3G if the services presently occupying the band were relocated.[3] The FCC also stated in its report that:

> *There currently is no single global approach as to how the frequency bands identified at WARC-92 and WRC-2000 will be used to implement 3G systems, and no consensus that common global bands for use by 3G systems are achievable.*[4]

What is important to note here is that alternative arrangements are possible for the 3G services provided in the future. At this time, however, it is necessary for the TRAI to allocate an equal amount of spectrum to all operators, and then allocate them the spectrum that would allow for deployment into the near future. The service providers today have already begun providing 3G or 3G-type services.

The TRAI also acknowledges that CDMA 2000 1X as deployed by Reliance Infocomm is an IMT 2000 capable system.[5] Thus, as the current 2G and 2.5G operators will begin to evolve into 3G operators, the TRAI will be able to allocate additional spectrum in a manner that reduces interference between different radio interfaces and yet allows for high network growth.

Higher frequency band allocations may also be required to take advantage of higher antenna efficiencies and bandwidth ratios.[6] In India, the entire 2500-2690 MHz band is available for IMT-2000 services if coordinated with the INSAT system from 2535-2655 MHz.[7]
Reliance Infocomm suggests making PCS and UMTS bands available to operators for the provision of advanced wireless services in a service and technology neutral manner.

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[2] National Telecommunications And Information Administration, *An Assessment Of The Viability Of Accommodating Advanced Mobile Wireless (3g) Systems In The 1710-1770 Mhz And 2110-2170 Mhz Bands*, July 22, 2002

[3] FCC, *Final Report: Spectrum Study Of The 2500-2690 Mhz Band The Potential For Accommodating Third Generation Mobile Systems*, March 30, 2001

[4] FCC, *Final Report: Spectrum Study Of The 2500-2690 Mhz Band The Potential For Accommodating Third Generation Mobile Systems*, March 30, 2001, p. i-ii

[5] TRAI Consultation Paper at 15

[6] See Comments of SkyCross, Inc. to the Federal Communications Commission at II

[7] NFAP 2002

Coordinating the Indian PCS and UMTS bands

The consultation paper raised a concern that allocation and assignment of a portion of the Indian PCS band for CDMA could influence the future use of the UMTS frequency band (1920-1980 MHz paired with 2110-2170 MHz) due to interference.[8] An analysis done by Qualcomm, Inc. shows that both allocations can coexist with proper planning.(report attached at Annex-5)

We suggest that the Regulator consider the solution that would minimize interference between the suggested band pairings. This is a hybrid approach that allows equal allocations from both the PCS and UMTS band pairings. In keeping with the above principles of level playing field, adequacy of spectrum, allowing growth of all technologies without interference problems the following allocation is suggested to be incorporated in the Spectrum Policy:

1) 1710-1755 MHz p/w 1805-1850 MHz (2 x 45 MHz) for GSM
2) 1850-1880 MHz p/w 1930-1960 MHz (2 x 30 MHz) for CDMA (B3)
3) 1900-1910 MHz p/w 1980-1990 MHz (2 x 10 MHz) for CDMA (B3)
4) 1755-1805 MHz p/w 2110-2160 MHz (2 x 50 MHz) for 3G as per ITU-R (B5) Recommendation M.1036-2. Equal spectrum for GSM and CDMA.
5) 452.5-457.5 MHz p/w 462.5-467.5 (2x5 MHz) for CDMA

With the above proposed allocation, the situation will be as follows:

?? The existing allocation for GSM is 25 + 25 MHz.
?? The existing allocation for CDMA is 20 + 20 MHz.

?? Total allocation of spectrum for GSM (existing plus the new proposed allocation) = 25 + 45 MHz = 70 MHz.

?? Total allocation of spectrum for CDMA (existing plus the new proposed allocation) = 20 + 45 = 65 MHz.

?? Total allocation for 3G = 50 + 50 MHz, to be equally divided between GSM and CDMA.

The above suggestions are :

?? In line with the ITU recommendations for selecting any of the given bands for 3G services.
?? In line with international standards and appropriate spectrum is allocated to all the mobile service operators.
?? Ensure level playing field between the GSM and CDMA operators.
?? Provide adequate bandwidth for the growth of mobile services in the country.
?? Ensure the most efficient and optimal utilization of spectrum.

[8] TRAI Consultation Paper at 15

?? Technology neutral approach adopted by the Government.

(In terms of policy we are in favour of technology neutral approach for spectrum allocation but to bring in parity with the GSM spectrum allocation we have suggested the 450 MHz to be earmarked for CDMA based operators)

Suggestion:

As has been explained in detail above, there is nothing called IMT –2000 spectrum and hence there is no question of IMT-2000 spectrum being considered separately and provided to operators only for providing IMT-2000 services. IMT-2000 service has to be considered extension of 2G services and no separate license is required for 3G services. The licenses are technology neutral. All licenses include provision of data services in the scope of services, without specifying the speed at which the data is to be transmitted, whether it is the basic license, cellular license or unified access licenses. Similarly the allocation of spectrum should also be service neutral i.e. the spectrum should be allocated and it should be left to the operator to decide which service to provide whether it is 2G or 3G.

Question: (v)

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

Response:

Every one is aware that spectrum is too precious a resource to be wasted in any manner whether in guard bands or non-allocation or improper allocation or inefficient utilization. Therefore, reorganization of spot frequencies assignment is essential to allocate contiguous carriers of spectrum and avoidance of wastage of this natural resource in guard bands. However, in the Indian context, the frequencies have not been allocated so far in contiguous manner due to non-availability of the entire band for the specific service. Reorganization is to be done in a manner that the purpose is achieved without causing much dislocation to the consumers and the service providers and involving least cost in changing the hardware including filters at the BTS**. The principle to be followed in reorganization should be least disturbance to all.**

The other pre-requisite for reorganization of spectrum would be that the entire bandwidth earmarked for the specific service should be available for that service. For example, 20 MHz earmarked for CDMA operators in 800 MHz band and 25 MHz earmarked for GSM operators in 900 MHz band as well as other allocations should be available for use by the telecom service providers. In case the frequencies are being used for any other purpose, by any other agency, reorganization may not be feasible, since piecemeal reorganization is not recommended. Fundamentally, the entire 20 + 20 MHz in 800 MHz band must be available for CDMA operators.

The operators have already made efforts to provide inputs to WPC especially in Delhi and Mumbai in the 800 MHz band.

Suggestion:
We recognize that this is a challenging problem to solve but we urge the Regulator to move towards contiguous spectrum assignment for operators for all the reasons outlined in the Consultation Paper. We have also suggested different ways to achieve the same in para No. 11 of the introduction part of this document.

Question: (vi)

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

Response:

There are two parts of this question :

a) Whether the band 1880-1900 MHz be made technology neutral for all BSOs/CMSPs/UASLs and be made available for FDD operations also?

and

b) Whether should it be kept technology neutral but reserved for TDD operations only ?

The Access Licenses are technology neutral. The Government has accepted the technology neutrality and allowed all access providers to provide access services using any technology, therefore, there is no justification for reserving any bandwidth for a particular technology.

However, technology neutrality would lose its significance if the band is made technology neutral but is restricted to TDD only because TDD operations would lead to wastage of the corresponding downlinks between 1960-1980 MHz.*(in the TRAI consultation paper it is printed inadvertently as 1970-1990)*

If this bandwidth can be used in FDD mode with better utilization, there is no justification for reserving it for the TDD mode. In fact, this portion forms part of USPCS band. It is used for CDMA operations all over the world. It will be in line with the international practice to allocate this spectrum in FDD mode, as the part of USPCS. Once it is made technology neutral it will be neutral for all BSOs/CMSPs/UASLs.

We therefore, recommend that the band 1880-1900 MHz paired with 1960-1980 MHz should be made technology neutral and available to service providers in India along with the bands noted in Question (iv) above and any other bands as defined by the

Government of India. Continuing to keep the band 1880-1900 MHz reserved for TDD does not encourage the most efficient use of spectrum for Indian consumers.

The Basic Service License reserved the 1880-1900 MHz band for the deployment of Wireless Local Loop TDD systems based on the indigenous CorDECT system. All Basic Service Operators now utilize CDMA technology and have migrated to the UASL. The WLL TDD systems specified in NFAP '02 and in the Basic Service License find use in India in rural and other environments with very low traffic levels. The demand for additional spectrum for mobile operators in the 1880-1900 MHz band is principally driven by the high density of subscribers in Central Business Districts (CBD) and the need to adequately plan to meet increased demand for voice services and high speed data services.
Since it is unlikely that usually rurally located TDD cell sites with very high traffic would ever be utilized in close proximity of the CBDs where FDD technology is deployed, it may be possible to coordinate the operation of both systems, especially when TDD and FDD systems operate in adjacent bands.

Suggestion:

This band should be made technology neutral and should be available for FDD operations also.

CHAPTER 3 : Technical efficiency of spectrum utilization

Question: (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.

Response:
Reliance Infocomm supports the TRAI effort towards improving the efficiencies of spectrum use. It is important that all wireless networks are efficient and put spectrum to its highest-valued use. These concerns are international, and discussions on spectrum efficiency occupy regulators worldwide.

However, Reliance Infocomm does not support the use of a single spectrum efficiency metric, and suggests that TRAI ensure high efficiencies of spectrum use by resorting to market based mechanisms and an insightful spectrum allocation policy.

Efficiency: Technical, Spectral and Economic
Spectrum efficiency discussions often confuse three separate measures – technical, spectral, and economic. In general, we define efficiency as the ratio of output produced and inputs provided to any system.

$$\eta = \frac{\text{output}}{\text{input}}$$

Technical efficiency is the ratio of the output extracted to the cost of all inputs. A technically efficient system derives the required output using the least amount of all inputs, and achieves production at the lowest possible opportunity cost. Technical efficiency is:[9]

$$\eta_{TE} = \frac{\text{output}}{\text{cost of all inputs}}$$

A spectrally efficient system uses the least spectrum to perform its function. Hence, we define spectral efficiency (or spectrum efficiency) as:

$$\eta_{SE} = \frac{\text{output}}{\text{least spectrum affected}}$$

An economically efficient system puts resources to their highest value, at the lowest cost of all inputs. Thus,

$$\eta_{EE} = \frac{\text{highest valued use}}{\text{least cost of all inputs}}$$

Value could be determined in terms of revenues generated, value of the information exchanged, or even the value of lives saved, for example, if we consider the use of police or fire department radio services.

For our discussion, we are mostly concerned with technical and spectral efficiency.

Efficiency Trade-off: Spectral and Technical

The spectral efficiency of any radio communications system increases greatly when advanced and sensitive receivers and highly capable transmitters with powerful coding techniques are used that impact only small amounts of spectrum to transmit large amounts of information.[10] However, the cost of these systems will correspondingly be greater.

Thus, a trade-off is possible between the technical efficiency and the spectrum efficiency of a device.[11] It is possible to build a spectrally efficient system that is costly and vice-versa. While extreme cases are improbable[12], we should consider the relationship between spectral efficiency and cost, especially since we are dealing with a market that is

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[9] Federal Communications Commission, *Spectrum Efficiency Working Group Report*, November 15, 2002, hereafter FCC SEWG Report, p. 5

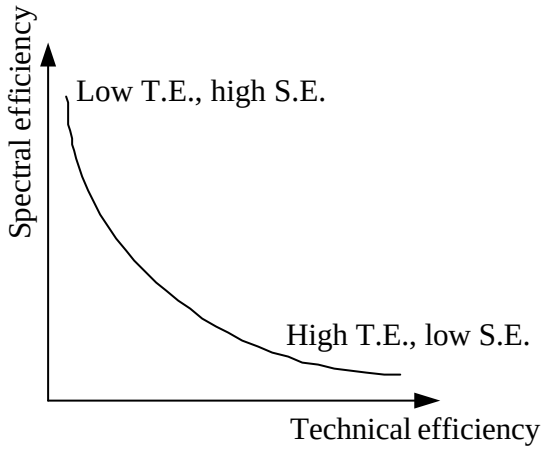
[10] *See generally* Federal Communications Commission, *Public Workshop On Spectrum Efficiency*, August 5, 2002, hereafter FCC SEWG Meeting Transcript

[11] Satapathy, D. P. and Peha, J. M., *Spectrum Sharing Without Licenses: Opportunities and Dangers*, in Rosston, G. L. and Waterman, D. (Eds.), Interconnection and the Internet: Selected Papers From The 1996 Telecommunications Research Conference, Mahwah, NJ: Lawrence Erlbaum Associates, 1997, pp. 49-75

[12] Spectrum is an input factored into technical efficiency of the system.

extremely price sensitive, and yet needs highly efficient systems to serve increasing demand.

We must consider the constraints that will be inherent in the design of any radio communications system. This is an important consideration – one must balance the spectral efficiency of the system with economic viability and cost – the technical efficiency.[13]



Trade-off between spectral efficiency and technical efficiency

Because of this inherent relationship in system design, we suggest that the TRAI consider the ramifications of technical efficiency-seeking objectives on the spectral efficiency and economics of wireless systems.[14,15]

Reliance Infocomm believes that spectrally efficient use of spectrum is important to prevent the waste of a scarce and valuable resource. TRAI should balance spectrum efficiency with technical efficiency objectives – ensuring the lowest cost of communications devices and services.

The regulator should also not use spectrum efficiency as a criterion for spectrum allocation/assignment. Such a technique is in fact, prone to creating technical inefficiencies in network design by increasing cost of deployment. Instead, the regulator should encourage efficiencies using market methods, which as explained below, encourages increases in spectrum efficiency and in network capacity.

[13] It is important to remember that technical efficiency is necessary, but not sufficient for economic efficiency. *See* Lee, D. R., *Economic Efficiency*, The Freeman: Ideas on Liberty, March 2001

[14] TRAI Consultation Paper at 19

[15] See example FCC Spectrum Efficiency Working Group in their Final Report at 5

Why Erlangs/MHz/km^2 is not useful as a spectrum efficiency measure

The Erlangs/MHz/km^2 metric is an incorrect metric to use for spectrum efficiency or utilization calculations. It is a more appropriate metric for technical efficiency. To recap, spectrum efficiency and technical efficiency are defined as:

$$\eta_{SE} = \frac{\text{output}}{\text{least spectrum affected}}$$

$$\eta_{TE} = \frac{\text{output}}{\text{cost of all inputs}}$$

If we consider the metric Erlangs/MHz/km^2, we are essentially considering the efficiencies of time, space, and frequency. Efficiency of time is denoted by the Erlangs per channel, efficiency of frequency is denoted by channels/MHz and efficiency of space is reuses/km^2, or cell site density.[16] Because this metric considers factors beyond only the amount of spectrum affected or efficiency of frequency, such a metric is a metric of technical efficiency, and not for spectrum efficiency. The metric includes a factor for the cost of the system: the efficiency of space or cell site density.

The currently suggested unit of Erlangs/MHz/km^2 is then misleading when comparing between the currently deployed GSM and CDMA networks especially when substantial percentages of GSM cells are deployed as micro cells. The reason for this, as with any universal metric for efficiency measurement, is that it is not sensitive to differences in technology and its deployments related issues.

CDMA is a macro cellular technology with a frequency reuse factor of one. CDMA cannot reuse frequencies the way GSM does. Planning of cells in GSM can reduce interference, by not allowing the same frequency to operate in an adjacent cell. This also means that GSM can deploy micro and pico cells to draw traffic from the macro cell in hot-spots. If the frequencies used by the smaller cells are different than those used in the macro cell, interference will not occur, and GSM will achieve extremely high spectrum efficiencies in terms of Erlangs/MHz/km^2.[17] Additionally, shielded cell sites – for example in valleys, buildings, and behind hills – can reduce interference further and increase reuse to higher levels.

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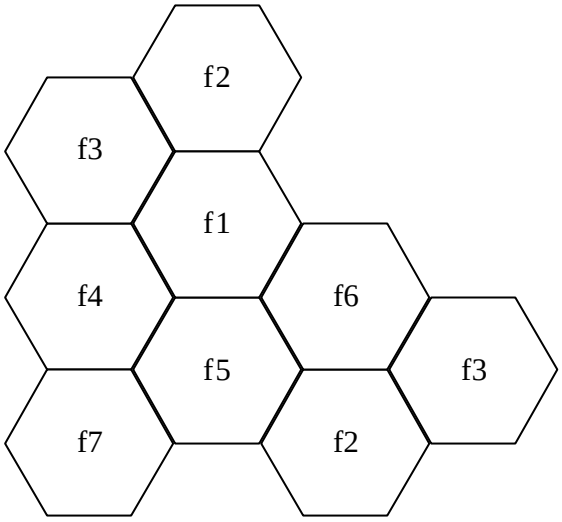
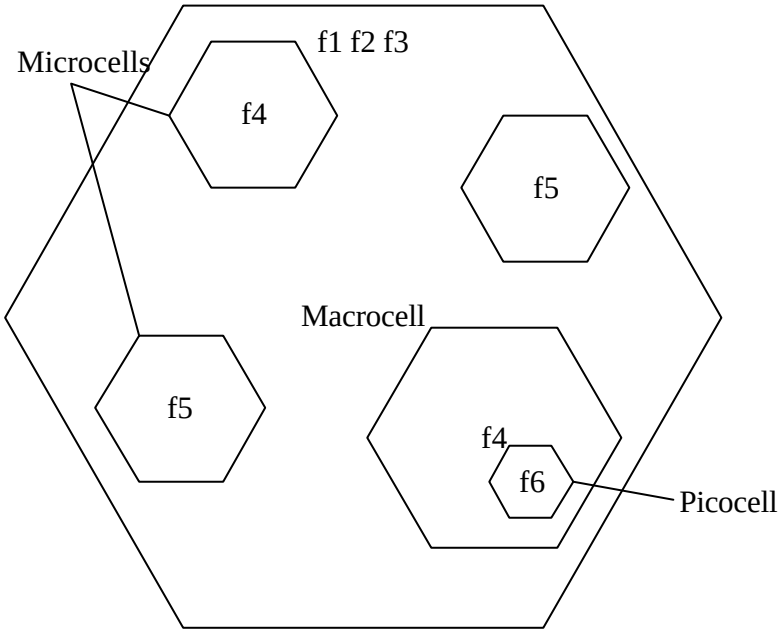
[16] Heeralall, S., *Discussion of spectrum efficiency and the factors that affect it*, Wireless Communications, 1992. Conference Proceedings., 1992 IEEE International Conference on Selected Topics in , 25-26 June 1992, p. 413 - 416

[17] *See, for example*: Lee, W.C.Y., *Efficiency of a new microcell system*, Vehicular Technology Conference, 1992 IEEE 42nd , 10-13 May 1992, p. 37 - 42 vol.1

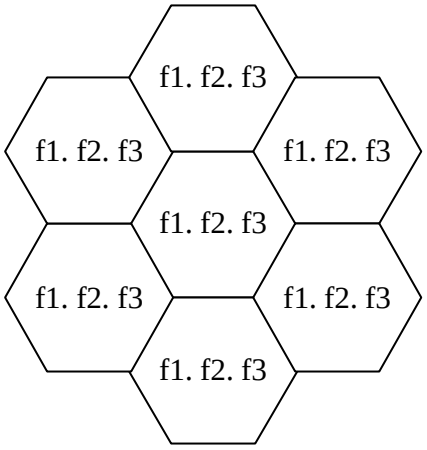


Frequency planning in GSM with macro cells

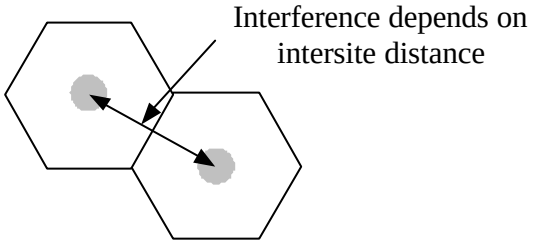


Use of micro and pico cells in GSM to enhance spectrum efficiency infinitely

However, because CDMA does not normally reuse frequencies in layers, it faces the problem of not being able to create micro and pico cells to enhance spectrum efficiency. The only way to increase spectrum efficiency is to place more cells in a given area. The spectrum efficiency of the system is then limited to the ability of the macro cells to not interfere with each other.



CDMA networks do not reuse frequency



Interference depends on the inter-site distance in CDMA

In GSM, the use of multi-level hierarchy in hotspots increases spectrum efficiency and reduces the frequency requirements. Spectrum efficiency increases because the same frequencies are reused to carry greater traffic. Frequency requirements of GSM systems also reduce because the reuse and spectrum efficiency increase, compensating any inefficiency of the GSM technology itself.

The example of GSM networks in London and the theoretical calculations in the Consultation Paper prove that the use of multi-level hierarchy helps GSM systems achieve capacities and efficiencies in Erlangs/MHz/km^2 similar to CDMA networks.[18]

We suggest that GSM systems in India should be encouraged to invest in micro and pico cellular technology so that they can use their allocated spectrum more efficiently.

It might be possible for GSM operators to over or under -estimate their efficiencies by using / not using a multi-level system hierarchy. We request that a specific criteria be fixed in order to encourage fairness in evaluation. Even the Consultation Paper points to

[18] TRAI Consultation Paper at 36

the fact that the efficiency calculations do "not take into account the efficiencies achievable by deploying multi layered architecture."[19]

If the Regulator is keen to establish one metric to measure spectral efficiencies across technologies, we recommend the use of Erlangs/MHz, and not Erlangs/MHz/km^2, which is comparable to the efficiency of frequency.[20] This metric does not compare technologies for technical efficiency by avoiding measures of efficiency of space.

We suggest TRAI not to use the Erlangs/MHz/km^2 metric to measure spectrum efficiency.

Definition of a Spectrum Efficiency Measure

In addition to the difficulty in balancing both the technical and economic efficiency of the system, the TRAI faces the task of defining spectrum efficiency. The definitions provided in the Consultation Paper are as recommended by the ITU.[21]
We would like to caution the Regulator against seeking to measure spectral efficiency. It has been noted by the FCC that:

> *After considering the comments and reviewing the record, the [FCC's Spectrum Efficiency] Working Group concludes that* ***it is not possible, nor appropriate, to select a single, objective metric that could be used to compare efficiencies across different radio services****. Any metric would provide, inherent in its assumptions, advantages to certain services and technologies, and disadvantages to others.*[22,23]

The use of a single measure in terms of Erlangs/MHz/km^2 or even Erlangs/MHz is not appropriate because the measure has no specific recognition of the actions of the service provider with respect to deployment of technology, and there can be under- or over-estimation of efficiency standards for different technologies. It is also anti-competitive and biases possible outcomes, by not encouraging possible improvements to efficiency. Instead, operators would set the figure as a target and aim to achieve only that.

Regulation should drive each network to achieve its highest possible efficiency (which depends on technical and organizational limits). This negates the need for arbitrary and disputable quantities of performance. Even the FCC states that:

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[19] TRAI Consultation Paper at 23

[20] Heeralall, S., *Discussion of spectrum efficiency and the factors that affect it*, Wireless Communications, 1992. Conference Proceedings., 1992 IEEE International Conference on Selected Topics in , 25-26 June 1992, p. 413

[21] TRAI Consultation Paper at 19

[22] FCC SEWG Final Report at 9. Emphasis added.

[23] *See also*, Burns, J. W., *Measuring Spectrum Efficiency – The Art Of Spectrum Utilisation Metrics*, Aegis Systems Ltd, United Kingdom

> *While not adopting a single metric, the [Spectrum Efficiency] Working Group still believes it to be possible, and prudent, to promote the efficient access to and use of spectrum.*[24]

Reliance Infocomm suggests the Regulator not adopt numerical metrics evaluate spectrum efficiencies across different technologies, and instead use market forces to ensure that spectrum is used efficiently.

The TRAI should measure network capacity rather than spectrum efficiency

Reliance Infocomm also urges TRAI to consider the recasting of spectrum in progress around the world. Spectrum is not 'ether'. Instead, spectrum exists only due to the action of two devices communicating on a common set of frequencies. In this concept, spectrum is non-existent, a creation of the networks that communicate through it.[25]

Rather than trying to measure the efficiency of spectrum, the Regulator should measure the capacity of networks that use spectrum, because system capacity and spectrum efficiency are related.[26] The Consultation Paper also points to such an approach.[27] If a network provides the highest capacity given its spectrum allocation, it is logical to conclude that it is using its spectrum efficiently. It is not prudent to compare different technologies and their network's efficiencies. It is more important to ensure that each network is operating at its highest capacity. As such, spectrum allocation should be divorced from spectrum efficiency, because only then will network design be most efficient, supporting the largest capacity and range of services at the lowest cost.

The efficiency of spectrum is indeterminate as it takes on the characteristics of the wireless network it uses. The Regulator should begin to analyze network capacity more than spectrum efficiency The TRAI can measure performance of operators and compare it with possible capacity. This allows the Regulator to know if each operator is putting fully to use the spectrum it has. The penalty for misuse of the resource could be a fine.[28] Such an approach will also assist the TRAI in assessing the capacity of each network on an individual basis, in a manner that reduces chicanery and creates incentives for each operator to maximize efficiency. It also considers the possibility of improvements in efficiency, and to changes in technological make-up of these networks.

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[24] FCC SEWG Final Report at 9

[25] For example, the colour 'green' does not exist. It is the reaction of certain wavelengths of electromagnetic energy from the Sun with the retina in our eyes. The same is with spectrum. 1900 MHz does not exist, until a cellular phone sends out energy at that frequency to communicate with a base station. *See generally*, Werbach, K., *Supercommons: Toward a Unified Theory of Wireless Communication*, Telecommunications Policy Research Conference, 2003

[26] Lee, W. C. Y., *Mobile Cellular Telecommunications*, Second Edition, 1995, p. 404

[27] TRAI Consultation Paper at 20-21

[28] Similar systems to discourage inefficiency have also been suggested to the FCC as part of its proceeding on spectrum efficiency. *See generally* FCC SEWG Report, and FCC ET Docket No. 02-135. *See also* Ofcom Consultation Document, *Ensuring effective competition following the introduction of spectrum trading*, June 2004

If the TRAI agrees to measure network capacity, it also supports the possible use of AIP as a spectrum pricing mechanism, and the use of market forces in ensuring the most efficient use of spectrum.

TRAI Should Rely on Market Forces to Ensure Efficiency

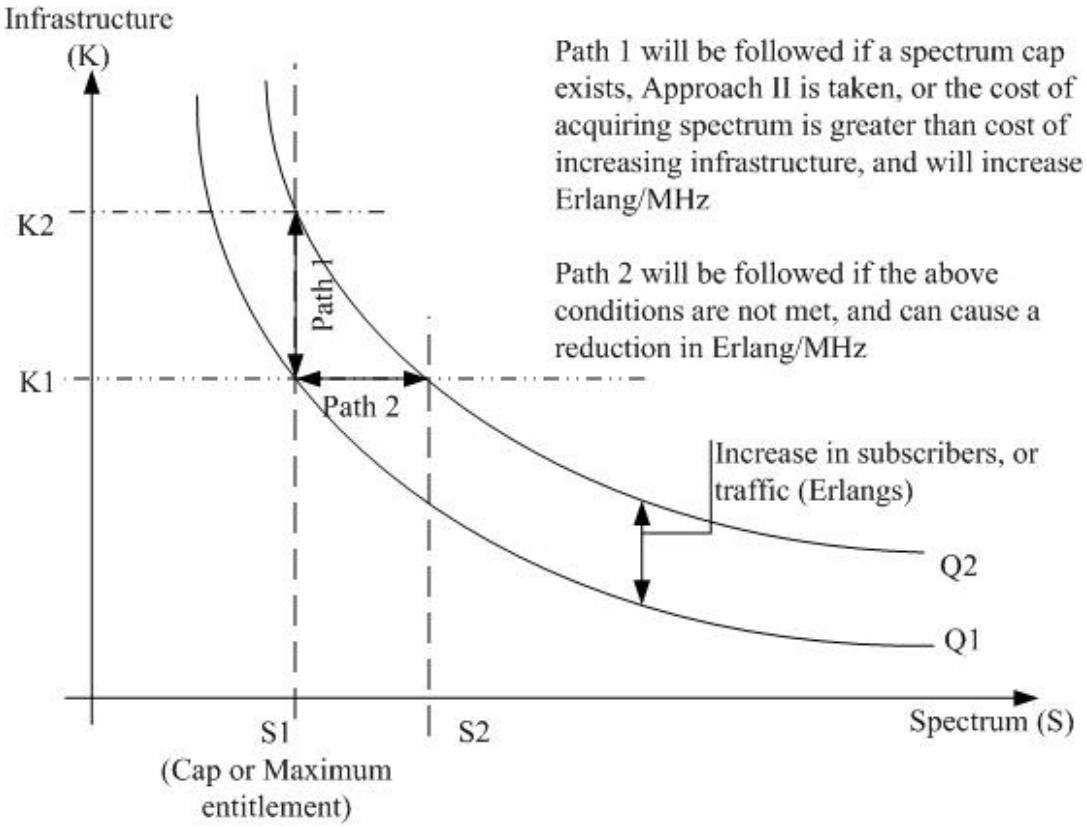
Reliance Infocomm believes that when all service providers have equal amounts of spectrum, as per Approach II,[29] market forces will create the incentives for them to use spectrum in the most efficient manner possible. This is an established economic fact.[30] This move will force service providers to use more efficient technologies, better network planning and management techniques to derive higher profits, without the need of any arbitrary efficiency measures.

Such an approach, depending on the market forces, is also in tune with Approach II (Consultation Paper Section 5.4) of spectrum allocation. Once all service providers have equal spectrum, it will only be in their own benefit to use it most efficiently. See figure below.

If the initial allocation is set at 10+10 MHz (as per Approach II) with additional spectrum available in a market, service providers will ensure that spectrum is obtained only when their capital expenditure is higher than acquisition costs of spectrum, or service cannot be improved without increasing operational costs, such as mitigating interference or reducing quality of service. This prevents inefficient use of spectrum. Further, this method is market-friendly and fits in well with the direction of spectrum policy in India.

[29] TRAI Consultation Paper at 60

[30] If all firms have an equal amount of a scarce resource, they must use it in the most efficient manner (within their individual constraints) in order to generate the maximum profit. An example is a pre-paid taxi. The driver who minimizes the distance driven, or maximizes the fuel efficiency of his engine, will earn the most profit.



It is essential that TRAI recognize that it can achieve the efficient use of spectrum through the creation of market incentives and strict performance criteria, and most importantly, discouraging the inefficient use of spectrum. Such methods will also be future-proof and ensure that operators concentrate more on performance rather than prediction or quantification.

Indicating the possible use of market principles to ensure efficient use of spectrum, the OECD says:

> *Efficiency in the allocation of licenses must be linked with efficiency in usage of the spectrum. Intuitively, a firm that made a competitive bid for spectrum through an auction procedure would tend to have a high incentive to use the spectrum efficiently. In turn this would mean that there is an incentive to build-out the network relatively rapidly. Other means are also available to ensure efficient use of spectrum. A market where competition was strong would provide appropriate incentives for efficient spectrum use, which in turn means that the number of licenses issued for a particular service is important. Allowing the trading of spectrum resources can help improve efficient use. Imposing build-out*

requirements on licensees can speed up the development of services, but does not necessarily provide the right incentives to use spectrum efficiently.[31]

Given the difficulty in predicting ways to measure efficiencies of devices in the future, the inadequacy of one metric today, and with the availability of other means available to achieve a high spectrum efficiency and utilization, Reliance Infocomm suggests to TRAI that it search for methods to encourage efficiency rather than looking for ways to quantify utilization.

Conclusion and suggestion:

To summarize our comments on spectrum efficiency,

1. The TRAI should not interchangeably use technical and spectrum efficiency
2. The trade off between technical (cost) and spectrum (resource) efficiency is important and should be considered when evaluating the performance of networks
3. Reliance Infocomm does not support the use of spectrum efficiency metrics
4. TRAI should consider evaluating the capacity of networks and using AIP to ensure that spectrum is being used efficiently
5. Reliance Infocomm suggests that the TRAI use market principles and allocation processes to ensure the maximum efficiency of networks
6. If a single metric should be used for spectrum efficiency, TRAI should consider using Erlangs/MHz
7. Reliance Infocomm does not feel that Erlang/MHz/km^2 is a correct spectrum efficiency measure.
8. TRAI should not use spectrum efficiency measures to decide on spectrum allocations, and instead consider methods of encouraging efficient use of spectrum rather than aiming to measure or determine what is efficient.

Question: (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?

"The confluence of 2.5G/3G networks, devices and apps mean data are starting to add value which should spur demand. An improving economic outlook should also enable uptake", says Goldman Sachs in its report dated April '04. The report adds," Data growth in Asia and Europe continues to be robust and is starting to move beyond SMS…..Data devices already represent a small fraction of reported net adds but we see this number growing dramatically over the next few years, which means net adds results should remain strong verses 2003 levels. The tradeoff is ARPU, which tends to be lower

[31] OECD, *Spectrum Allocation: Auctions And Comparative Selection Procedures - Economic Arguments* , Working Party on Telecommunication and Information Services Policies, p. 27, available at http://www.oecd.org/LongAbstract/0,2546,en_2649_34225_27125983_119666_1_1_1,00.html

for data only devices. But lower ARPU belie the value created by the higher margins and penetration delivered by Data devices so we think investors increasingly must look beyond ARPU….."

The wireless data growth prospects are becoming bullish due to catalysts that include:

- ?? Increasing penetration of advanced devices,
- ?? Broader 2.5G and 3G network deployment,
- ?? IP wireless,
- ?? Evolution in pricing schemes
- ?? Growing end user education and awareness.

Specifically CDMA carriers have increasingly more scope for providing wireless data services because the upgrade on the CDMA path is software base and hence it is easier to extend broadband data coverage across the entire network footprint. And because the technologies are backward compatible, the new data devices will be able to function on 1XRTT or IS-95 in more rural areas. The CDMA carriers are very aggressive on data through its 1XEVDO upgrades and by aggressively promoting their network quality and increasing brand strength among enterprise users.

International experience

Korea and Japan have the most advanced marketplace for telecommunications with 74% mobile wireless penetration utilizing CDMA technology. Popular wireless data content and applications available on CDMA2000 1X and 1xEV-DO networks in Korea include video messaging and monitoring of people and assets, video (news/TV) on demand, recording and sending of video clips, multi-media messaging, broadband Internet access for companies, residents and public entities, interactive gaming, live music downloads (songs and videos), and interactive map and location based services. Wireless data services can also be used in a number of other applications such as the provision of emergency services, ATM connectivity, and Internet access in a variety of places like railways, schools and hospitals where people could be diagnosed remotely.

A number of wireless carriers with CDMA networks around the world are deploying a CDMA2000 wireless broadband technology referred to as 1xEV-DO. This technology delivers data at peak rates of 2.4 megabits per second and at average rates of 300-600 kilobits per second.

Ubiquitous, high-speed wireless broadband service is provided today over licensed spectrum via 1xEV-DO technology. PCMCIA cards with 1xEV-DO can be used with laptop computers for data connectivity and are widely used in the United States, Japan and Korea. In addition, in Japan and Korea, over 40 models of phones and PDAs with EV-DO technology, made by a variety of manufacturers in a wide assortment of different and appealing designs and features, are on the market.

Indian context

Such devices will also become popular in India, allowing wireless subscribers to access new data services, such as email, web browsing, downloads, and multimedia applications opening many new opportunities for software development. Indeed CDMA2000 1X operators in India have begun to offer an array of innovative multimedia services such as live TV streams. Given India's well known reputation in the IT software development field, the number of jobs which could be created in the provision of content and applications for wireless data is in the thousands with countless opportunities for export of such applications.

USO guidelines

Apart from this, the data service demand in India is also likely to increase in view of the implementation of **guidelines for universal service support.** As per the guidelines issued by the government, it was provided that the government will endeavor to provide data transmission facilities within 5kms of every village and at least those villages where regular post offices are located. In the phased programme about 35,000 VPTs were proposed to function as Public Telecom and Info Centres(PTICs). As per the guidelines it is also provided that high speed PTICs (HPTICs) are also proposed to be established to provide wide band applications like Tele-education, Tele-medicine base don two basic channels i.e. 128 kbps. In the first phase by '2004 about 2HPTI's were proposed to be set up in each SDCA i.e. about 5000 HPTICs.

The government seeks to achieve national objective of rapid low cost expansion of telephone and internet connectivity in rural and remote areas as referred in planning commission resolution no: IT-TF/S98. Going by this IT policy, the VPTs in future should have access to internet. This access can be provided by the nearest Internet Node with or without any technical enhancement but the bottlenecks are two folds. One is the availability of terminal equipment at the VPT to convert it into PTICs and the other is the inadequacy of technologies to support data services. (TRAI Consultation Paper3/2000 on USO)

The CDMA systems deployed by us have overcome this difficulty since CDMA is he most economical way of covering rural and remote areas and capability of providing state- of- the- art network and a wide variety of high-speed data applications perfectly relevant even in rural scenarios such as:
e-Kiosks
e-governance
e-education
e-healthcare.

Thus, significantly new contents and applications are emerging for wireless data services that offer compelling value to the consumer. Similarly new devices will be introduced and existing device will evolve to provide a more enhanced wireless data experience. Wireless modem cards allow laptop and notebook computers to access the internet and intranet anywhere anytime.

CII report

These will lead to increased data volumes. In addition, improved usability and higher data rates will drive substantial acceptance and penetration of wireless data services. The CII in its report (March '2004) has given broadband subscribers target as follows:

Year Ending	Broadband Subscribers Target
2006	3.35 Million
2010	10.1-10.6 Million
2020	32 – 39 Million

This shows the potential for growth of broadband services in India. The TRAI in its recommendations in April '2004 on the broadband issues stated that:

> *"3.7.3 Third Generation and Beyond Mobile Services*
> *3.7.3.1 Owing to limited reach and scope of broadband services, today there is not much demand for mobile broadband services. Once, the demand for broadband picks up, the demand for mobile broadband may also get accentuated. At that stage, services such as 3G and beyond will become attractive and affordable. This would in turn further accelerate the rollout of broadband. …."*

Moreover, in the case of CDMA operators in India particularly in case of Reliance Infocomm almost all the handsets are data enabled and hence it can be safely assumed that more than 50% of the subscribers may be using their handsets for data services. Wireless terminals, either fixed wireless or mobile are being used to provide Internet facility for transmission of data at a speed of more than 144 kbps.

With the Regulator having already made recommendations for **broadband services using** both fixed and wireless technologies the provision of data services is going to be an increasingly more important area for growth of wireless networks.

It is, therefore, essential that adequate and separately dedicated carriers should be allocated to the mobile operators for provision of data services and the time limit has to be as soon as possible.

CDMA technology permits the carriage of voice and data traffic on the same carrier. However, for the best quality and speed transmission data can be achieved only through a dedicated separate carrier. To start with, a minimum of two carriers is needed for the data services. Particularly, in the Indian context, the mobile service providers are facing the issue of declining ARPU, the need for provision of data services is very urgent for better utilization, maintenance and sustaining their networks.

Reliance Network - data services and spectrum requirements

Reliance Infocomm is developing a series of enhancements to 1xEV-DO technology. One enhancement will greatly increase the speed for uploading data. There are a number of other enhancements to the 1xEV-DO technology that also enable new services and improve the user experience. For example, quality of service software will enable carriers to offer consumers different data rates at different price points and will assign faster data rates and lower latency for users who subscribe to services that need that enhanced performance, thereby permitting carriers to offer a host of exciting new services such as video telephony, video conferencing, and streaming video and audio. In short, we can say that Inter User QoS (to differentiate Users) and Intra User QoS (to differentiate applications) are being incorporated in the Revision A of 1xEV-DO. 1xEV-DO technology will also enable multi-casting, the transmission of wireless video and audio either on an on-demand or network scheduled basis.

Other enhancements that are currently being developed include the ability to transmit and receive instant multimedia messages and a series of improvements to overall system capacity by supporting phones with dual antennas and to sector capacity through improved equalizers. All of these enhancements will improve services, drive low costs, and enable wireless carriers who deploy 1xEV-DO to offer an even more popular and cost-effective ubiquitous wireless broadband service on their licensed spectrum.

Suggestion:

We have shown above that the requirements for mobile data services are increasing from the current levels of 50% in the network to 90% particularly in the CDMA networks. This growth of wireless data requirements will increasingly need additional spectrum of at least 5 + 5 MHz as data carriers immediately. In addition to 15 + 15 MHz as stated above, the Regulator should make a provision for 5 + 5 MHz to meet the immediate requirements of wireless data services.

CHAPTER 4 : Spectrum Pricing

Questions: (ix)

Is there a necessity to change from the existing revenue share method for determining the annual spectrum charge?

Response:

The current pricing regime based on revenue share is of course simple, understandable and accountable but has the disadvantage for the efficient operators (in terms of revenue) even within the same technology, as stated by the TRAI in its consultation paper. In view of this the TRAI has opined that the fee structure needs to be changed from the present revenue sharing to the fee based on amount of spectrum assigned. This logic of the

regulator is relevant that there should be a change in the pricing policy for spectrum and entry fee be kept separate from the annual license fee.

Suggstion:

Yes there is a need for change from the existing revenue share method for determining the annual spectrum charges.

Question: (x)

If yes, what methodology should be used to determine spectrum pricing for existing and new operators? (Please refer table in Section 4.8)

Response:

Internationally, different countries have used different methods for fixing the spectrum charges. Though these different methodologies do provide a guide for fixing the spectrum charges but no one method can be copied in India due to the objectives of the telecom policy (increasing teledensity, penetration in rural areas and service at affordable rates to the masses) being different here from those which may be followed in other parts of the world.

From 1994 onwards the government has issued licensees for providing mobile services in India starting with Metro areas and spreading to other parts of the country over a period of time. In each service area, barring a few exceptions, there are six to seven mobile operators providing mobile services using different technologies – GSM or CDMA. **In terms of the competition this is a fairly competitive structure** and there is less likely hood of the new operators coming in, though theoretically this possibility is not ruled out.

The existing operators using any technology have made huge investments in the infrastructure and may need additional spectrum for expansion of their networks. Therefore any pricing policy to be considered should take into account the requirements of additional spectrum for the existing operators in such a manner that no additional burden is put on them which would lead to making the service more costly and this will be against the basic objective as laid down in NTP'94 and NTP'99 of providing affordable service to the masses.

It has been indicated in the consultation paper that Cost recovery method of pricing is appropriate where there is no excess demand for spectrum. The concept of "no excess demand" would imply that the spectrum is more and the demand for the same is less. It is generally believed that in the Indian context that the demand is more and the supply is less (because available spectrum for mobile civil use is held by other users) and hence it would be argued that the cost recovery method cannot be applied here**. But this fallacy**

needs to be understood in the real sense. We can say that spectrum is a valuable resource and it should be used judiciously. But we cannot say that there is less spectrum available than the demand for the commercial deployment by the telecom service providers. In fact the same spectrum is available to all the countries of the world but the use to which the spectrum has been put varies from country to country as per their local needs, though keeping in line with international standards.

In case the spectrum is not immediately available for use by the telecom service providers, it has nothing to do with the scarcity of spectrum but this situation is because of the legacy. Till the spectrum was not used by the private telecom service providers, it was being provided to the Govt. organizations including defence, railways, IOCL,ONGC etc., for use for their wireless applications.

After the Govt. allowed the private sector to participate in the provision of telecom services, the private sector needed the spectrum to provide wireless services and hence there arose the need for re-allocating the spectrum from non-telecom users to the telecom users. This created the demand for spectrum for commercial deployment**. Therefore, what is now needed is the re-allocation of spectrum from one use to the other.** But that involves various issues about the methods of re-allocation or re-farming and the cost of shifting from one use to the other.

Suggestion: In view of the above we suggest the method of cost recovery for the spectrum pricing. We suggest the following:

Charges	Spectrum to existing operators upto 2x15 MHz. (spectrum entitlement as a part of license).	Additional spectrum to existing operators beyond 2x15 MHz.	New entrants
One time entry fee	NIL	NIL	Same as paid by existing licensees to ensure level playing field.
Annual charges	Minimum charges based on recovering the cost of	Charge per MHz to be arrived at on the basis of AIP	Same as proposed for the existing licensees to ensure

	administering spectrum on charge per MHz basis.	method which can also ensure spectrum efficiency based on market mechanism.	level playing field

Question: (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?

Response:

Since we have suggested Administration cost basis for spectrum pricing up to the initial entitlement limit of 15 + 15 MHz the issue of any new spectrum pricing is not relevant up to this limit. AIP can be used for creation of market based spectrum efficiency mechanism method for the spectrum pricing and hence we need not comment on this question.

As a matter of policy and principle we say that, the solution proposed in the consultation paper that of basing the value of spectrum on "Second Best" technology is appropriate since this provides users of that technology with an incentive to use it in the most efficient manner while avoiding to penalize users of more efficient technology.

Another aspect to be kept in mind is the investment decision making for a particular technology when AIP is used for pricing the spectrum. In normal circumstances the spectrum pricing can influence the decision for choosing any technology. However, in the current Indian context this theory may also not be applicable because the decisions about the technology have already been taken and it is highly unlikely that any operator would like to switchover from one technology to another because of the spectrum pricing for a particular technology.

Suggestion:

We recommend the Administration cost recovery method for the spectrum pricing up to 15 + 15 MHz. However, beyond 15 + 15 MHz we suggest market driven efficiency based AIP method.

Question: (xii)

Please provide your comments on the assumptions used in A.I.P

Response:

The methodologies proposed in the consultation paper are theoretical in the sense that the assumptions used are not practical in the current scenario. Using base level of capacity and a number of sites to provide coverage in urban and rural areas or urban or total population, reasonable but equal market share for all the service providers etc are academic assumptions which can not be applied in the real world specifically in the current Indian Context.

Suggestion: Using base level of capacity and a number of sites to provide coverage in urban and rural areas or urban or total population, reasonable but equal market share for all the service providers etc are academic assumptions which can not be applied in the real world specifically in the current Indian Context.

Question: (xiii)

In case Auction methodology is used for pricing the spectrum, please give suggestions to ensure that spectrum is available to those who need it.

Response:

Auctioning of the spectrum has been used in different parts of the world where the spectrum has been licensed for providing any mobile services or for providing specific 3G services. Additionally, auction has been adopted as an approach for allocation of spectrum when the spectrum is initially allocated for providing the service and not when 6 / 7 operators are already operating the service and each has already been allocated spectrum, though to a different extent and in differing degrees. Considering the option of Auction midway may lead to a situation that one or two operators may grab larger amount of spectrum by offering large amounts and the others are left without any additional spectrum.

Another important issue is that we can adopt process of auction only for a product / resource, which is readily available and can be given immediately after the auction and after the selected bidder makes the payment as per the auction procedure. Since we are dealing with a product / resource which is not readily available, and since this aspect is known to the bidders, whether auction will result in any serious bidding is questionable. The fact that the bidders are aware of the immediate non-availability of the spectrum may also lead to spurious kind of bidding where the bidders may quote astronomical figures in the knowledge that they do not have to pay anything immediately but will be able to block the spectrum for the serious players for the future. All the theories and points in favor of auctioning the spectrum would have been acceptable incase we had the spectrum readily available and six/seven service operators had not been already operating in different parts of the country, which however, is not the case.

Suggestion:

Therefore, the option of auctioning spectrum in the present Indian context may not be the appropriate methodology for fixing the price for spectrum or as a method of spectrum allocation.

Question: (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?

Response:

If it is agreed that there is a need for change of the methodology of spectrum pricing, it is in view of the realization that the present spectrum pricing is not suitable or not in line with established practices or is not based on scientific calculations or is putting avoidable burden on the subscriber in the form of higher tariffs etc. Therefore, the changed methodology suggested above should be applicable to the spectrum requirements upto 15+15 MHz and market driven efficiency based AIP method beyond 15+15 MHz.

Suggestion:

The changed methodology should be applicable to the spectrum requirements upto 15+15 MHz and market driven efficiency based AIP method beyond 15+15 MHz.

Question: (xv)

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

It has been rightly pointed out by the TRAI that on purely commercial considerations the service providers may not find it economically viable to cover substantial areas where the returns are going to be less than the cost.

It may not be out of place here to say that in order to remove regional imbalances in the industrial growth in the country and to encourage the industries to go to the areas where there was no industrial development, the Govt had introduced the concept of **backward industry districts**. Large concessions were announced in the form of waiver of income tax, excise duty, sales tax, concessional loans and so on for the entrepreneurs to go and establish industries in such areas. This concept did help and large number of industries, both medium and small were established in such areas leading to industrial growth in these backward districts.

In line with the above precedence it is essential that some incentives need to be given to the telecom service providers to go into the rural and remote areas in order to achieve the goals laid down in NTP'99. The incentives could be deducting the revenue obtained from

services in such areas from the gross revenue for the purpose of calculating Annual License Fee, exemptions of excise/custom duties on the equipment used in such areas and so on. Additionally, the government should also encourage use of 450 MHz band in the rural areas and it should be allotted without any entry fee or annual spectrum charges.

These steps will go a long way to achieve the objectives of NTP99 and also meet the targets laid down in USO policy of the government. This will also help achieve the objectives and targets laid down in the broadband policy recommendations given by the TRAI.

Suggestions:

For encouraging the coverage in rural areas special discounts as described above are essential.

Question: (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?

Response:

TRAI has an important issue regarding the high spectrum royalty charges and the structure of charge determination.

Before responding to the specific question on the formula for the royalty charges, we would like to draw the attention of the Authority to the disparities in the existing allocation and the charges paid by the cellular operators and the basic (Unified Access) licensees. We would therefore, like to respond as follows:

UASLs who apply for microwave links are allocated frequency assignments on town-wise basis for a particular circle whereas CMSPs are allocated the frequency spot for the entire circle. Since the UASL operators are to be treated at par with the 4th Cellular licensees, and keeping in view the level playing field , it is essential that we should be allocated frequency assignments for the entire circle instead of town-wise allocations.

In addition to the above, there exists a variation in the microwave royalty charges and license fee payable to WPC Wing. This is summarized in the following table:

UASL (erstwhile BSO)		**CMSP**	
Royalty Charges	R = M x W x C where M = Fixed multiplier W = Weighting factor C = No. of RF channels	**Spectrum Charges* for MW access networks (10 GHz and beyond)**	Bandwidth upto: ✍ Circle: 112 MHz ✍ Metro: 224 MHz

			@ 0.25% of AGR p.a. Additional allocation: ✍ Circle: 28 MHz ✍ Metro: 56 MHz @ 0.05% of AGR p.a.
License Fee	L = 1000 x N where N = No of Base stations (transmission towers for MW)	**Spectrum Charges* for MW backbone networks (below 10 GHz)**	Bandwidth upto: ✍ 56 MHz @ 0.1% of AGR p.a. ✍ For every additional 28 MHz @ 0.05% of AGR p.a.
		* Spectrum charges include the royalty charges for spectrum usages and license fee for the fixed stations in MW access links.	

Ideally, we would suggest that the price/charge for microwave links should also be based on the cost recovery method, but in view of the reasons stated above it is only appropriate that the spectrum charges by the UAS licensees be first brought in line with the 4th CMSP's payment terms. Since we are proposing the new method for royalty calculation in line with what is being paid by the cellular operators, there is no rationale for proposing any different values for the M,C,W.

Suggestion:

There is a need for change of the formula for payment of royalty charges for the basic (Unified Access) licensees for terrestrial links. Ideally, we should suggest this charge also to be based the cost of cost of administration recovery method. However, due to the reasons stated above, we propose:

?? migration to royalty charges based on proposed percentage basis of AGR to be in line with the similar charges for the cellular operators.

?? it is essential that we should be allocated frequency spots for the entire circle , again in line with the cellular operators, instead of town-wise allocations.

Question: (xvii)

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

Response:

Yes. The TRAI should introduce different pricing levels for shared spectrum versus protected spectrum. Economic theory and historical common precedent will support such differentiated pricing. Protected spectrum is similar to protected property, such as privately held land or a family home. Shared spectrum can be analogized to a shared or common resource such as a public park. Obviously, the barriers to entry must be greater to a protected property versus a shared resource.

Protected spectrum should be priced according to market principles and to reflect the true value of the spectrum. The auction or AIP, or cost recovery methods are possible ways to price this spectrum.

Suggestion:

TRAI should introduce different pricing levels for shared spectrum versus protected spectrum. The auction or AIP, or cost recovery methods are possible ways to price this spectrum.

CHAPTER 5 : Spectrum Allocation

Question: (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.

Response:

We are in favor of TRAI following Approach II as described in section 5.4 of the TRAI consultation paper. We feel that all mobile service providers in India should have access to a minimum amount of 2 x 15 MHz of spectrum initially irrespective of the technologies and bands used and that the spectrum allocation should be contiguous where possible.

Approach II ensures a transparent and level playing field and eliminates the case-by-case approach based on the different sets of criteria currently used in India, which is subjective and inconsistent with technology neutrality. Approach II also leads to an equal allocation of spectrum to all operators. TRAI should not allocate unequal amounts of spectrum to service providers on the basis of technology because:

- ?? Unequal allocation promotes inefficiency,
- ?? punishes the more efficient service provider or technology,
- ?? goes against the spirit of the UASL by biasing against possible competitive outcomes
- ?? favouring one system over another.

Moreover, unequal endowments will lead to distortions in any future market growth. Allocations that reward specific technologies lead to technology arbitrage, where operators chose technologies to gain a greater allocation and then can migrate towards other technologies. Such a possibility even affects the migration of different service providers to 3G operations, and damages competition.

The TRAI definitely wishes to maintain a high efficiency of spectrum use. Hence, it should not punish the more spectrally efficient technology by weakening its market position and allocating it lesser resources. All operators have paid the same license fees under the unified license scheme. The allocations and benefits should then be the same in the interest of fairness.

It is important for the TRAI to allocate an equal amount of spectrum to all operators, and to achieve this aim, we suggest the use of the 1900 MHz PCS band for CDMA service providers, and 450 MHz band for use in rural and high-cost areas.

As the allocation currently stands, the amount of spectrum reserved for CDMA operators (up to 2 x 5 MHz) is not enough even to support the minimum capacity projections required over the next two years for voice services alone. As noted by the TRAI, international practice has been to make 2 x 10 MHz or more spectrum available to service providers. Ideally, TRAI should allocate larger blocks of spectrum of at least 2 x 15 MHz or 2 x 20 MHz to operators.

Larger blocks of spectrum afford operators increased flexibility for the provision of services and permit better network planning and greater subscribers benefits.. It is important that the Government of India make additional spectrum available for commercial service providers as soon as possible in order to be consistent with international practice and facilitate the growth in wireless subscribers expected by 2005.

Approach I will freeze the allocation of existing levels provided except those where license conditions warrant further allocation. Reliance Infocomm does not support this

approach as the current spectrum allocation for CDMA operators in India varies from 2 x 2.5 MHz to 2 x 5 MHz compared with 2 x 4.4 to 2 x 10 MHz for GSM operators.

The amount of spectrum assigned should be independent of the technology chosen by the operator and the same regulatory environment should apply equally to all mobile service providers ensuring that their success or failure depends solely on marketplace factors. Thus, it is imperative that CDMA operators have access to the same amount of spectrum as GSM operators on an equal basis, with the same regulatory conditions.

Reliance Infocomm further believes that there is no need for the regulator to determine the efficiency of either technology in order to allocate spectrum. Given the complexities and ever-changing nature of mobile network technologies, the Government may not be in the best position to determine the spectrum needs of each service provider. The regulator should instead work to establish a level playing field that will enable operators to compete on an equal basis with the freedom to leverage the strengths of their chosen technologies and services to their full potential.

Suggestion :

In view of the reasons stated above we support Approach-II

Question: (xix)

At what stage the amount of spectrum allocation to new entrants be considered in the 800 MHz / 900 MHz/ 1800 MHz frequency bands?

Response:

At present the Government has issued licenses to the mobile service operators using both GSM and CDMA technologies. The number of operators in each service area, is about 6/7 and there is enough competition by any standards. Though there is no bar on the entry of new service providers since any one fulfilling the eligibility criteria can apply for the license and if the applicant meets all the criteria, the Govt shall issue the new licenses also.

However, in actual practice, the new entrants entry may be very difficult on account of the existing operators having established themselves and new entrant not finding it very conducive to enter the market where competition already is very tough. Thus the possibility of new entrants is very remote, if any.

Therefore, instead of considering allocation for the new entrants the regulator should first concentrate on meeting the spectrum requirements of the existing operators. The first priority should be to provide adequate spectrum as per the international standards to the existing operators and once this has been achieved then only we should consider the possibility of any spectrum for the new entrants.

Suggestion:

Spectrum allocation for the new entrants should be considered only after meeting the requirements of the existing service providers to the extent of at least 15+15 MHz in the appropriate bands..

Question: (xx)

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

Response:

Yes the allocation of spectrum needs to be service and technology neutral. However, the technology / service neutrality can only mean that the service providers are free to use any technology for providing mobile services but having chosen the technology they need to be given spectrum which is suitable for their technology. Neutrality would also mean that the regulator does not promote one technology over the other. The regulator should not discriminate between technologies at the time of allocating spectrum and let the operators choose the band suitable for their technology and the spectrum should be made available in that band without any preference for any technology.

We strongly support service and technology neutral allocation of spectrum. We believe that enabling operators to choose which technology to use and which services to provide over their spectrum creates a great number of substantial social and economic benefits.

Service and technology neutrality is of the utmost importance to allow for the development of innovative applications, technologies that are more efficient, increased consumer choice, lower prices, and competition. We also believe that part of technology neutrality as it pertains to spectrum allocation is licensing frequency bands that encourage multiple technology standards to compete. The ultimate tests of service and technology neutrality are

- ?? whether an operator has the freedom and flexibility to select the technology that makes the best commercial sense and offer its choice of services without interference from governments, and
- ?? whether the operator can benefit from any available incentives (i.e. receiving additional spectrum) to the same degree regardless of the technology used and service provided.

Practical considerations govern the choice of technology that an operator will use. If the TRAI seeks to award spectrum in a technologically neutral manner, it should allow the operator to decide which band of spectrum would be best suited for its purposes. If the Regulator instead chooses to allocate it one band only, and this band is incompatible with its choice of technology, the spectrum allocation policy cannot be technology neutral. Hence, the sequencing of the allocation is of utmost importance, and the allocation must allow the operator to select the bands for which it wishes to compete. Only when this

happens, and the criteria specified above as (a) and (b) are satisfied, will the policy be technology and service neutral.

Suggestion:

We support that spectrum should be allocated in a technology and service neutral manner.

Question: (xxi)

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

Response:

Spectrum caps are useful to prevent the hoarding of spectrum, and we support the establishment of caps in principle The cap on spectrum allocation is needed in the present Indian context due to the spectrum being not readily available. Presently the major part of spectrum in every band is being held or used by the existing various users of wireless systems including defence. The scarcity of the available cleared spectrum and comparatively larger number of operators in each service area would dictate that the spectrum should be rationed for use of the telecom service providers in the sense that there should be a cap of the maximum amount of spectrum which can be allocated to a service provider.

However this view is subject to two qualifications:

- ?? Firstly, cap should not be the reason for not allocating adequate spectrum to the service providers as per the international standards
- ?? Secondly, this situation should be reviewed after some time , say two to three years, to see whether additional spectrum has become available from other non-telecom users and allocation as per international standards is available to the existing telecom service providers.

The TRAI should consider using spectrum caps initially to limit the entitlements, then to control the total amount of spectrum made available to bidders in any future auction or assignment of spectrum. We suggest TRAI should enforce spectrum caps for each operator, at every stage of allocation, and for all operators as a total. For example, GSM/CDMA operators can have an individual cap at 20 + 20 MHz. The caps should be high enough to allow for expansion of services and technologies, but at levels that prevent anti-competitive use.

For example, the FCC says:

> *The Commission decided last year to "sunset" the CMRS spectrum aggregation limit, or "spectrum cap," effective January 1, 2003. The Commission found that the cap, by setting an a priori limit on spectrum aggregation without looking at the particular circumstances of specific proposed transactions, was unnecessarily inflexible and could be preventing beneficial arrangements that promote*

efficiency without undermining competition. However, the Commission also stated that it would continue to pursue the objectives of "discourag[ing] anticompetitive behavior while at the same time maintaining incentives for innovation and efficiency," but would do so by performing case-by case reviews of proposed CMRS spectrum transactions rather than by applying a prophylactic rule.[32]

Suggestion:
The market in India is not yet fully matured. The anti-competition regulations /legislation in India are will not/ in their present form, be able to control the anti-competitive behavior (hoarding of spectrum to jeopardize competition) and hence we suggest the cap.
While we are in support of spectrum caps, TRAI should be careful about how they should be set, and for what exact purpose. Secondly there should also be a provision for periodic review as and when required.

Question: (xxii)

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

Response:

As we have already pointed out above the concept of scarcity is relative. The amount of spectrum available to all the countries is same and the countries have deployed the spectrum for different uses in manner which suits their requirement and hence there cannot be one solution which will suit all. In India due to the legacy, spectrum has been allotted to different users when the spectrum was not provided to the telecom industry for the commercial deployment. Now when the Govt has permitted the private sector to provide telecom services, the requirement of spectrum needs to be met by re-farming or re-allocation to meet the requirements of all the users in appropriate bands.

Scarcity would therefore be only in respect of immediate availability of spectrum in the appropriate bands. In view of this, we would suggest that the telecom service providers should be allocated adequate and appropriate spectrum as per the international standards and norms. Since, the telecom service providers have already established their networks having committed large investments , it is imperative that they should have the required spectrum to provide the services to the customers which their technology is capable of providing. Therefore, whatever method is adopted , it should ensure that the existing mobile operators are not deprived of the required spectrum whether it is relatively scarce or not. In any case there is no spectrum at present available which is useful for the provision of telecom services and for which there is no demand. The areas that have demand for spectrum are typically the CBDs and down town areas. Thus the procedures need be in place for allocating spectrum to operators in these areas. There is no scarcity in other areas because there is no demand for spectrum in those areas.

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[32] FCC, *In the Matter of Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, WT Docket No. 02-353, Notice Of Proposed Rulemaking, November 22, 2002, p. 18

Suggestion :

In view of the above submissions , we suggest that there is no need to evolve any new method of allocation of spectrum in different areas. The existing method of allocation of spectrum may continue and it should be ensured that the existing mobile operators are not deprived of the required spectrum whether it is relatively scarce or not or in a specific area.

Question: (xxiii)

Which competitive spectrum allocation procedure (auction/ Beauty Contest) be adopted in cases where there is scarcity?

Response:

We have already explained above No. ----that auction is not an appropriate option at present in the Indian context. We have also explained above that in the Indian context the first and the foremost requirement is the allocation of adequate and appropriate spectrum to the already licensed telecom service providers.

Various methods/procedures have been adopted by the regulators in different countries of the world and such methods and procedures are relevant when the spectrum has to be allocated for the first time for provision of the services. The term "scarcity" in the Indian context is because of the spectrum used for mobile services internationally is held by other agencies . Spectrum availability is the same in all countries and it is only that regulation that could free up spectrum for mobile services. While the fairest procedure for spectrum award could be an auction , one should be careful about its relevance in developing countries.

In the Indian context, the license have already been issued, service providers are already providing the service after having established the state-of-the art network and hence presently their requirement is to have adequate, contiguous and appropriate spectrum in one chunk. Hence, applicability of any economic theory or methods or procedures for allocation of spectrum will be meaningful only after allocating the minimum required spectrum of atleast 15 + 15 MHz each for the mobile service operators.

Suggestion:

Therefore, any method which gives equal spectrum for all service providers and minimum of 15+15 MHz allocation as per the international standards and which does not differentiate between technologies is suitable for the Indian context.

Question: (xxiv)

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

Response:
It is recognized that spectrum is an extremely valuable resource and needs to be used efficiently. Any spectrum not allocated and withheld can not be seen to be used efficiently. The present license condition of fourth CMSP provides for spectrum in 1800 MHz band and any allocation from 900 MHz band to the 4th CMSP will be against the license conditions.

The very fact that this question has been raised shows that there are areas where 900 MHz band is available even after meeting the requirements of the first three GSM cellular licensees. In such a situation and in such areas the following is suggested :

Presently the CDMA allocations in 800 MHz band are restricted to 824 –844 MHz p/w 869-889 MHz. Internationally the CDMA allocation in 800 MHz band is in the range of 824 –849 MHz p/w 869-894 MHz. The bandwidth from 844-849 MHz is not being utilized presently in India able to guard band requirements because the downlink from 889-894 MHz is being utilized by the GSM operators. Therefore, in case there are areas where segments in 900 MHz band is available even after meeting the requirements of first three GSM operators, in such areas 5MHz downlink (889-894 MHz) of 900 MHz band should be utilized for pairing with 844-849 MHz and maybe allocated to the CDMA operators to meet their expanding requirements of spectrum, as they already have only 20+20 MHz in 800 MHz band . Such a suggestion will not only be in line with international standards of 800 MHz band pairing but would also lead to utilization of the 5MHz (844-849) which is deprived to CDMA operators in India at present.

Suggestion:

In case there are areas where segments 900 MHz band is available even after meeting the requirements of first three GSM operators, in such areas 5MHz downlink (889-894 MHz) of 900 MHz band should be utilized for pairing with 844-849 MHz and maybe allocated to the CDMA operators

Question: (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.

Response:

As we have already explained above there is no specific band which can be called IMT – 2000 band since as per ITU recommendation no: 1036 there are different bands which

have been identified for IMT-2000. The said recommendation has been reproduced in the TRAI consultation paper in para 2.3 on page-7.

The ITU –R recommendations M.1036 states ,

> *" IMT-2000 will operate in the frequency bands identified in the Radio Regulations (RR) as intended for use on a worldwide basis by administrations wishing to implement IMT-2000 , as follows:*
> *WARC-92 identified the bands:*
> *- 1885 - 2025 MHz*
> *- 2110 – 2200 MHz*
> *and WRC-2000 identified the bands*
> *- 806 – 960 MHz***
> *- 1710-1885 MHz*
> *- 2500-2690 MHz*
> *for possible use by IMT-2000 systems, noting(in accordance with RR No. 5.388) that identification of these bands does not establish priority in the RR and does not prelude use of the bands for any other services to which these bands are allocated. Also, some administrations may deploy IMT-2000 systems in bands other than those identified in the RR."*
> ***The whole band 806-960 MHz is not identified on a global basis for IMT-2000 due to variation in the primary mobile service allocations and uses across the three ITU regions.*

Therefore, **calling any band as MT-2000 band is a misnomer**, since there are different bands which can be used as IMT-2000 bands. The table below this recommendation explains that 800 / 900 / 1800 / 1900 MHz bands or a combination of two three bands can be used for IMT-2000.

Irrespective of which band is used for IMT-2000 , the minimum blocks of additional spectrum should be such that each operator gets at least 15 + 15 MHz , whichever may be the technology used. Larger blocks of contiguous spectrum provide operators with additional capacity, the ability to plan for long-term growth and greater flexibility to offer a variety of voice and data services.

Therefore, the blocks should be in such a manner that the total spectrum with each operator becomes at least 15 + 15 MHz. For example, if an operator already has 5 + 5MHz , the suitable block for him should be 10 + 10 MHz and those already having 10 + 10 MHz , a suitable block for them would be 5 + 5 MHz and so on.

As regards to the new entrants , it has been explained in different paras above that the case for new entrants should be considered only after ensuring minimum bandwidth of 15 + 15 MHz for each operator. After meeting this requirement of the existing operators , the block for the new entrants can be suitably decided based on availability of spectrum in each area.

We suggest TRAI to consider a number of different frequency pairing band options and design a fair assignment process that would meet the needs of operators to receive the

spectrum they require to offer a variety of voice and data services, including broadband data access.

Suggestions:

Therefore, the blocks should be in such a manner that the total spectrum with each operator becomes 15 + 15 MHz, whichever may be the technology used.

Question: (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?

Response:

We believe that the term, "IMT-2000 spectrum" is a misnomer since as highlighted in ITU Recommendation M.1036-2, IMT-2000 systems can be deployed in any band, and multiple bands have been identified for IMT-2000 systems.

We have already submitted above that the so called IMT-2000 spectrum should be treated as continuum to 2G, we support the allocation of additional spectrum to existing operators using spectrum below the specified benchmark in the so called IMT-2000 bands. Concerns that might prevent such allocation are to do with the reduction in band space available for 3G services, and the possible interference that might occur in the future.

However, as has been pointed out by us in previous sections of this response, we believe that it is possible to coordinate the operation of the 2G and 3G services in the so called IMT-2000 bands, and simultaneously, consider alternate band arrangements as has been done in the United States by the FCC and NTIA.

Suggestions:
In view of what is stated above, we support the proposal to treat to those existing operators using the spectrum below the specified benchmark to be eligible for additional spectrum from the so called IMT-2000 band.

CHAPTER 6 : Re-farming, Spectrum Trading , M&A and Surrender

Question: (xxvii)

What approach should be adopted to expedite the re-farming of 1800 MHz and IMT – 2000 spectrum from existing users?

Response:

Re-farming of spectrum has become absolute necessity in view of the increasing requirements for commercial use of spectrum in providing wireless telecommunication services. Large amount of spectrum in 1800 MHz and 1900 MHz band is presently being used by non-telecom users , particularly Defense. It is no doubt true that no one can overlook the Defense requirements but at the same time the requirements for commercial use of spectrum by the Telecom service providers also can not be ignored when the licensees have been granted license by the Government after payment of huge entry/license fee.

Re-deployment of frequency at the expiry of current license period or at the end of the equipment's lifetime are not the right approaches since these will take a very long time and will defeat the very purpose of immediate requirement of redeployment of frequency. The only method which will be effective is the forced migration into other frequency bands.

Though it has been indicated in the consultation paper that this can be technically and economically difficult process to implement and it may require new costly infrastructure and longer transition period but still this is the only long term solution to meet the increasing spectrum requirements of telecom service providers

As regards the compensation for the redeployment it is proposed that the redeployment should be funded from a central resource which should be created by contributing the entire entry fee /license fee paid by the service providers for obtaining/using the spectrum. In case of any short fall it should be compensated from the central fund. The time scale for re farming should be as early as possible because otherwise the very purpose of re-farming will be defeated.

Suggestion:

In view of the above, it is suggested that since re-deployment of frequency at the expiry of current license period or at the end of the equipment's lifetime are not the right approaches, the only method which will be effective is the forced migration into other frequency bands. It is further suggested that the redeployment should be funded from a central resource

Question: (xxviii)

What approach should be adopted for re-farming of spectrum after expiry of license?

Response:

As regards the Telecom licenses are concerned, it is stated that most of the licenses are for a period of 2 years extendable for 10 years at a time. It is felt that the expiry of license period of the existing telephone operators is too far a period to consider re-farming at their expiry.

In the case of other non telecom service licenses , if any , after the expiry of the license period the spectrum should be allocated appropriately to the existing operators to meet their increasing requirements of spectrum for data and broadband services.

Suggestion:

For the telecom licenses the license period is too far to consider any method of re-farming at present and for the non-telecom licenses , if any, the spectrum after the license expiry should be appropriately used to meet the requirements of the telecom service providers.

Question: (xxix)

Should there be any refund for spectrum surrender in principle?

Response:

There is no logic for any refund on account of spectrum surrender in principle. However, in case of forced surrender of spectrum , the Govt should consider refund in some form.

Suggestion:

Though there is no logic for refund for spectrum surrender in principle. However in the case of forced surrender of spectrum some refund can be considered.

Question: (xxx)

Should there be refund for spectrum surrender consequent to unified Access license policy? If yes, what should be the basis?

Response:
There is no rationale for any refund for surrender of spectrum in the case of policy changes like Unified Access License since government policy changes and amendments in the license conditions are done as per the powers given under the license for amending the license. Moreover the license conditions have been changed , particularly in the GSM licenses , which have benefited the existing licenses to a very large extent but the operators have not paid any additional payment for the benefits granted by the change of government policy . The points against the refund as given in para 6.1.1 of the consultation paper are applicable in this case.

Suggestion:

There is no rationale for any refund for surrender of spectrum in the case of policy changes like Unified Access License

Question: (xxxi)

How should the amount of refund be estimated?

Response:
Not applicable in view of replies given to the above questions. However in the case of forced surrender the option (b) in para 6.1.1.1 of the consultation paper is suggested.

Suggestion:
Not applicable in view of replies given to the above questions. However in the case of forced surrender the option (b) in para 6.1.1.1 of the consultation paper is suggested.

Questions: (xxxii)
Should we open up the spectrum market for spectrum trading? If yes, what should be the time frame for doing so ?

Response:

We believe that spectrum trading and secondary markets, especially in conjunction with a liberal technology-neutral spectrum policy encourages more efficient use of spectrum and brings substantial benefits to citizens by ensuring that spectrum is used in the best manner possible to deploy technologically advanced services of great social and economic benefit.

However, such trading mechanisms have wide implications for the licensees in India. . We suggest that trading of spectrum should be taken up as a separate point of consultation to evolve a long term strategy and policy rather than making it a part of the present consultation document.

Suggestion:
Spectrum trading should be delinked from the present consultation process since trading has been permitted in mature markets and it involves larger implications and a deeper study is required.

Question : (xxxiii)

What are the pre-requisites to adopting spectrum trading?

Response:

In reply to question no(xxxii) above we have suggested trading to be considered separately and not as a part of this consultation process.

Question: (xxxiv)
Whether we should specify a cap higher than 2 X 15 MHz for Metros and Category "A" service area and 2 X 12.4 MHz for Category "B" and "C" service area in case of M&As or should it be retained?

Response:
The cap should be uniform at 20 + 20 MHz irrespective of category of circle..

Question: (xxxv)
In case, IMT 2000 is considered as a continuum of 2G services, is there a need to have a cap higher than that without IMT 2000 services? Should there be individual caps on 2G and 3G spectrum or a combined cap?

Response:

The telecom licenses issued to the access providers including Unified Access Licensees contain a provision that the service includes the transmission of voice and non-voice messages and hence the licensees are permitted to provide all types of voice and data services. Therefore, in the Indian context there may not be a separate specific service to be called IMT-2000 service for which any special license is required.

However, since the requirements for wireless data services are going to increase tremendously in the coming times, we suggest that the cap to include data services should be some what higher than the existing cap. In this case the cap should be 20+20 MHz. But it has to be ensured that all the operators using any type of technology get this minimum of spectrum 20+20 MHz. Even in the case of mergers also this limit should be applicable.
The cap has to be a combined cap whether it is a 2G or 3G service.

Suggestion:

In the Indian context there may not be a separate specific service to be called IMT-2000 service for which any special license is required. However, since the requirements for wireless data should be in the form of High Multimedia Messaging (HIMM) and other real video gaming services are going to increase using mobile devices, the combined cap to include such data services should be 20+20 MHz.

Question: (xxxvi)

In case of M&As where the merged entity gets spectrum exceeding the spectrum cap, what should be the time frame in which the service provider be required to surrender the additional spectrum?

Response:
In case of mergers and acquisitions if there is a total spectrum which is exceeding the spectrum cap , the entity will have to surrender the additional spectrum as soon as possible but in any case not later than 6 months. Thereafter the spectrum should be automatically stand withdrawn.

Suggestion:
In such a case the entity will have to surrender the additional spectrum as soon as possible but in any case not later than 6 months

Annex-1

SPECTRUM TO CDMA OPERATORS IN OTHER COUNTRIES

S. No	Country	Bandwidth Per Operator
1.	Argentina	15 + 15 MHz
2.	Australia	10 + 10MHz
3.	Brazil	11.5 + 11.5 MHz
4.	Canada	12.5 + 12.5 MHz
5.	Chile	10 + 10 MHz
6.	China	10 + 10MHz
7.	Dominican Republic	20 + 20 MHz
8.	HongKong	7.5 + 7.5MHz
9.	Indonesia	10 + 10MHz
10.	Japan	15 + 15MHz
11.	Korea	12 + 12 MHz
12.	Mexico	17.5 + 17.5 MHz
13.	New Zealand	20 + 20MHz
14.	Philippines	10 + 10MHz
15.	Taiwan	20 + 20MHz
16.	Thailand	12.5 +12.5MHz
17.	USA	18 + 18 MHz

Annex-2

USE OF 1900MHz USPCS BAND BY CDMA OPERATORS IN OTHER COUNTRIES

From the table given below it is clear that in most countries where CDMA technology is used, the frequency allocation is either in "800 MHz or 1900 MHz" OR "800 MHz and 1900 MHz" .

Country	Operator	Technology	Frequency Band
Korea	SK Telecom	CDMA2000	800 MHz
Korea	LG Telecom	CDMA2000	1800 MHz (Korean PCS)
Korea	KT Freetel	CDMA2000	1800 MHz(Korean PCS)
USA	Monet	CDMA2000	1900 MHz
Brazil	Telesp	CDMA2000	800 MHz
USA	Leap Wireless	CDMA2000	1900 MHz
USA	Verizon Wireless	CDMA2000	800 and 1900 MHz
USA	MetroPCS	CDMA2000	1900 MHz
Canada	Bell Mobility	CDMA2000	800 and 1900 MHz
Japan	KDDI	CDMA2000	800 MHz
Puerto Rico	Centennial Wireless	CDMA2000	1900 MHz
Brazil	Telefonica Cellular	CDMA2000	800 MHz
Canada	Telus Mobility	CDMA2000	800 and 1900 MHz
New Zealand	Telecom N.Z.	CDMA2000	800 MHz
Chile	Smartcom PCS	CDMA2000	1900 MHz
USA	Sprint PCS	CDMA2000	1900 MHz
USA	Cellular South	CDMA2000	800 MHz
Moldova	Interdnestrcom	CDMA2000	800 MHz
Israel	Pele-Phone	CDMA2000	800 MHz
Colombia	EPM-Bogota	CDMA2000	1900 MHZ
India	TataTeleservices	CDMA2000	800 MHz
Venezuela	Telcel	CDMA2000	800 MHz
USA	KiwiPCS (Comscape)	CDMA2000	1900 MHz
Venezuela	Movilnet	CDMA2000	800 MHz
Canada	Aliant Mobility	CDMA2000	800 MHz
Canada	MTS Mobility	CDMA2000	1900 MHz
Indonesia	Telecom Flexi	CDMA2000	800 MHz
Australia	Telstra	CDMA2000	800 MHz
Ecuador	Bell South	CDMA2000	800 MHz
Panama	Bell South	CDMA2000	800 MHz
Mexico	IUSACELL	CDMA2000	1900 MHz
Puerto Rico	Verizon Wireless	CDMA2000	800 MHz
Thailand	Hutchison CAT	CDMA2000	800 MHz
Nicaragua	Bell South	CDMA2000	800 MHz

Dominican Republic	Centennial Dominicana	CDMA2000	1900 MHz
China	China Unicom	CDMA2000	1900 MHz
Canada	Sasktel Mobility	CDMA2000	800 MHz
Columbia	Bell South	CDMA2000	800 MHz
Brazil	Giro (Vesper)	CDMA2000	1900 MHz
India	Reliance Infocomm	CDMA2000	800 MHz
India	Garuda 1X	CDMA2000	800 MHz
Guatemala	Bell South	CDMA2000	1900 MHz
USA	Midwest Wireless	CDMA2000	1900 MHz
Vietnam	S-Fone	CDMA2000	800 MHz
Guatemala	PCS	CDMA2000	1900 MHz
Taiwan	APBW	CDMA2000	800 MHz
Chile	BellSouth	CDMA2000	1900 MHz
Peru	Telefonica Moviles	CDMA2000	800 MHz

Annex-3

COUNTRIES WHERE BOTH - GSM AND CMDA ARE CO-EXISTING

COUNTRY	GSM	CDMA
US	800 & 1900	800 & 1900
Canada	800 & 1900	800 & 1900
Mexico	800 & 1900	800 & 1900
Argentina	800 & 1900	800 & 1900
Brazil	1800	800
Chile	800 & 1900	800 & 1900
Peru	800 & 1900	800 & 1900
Ecuador	800 & 1900	800 & 1900
Colombia	800 & 1900	800 & 1900
Guatemala	800 & 1900	800 & 1900
Panama	800 & 1900	800 & 1900
Nicaragua	800 & 1900	800 & 1900
Dominican Republic	800 & 1900	800 & 1900
China	900 & 1800	800
Thailand	900 & 1800	800
Australia	900 & 1800	800
Malaysia	900 & 1800	800
Russia	900 & 1800	450
Romania	900 & 1800	450
Latvia	900 & 1800	450
Georgia	900 & 1800	900 & 1800
Taiwan	900 & 1800	800
New Zealand	900 & 1800	800
Venezuela	900	800
El Salvador	800 & 1900	800 & 1900
Jamaica	800 & 1900	800 & 1900
Nepal	900	800
Nigeria	900/1800	800/1900

Annex-4

KOREAN PCS BAND – ITS APPLICABILITY IN INDIA

Korea is the only example which is using the Korean PCS band of 1750-1780 MHz p/w 1840-1870 MHz. This band however **is not the same as standard DCS 1800 band** which is 1710-1785 MHz p/w 1805-1880 MHz. The peculiarities of the Korean PCS band as explained below make this band non-applicable in the Indian conditions.

(ix) Korea is using Korea PCS Band which is 1750-1780 MHz p/w 1840-1870 MHz. This band however **is not the same as standard DCS 1800 band** which is 1710-1785 MHz p/w 1805-1880 MHz.

(x) Korean PCS has a FDD spacing of 90 MHz instead of 95 MHz as is available in DCS 1800.

(xi) There maybe one or two vendors making equipment and handsets in the 1800 Korean PCS band specific to Korean needs but none are making equipment and handsets in the DCS 1800 band.

(xii) There are no dual mode/multimode terminals in 800/KPCS or 800/KPCS/USPCS even after 8 years or more in Korean CDMA implementation.

(xiii) Korean PCS is 30 + 30 MHz (1750-1780 p/w 1840-1870 MHz) whereas DCS 1800 is 75 +75 MHz (1710-1785 MHz p/w 1805-1880 MHz).

(xiv) In Korea, out of the three operators, one operator is using 800 MHz band for CDMA operations and the other two operators are using 1800 MHz Korea PCS band and there is no inter-operator of mixed band of 800 and 1800 MHz.

(xv) Thus, the situation in Korea is "800 MHz OR 1800 MHz" and not "800 MHz AND 1800 MHz".

(xvi) Therefore. Korean example is not applicable in the areas where the same operator has to work in 800 MHz and 1800 MHz band.

Annex-5

QUALCOMM REPORT ON INTERFERENCE

(This report by Qualcomm was prepared in April '04 in response to the UMTS paper on Interference issues)

The UMTS Forum provides its views on the approach being considered by some governments of using a combination of the ITU B1 (hereafter B1) and ITU B3 (hereafter B3) band plans to provide spectrum for IMT-2000 services. Please see table 1 and 2 for the exact frequencies.

The UMTS Forum does not support this approach by arguing that such a combination will require additional filtering in both systems, new and more difficult hardware specifications, case-by-case site coordination and will result overall inefficient usage of spectrum. However it is clear that advanced wireless services, including IMT-2000, will be introduced in both of these bands. Indeed it is already widely introduced in these bands in the form of cdma2000, primarily in ITU bands A1 and B3 as shown earlier in paragraph 10. The UMTS Forum view is that the spurious emissions and wideband noise from the B3 CDMA BS transmitters will severely impair any subsequent use of the B1 bands, by jamming the B1 UMTS BS receivers. They somehow consider the B1 band to more important than the B3 band and therefore governments should restrict the use of the B3 band to the only the portion of the B3 band that does not overlap the B1 band. This small band covers the range from 1900-1910/1980-1990MHz. Then the UMTS forum goes on to say that even if only this 10+10 MHz band is allocated it will still interfere with the B1 band at frequencies below 1980MHz, and the CDMA operators must provide the entire guard band needed to ensure the B1 band is not degraded. They mention that up to10MHz of guard band could be needed, which of course leaves no spectrum for the CDMA operators.

One could equally well argue for the opposite case, which is that governments should restrict the use of B1 to the range of frequencies that do not overlap the B3 band. There is even more reason to argue for this case, since there is far more IMT-2000 compliant systems operating today in B3 than there are in B1.

We believe that both of these arguments are invalid and unfair and believe there must eventually be a compromise to meet the needs of all the operators. Initially allocating the 10+10 band of 1900-1910/1980-1990 MHz is the reasonable choice since this avoids the corDECT interference issue raised as an objection to CDMA deployed in the lower portion of the 1900 MHz band, but any sub-band in the suggested range would work as well for the CDMA operators. India's approach of technology neutrality and flexible use of the spectrum have and will continue to result in advanced wireless services being introduced in multiple frequency bands, including the 800 MHz, 1800 MHz, and other allocated bands. In fact, India's policies are bringing advanced wireless services to the marketplace sooner than in most markets. They need to continue this aggressive approach. To do this in a timely and fair manner, the government should require that operators share the responsibility of this guard band, and one must consider all the options of providing a guard band.

We will now focus on the technical arguments presented by the UMTS Forum.

The UMTS Forum argues that at least a 5 MHz guard band will need to be used between a CDMA BS TX and a UMTS BS RX, as well as requiring the Government establish lower spurious emissions requirements that will result in costly transmit signaling filter for the CDMA network. They also say that the WCDMA BS receivers may need more costly receive filters to avoid being overloaded. In their analysis, the UMTS Forum assumes that the CDMA BS TX band is 1930 – 1990 MHz; however, the preferred proposal in India is to use the 1980-1990 MHz band for CDMA BS TX and affordable transmit filters can be designed to address this matter due to the smaller band allocation.

The UMTS Forum failed to mention that there is some inherent guard band when both technologies are employed normally. Assuming cdma2000 is deployed in B3 (or a portion thereof) and WCDMA is deployed in B1, normal design practice will place the last cdma2000 carrier 1.25 MHz above the 1980 MHz boundary and the first WCDMA carrier 5MHz below the 1980 MHz boundary. This results in a carrier to carrier spacing of 6.25MHz, which has an inherent guard band of 625 -3.84/2- 1.23/2 = about 3.7MHz. According to the UMTS forum, a minimum of 5MHz guard band is required. Where could an additional 1.3MHz come from?

If CDMA were to make the adjustment, it could do so by simply not using the lowest carrier available. That removes 1.23MHz from the overall band.

It is actually simpler to get even more guard band if WCDMA were to make the adjustment. If the entire B1 band were filled with WCDMA carriers, normally they would fit a maximum of 11 carriers deployed exactly 5 MHz apart. By decreasing this spacing to 4.8 MHz (which is allowed by the UMTS standard), the occupied bandwidth of the 11 WCDMA carriers would decrease by 2MHz. This reduction, when added the inherent guard band of 3.7MHz would provide a total guard band of 5.7MHz, greatly easing the interference conditions.

Both of these arguments simply prove that there are other ways (than requiring costly filters) that are available to reduce interference which have been ignored by the UMTS Forum.

Furthermore the UMTS Forum argument is based on a worst case scenario when it considers the potential for spurious emissions from a CDMA BTS TX to WCDMA RX. In calculating the minimum isolation for CDMA BTS TX, the UMTS Forum assumes a allowable interference level of -110dBm/3.84 MHz or a noise density of 175.8dBm/Hz which is a about 6dB below the inherent noise density of a good BTS receiver. The UMTS Forum also assumes the worst case noise density from a CDMA2000 BTS of -13dBm/MHz (or -73dBm/Hz); this is a specification from a technical standard but commercial BTS already perform better. Furthermore, the UMTS Forum also assumes that no site coordination takes place among operators. The UMTS Forum concludes that the only way to prevent the interference from the spurious emission coming from the

PCS1900 band in the WCDMA RX UMTS band is to install additional filters to all PCS1900 base stations. Assumptions are critical in developing any argument and we believe that the assumptions made by the UMTS Forum do not reflect performance of today's CDMA equipment nor reflect the market situation where operators will coordinate their systems to avoid interference. It is simply not the case that the expensive technical modifications of infrastructure must occur to permit the use of some of the PCS and UMTS frequency bands.

Annex-6

USE OF 450 MHz by CDMA OPERATORS IN SOME COUNTRIES

COUNTRY	OPERATOR	FREQUENCY(MHz)	TECHNOLOGY
Belarus	Belcel (trial)	450	CDMA2000
Georgia	Iberiatel	450	CDMA2000
Indonesia	Mobisel	450	CDMA2000
Romania	Zapp Mobile (Telemobil)	450	CDMA2000
Russia	Skylink-Delta Telecom	450	CDMA2000
Russia	SOTEL-Video Skylink	450	CDMA2000
Russia	Moscow Cellular	450	CDMA2000
Uzbekistan	Uzbektelecom	450	CMDA2000