



Cellular Spectrum Refarming, Spectrum Pricing, Analysis and Recommendation

Nepal Telecommunication Authority

Magh, 2065 (Feb, 2009)



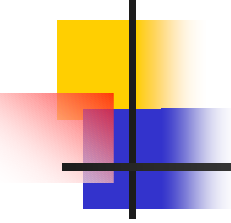
Key Issues in Refarming

- Demand in Spectrum High
- Operators occupy spectrum inefficiently, and are reluctant to surrender extra spectrum
- 3G bandwidth is limited due to improper spectrum assignment



Spectrum Demands

- Nepal Satellite requests to increase assigned bandwidth
- UTL requesting one additional carrier in CDMA800 band for EVDO operation
- STM's request for 2x5 Mhz for its WLL services
- Smart Telecom request for spectrum for WLL



Need for Spectrum Refarming

- Current Spectrum Assignment method is ***ineffective and inefficient***
- Refarming Goals
 - Utilize spectrum efficiently
 - Make spectrum available to needy ones
 - Reorganize 3G spectrum

Available Cellular Spectrum

BANDNAME	FREQUENCIES	BANDWIDTH	REMARKS
CDMA800	824~844 Mhz 869~889 Mhz	2x20 Mhz (2x16 Mhz Available)	4 Mhz Overlaps with EGSM
GSM900	890~915 Mhz 935~960 Mhz	2x25Mhz	
EGSM	880~890 Mhz 925~935 Mhz	2x10 Mhz (2x2.4 Mhz available)	Limited to 5 Mhz as a result of overlap with CDMA. Out of 5 Mhz, 2.6 Mhz considered as guard band
GSM1800	1710~1755 Mhz 1805~1850 Mhz	2x45 Mhz	Limited from 2x75 Mhz to 2x45 Mhz due to CDMA 1900 band use
CDMA1900	1850~1880 Mhz 1930~1960 Mhz	2x30 Mhz	Now occupied by UTL. Need to vacate it for GSM
IMT2000 (3G)	1960~1980 Mhz 2150~2170 Mhz	2x20 Mhz (Could be 2x60 Mhz)	If CDMA is vacated, it can be 2x60 Mhz (1920~1980, 2110~2170 Mhz)

Current Cellular Spectrum Paired Assignment (Mhz)

	CDMA 800	GSM 900	EGSM 900	GSM 1800	CDMA 1900	IMT 2000	Total
Allocated Band Operator	16	25	5	45	30	20	141
NDCL	8	7.2+2.4* +2.4*	-	9+6*		10	45
SNPL		6+2*		9+2*		10	29
UTL	3				10		13
NSTPL	5	4.4		9			18.4
STM			2.4				
			2.6 Guard band	3 Guardband			5.6
Total Grand	16	24.4	5	38	10	20	113.4
Free Band	0	0.6	0	7	20	0	27.6

Note: Only one side of the duplex Bandwidth is shown in the figures to minimize space in the table.

*** Temporary Assignment**



Spectrum Refarming Objectives

- Vacate Spectrum from
 - NDCL: 2x4.8 Mhz in GSM900, 2x3 Mhz from GSM1800
 - UTL: 2x10 Mhz from CDMA1900
 - SNPL: 2x2Mhz in GSM900
- Enhance available bandwidth by
 - Increasing GSM1900 Mhz bandwidth from current 2x45 Mhz to 2x75 Mhz,
 - Releasing 2x6.8 Mhz in GSM900 and 2x3 MHz in GSM 1800 MHz
 - Increase 3G spectrum from current 2x20Mhz to 2x60Mhz
- Retain released bandwidth in a *POOL* for need based assignments.



Refarming Initiatives

- NTA engaged Consultant to review spectrum management
- Consultant recommendation for Refarming
- NTA issued consultation paper in this regard.



Comments on Refarming

- NDCL:
 - Not possible to release,
 - Will restrict expansion
 - Will degrade quality,
- SNPL:
 - Difficult to vacate in short time
 - will delay development activities
 - Will divert resources intended for development
- UTL: Desires to acquire GSM band once unified licensing regime is introduced
- Expert's Opinion:
 - Use strong fiscal instruments to discourage spectrum hoarding.



Analysis and Findings



Key Findings

- Spectrum Hoarding Tendencies
 - No costs at all to reserve and hoard spectrum
 - Need to pay only upon usage
 - No guarantee to obtain spectrum when needed.
- Instruments to address these tendencies
 - Simplify Pricing formula
 - Establish Proper Spectrum Assignment Policy/Criteria
 - Increase Spectrum Usage Charges
 - Set extra fees for spectrum Hoarding



How to Discourage Spectrum Hoarding?

- **Set Standards for Spectrum Allocation**
 - Minimum No of Subscribers per MHz
 - Minimum Revenue to be generated per Mhz
 - Determine minimum spectrum necessary to provide the services
 - Regard excess spectrum as Hoarded Spectrum
- **Set spectrum prices according to its real value to Operators**

Price spectrum for Reservation and not use.

 - Fixed Rates e.g. Rs/Mhz
 - Variable Pricing: % of Revenue
 - Mixed Pricing: combination of both (as suggested here)
- **Set Premium prices for Hoarding**
- **Revoke hoarded spectrum if kept unused for over 2 years.**



Basic Considerations For Spectrum Assignment – 1

Available cellular spectrum (2x120 Mhz) must support at least 80% of national population.

- Thus Each 2x1 MHz bandwidth must support around 0.7 % of the population.
- Considering Nepal's population to be 30 Millions, Each *2x1 Mhz must support 200,000 potential customers, i.e. 100,000 customers/Mhz*



Basic Considerations For Spectrum Assignment – 2

- Smaller spectral bandwidths are less efficient.
 - For an example, 60 % increase in GSM Bandwidth (e.g. from 2x6 Mhz to 2x10 Mhz) results in 135 % or more in subscriber capacity (subs/Mhz)
- Applicability and capacity of frequency bands:
 - Low frequencies (e.g. GSM900 and CDMA800) offer four times more coverage than higher frequencies (GSM1800 or CDMA1900).
 - Low frequencies better suited to low population density e.g. rural areas,
 - High frequencies better suited for high population density population areas



Basic Considerations for Spectrum Assignment - 3

- CDMA offers more capacity (subscribers/Mhz) than GSM
- Number of Subscribers Supported by each 2x1Mhz depends on Network size (frequency bandwidth, number of BTS and TRS/BTS and traffic per subscriber)
Typically, it may vary from 60,000 to 300,000 in case of GSM, and to 450,000 in case of CDMA
- Spectrum Assignment Criteria
 - Subscriber Base criteria suitable to promote Penetration,
 - Revenue base criteria suitable for high traffic networks.
- Revenue Base criteria defined as

Bench marks based on Number of Subscribers x Typical Average Revenue per subscriber (ARPU)



Some International Practices in Spectrum Assignment

- Bangladesh: Max. 2x21.5 MHz/Operator
(Grameen Phone for over 20 million Subscribers)
- India: Max. 2x15 MHz/operator
- Pakistan: Max 2x13.6 MHz/operator
- Average:
 - Asian <2x15MHz/operator
 - Global average: 2x22 MHz/operator
- Lessons
 - Need to set limits to spectrum assigned to a single operator
 - Must define criteria for spectrum assignment

Subscriber and Revenue base Criteria for Spectrum Allocation

Subscriber or Revenue Based Criteria for assignment of GSM and CDMA spectrum
(as preferred by operator)

Criteria for GSM						
Bandwidth (Mhz)	2x2.4	2x4.4	2x6	2x7.2	2x8	2x9
Subscriber Base ('000)	150	500	900	1,200	1,400	1,800
Revenue Base Rs. ('000)	540,000	1,800,000	3,240,000	4,320,000	5,040,000	6,480,000
Bandwidth (Mhz)	2x9.6	2x11	2x12	2x15		
Subscriber Base ('000)	2,000	2,500	3,000	4,500		
Revenue Base Rs. ('000)	7,200,000	9,000,000	10,800,000	16,200,000		
Criteria for CDMA						
Bandwidth (Mhz)	2X2.5	2X3.75	2X5	2X6.25	2X7.5	2x8.25
Carriers	(2 carriers)	(3 Carriers)	(4 carriers)	(5 Carriers)	(6 carriers)	(7carriers)
Subscriber Base ('000)	500	800	1,200	1,700	2,500	3,500
Revenue Base Rs. ('000)	1,800,000	2,880,000	4,320,000	6,120,000	9,000,000	12,600,000



Notes on:

Subscriber and Revenue base Criteria for Spectrum Allocation

1. Bandwidth shown in the table is the sum total of bandwidths assigned in different frequency ranges for the same type of services (GSM or CAMA)
2. Subscriber Base: These are the figures of active subscribers (VLR) averaged over a month.
3. Revenue Base: Audited Annual Revenue
4. The spectrum allotment: based on carriers numbers (2x1.25 Mhz for CDMA and 2x1.2MHz for GSM) subject to availability of spectrum.
5. Calculation of Required bandwidth in GSM between 2x12 Mhz and 2x15 Mhz may be done as follows:
Let the subscriber number be: 3,700,000. The essential bandwidth is:
$$2x[12+(15-12)/(4,500-3,000)*(3,700-3,000)] = 2x13.4 \text{ Mhz} = 26.8 \text{ Mhz}$$
5. GSM bandwidth taken as next higher multiple of 2x200 Khz (1 carrier), and CDMA of 2x1.25Mhz (one carrier)

These Figures are very relaxed compared to DOT India Criteria for 'A' and 'B' circles as given in the annexes: ref. DOT Order No. J-14025/200(17)/2004-NT



Spectrum Pricing

- Spectrum is very precious
- All countries charges spectrum on Reservation or Holding
- Spectrum not properly valued yet in Nepal
 - Charged only if used.
 - No charge at all on holding.
 - No charge to NDCL
 - Where spectrum is charged, it is less than Rs 0.75 millions/Mhz/Year or less than 2.5 paisa per Mhz per year (probably the lowest in the world)

Current Spectrum assignment and pricing

Operator	Current Subs base ('000)	Spectrum Assigned (Paired Mhz)	Possible subs base with the spectrum ('000)	Spectrum required for current service (Paired Mhz)	As of Jan 08 Spectrum Fee adds up to Rs Millions per Mhz	Used Spectrum as a Proportion of Assigned spectrum	Proportion of customers supported against possible
2G and 2.5G spectrum Usage (Ordinary mobile and or WLL with or without mobility)							
NDCL	2,860	2x35	12,000	2x14.15	N/P	40%	24%
SNPL	1,720	2x19	5,700	2x9	0.74 *	47%	30%
UTL	117	2x12.5	6,500	2x2.5	0.1 approx.	20%	<2%
NSTPL	0	2x18.4	4,900	0	0	0	0
STM	0	2x2.4	200	0	0	0	0
3G Spectrum Usage (Price not yet defined)							
NDCL	NA	2x10			0		
SNPL	NA	2x10			0		

Note: * Calculated as a ratio of Rs 28 millions per 2x19 Mhz
 N/P: does Not Pay NA: Not Available,



Spectrum Pricing- Examples

Three methods are in practice

Fixed : Rs/Mhz/Year

Variable e.g. % of annual revenue

Mixed: A combination of the Two above

1 Fixed Price Scheme

- Pakistan sold, through auction, 2x13 Mhz band for US\$300 millions for a period of 15 years, which comes to:

Rs 50 millions/Mhz/year

- Bangladesh auctioned spectrum at 800 million takas/Mhz, which comes to:

Rs 25 millions per Mhz/year



Spectrum Pricing- Examples (Contd..)

2 Variable pricing

- Most common is as a % of Adjusted Gross Revenues
 - From 2 % upto 6% in India, depending upon network size
 - 5% in Hong Kong
- Nepal and Thailand charge by counting TRX units (Thailand has strict rules for time-bound deployment of systems or revoke spectrum)

3 Mixed Type

- e.g. Australia



Considerations for Spectrum Pricing -2G & 2.5 G

- Consultants suggest comparison of spectrum charges based on annual Price per Mega hertz per Population (PMP)
- PMP vary from country to country and are mostly in the range from Rs 0.5 to Rs 5/Mhz/Population/year (some countries have even much higher PMP figures)
- Indian charges add up to around Rs 0.67/Mhz/Year (derived from 6% of annual revenue of comparable operator in Nepal)
- For Nepal's population the charge @ Rs0.5 to Rs 5 it comes to around

Rs 15 millions to 150 millions/Mhz/year



Spectrum Pricing Practices -3G

- Asian Average: Rs 16.0/Mhz/Pop
- European Average: Rs 68.0 “
 - Only Beauty Contest Rs 14.5
 - Lowest charge by Sweden: Rs 2.5
- India intends to charge Rs 2.5
 - Intends to earn through auction \$ 6 billions total for new operators
 - For existing operators levy a one time Charge and additional 1% in the revenue sharing for spectrum fee)
- Nepal has not yet set any fee fro 3G Spectrum
If Rs 1.5/Mhz/Pop is adopted for Nepal,
It will be then Rs 45 millions/Mhz/Year



Pricing Instruments - Options

- Fixed Spectrum Prices
- Variable Prices
- Mixed Method.
 - Usage Based Charges
 - Holding Charges (relatively higher)



Features: *Fixed Pricing*

Fees based on Reservation/Holding

- Paid annually as Rs/Mhz
- Advantage Encourages Efficiency
promotes frequency Re-use and
encourages multiple base stations
- Disadvantage
Difficulties for small operators



Suggested Pricing Option 1: *Fixed Pricing*

- Price set fixed as Rs per Mhz (sum total of bands in FDD and TDD)
- $\text{Price/Mhz} = \text{BW} * \text{R} * \chi * \gamma * \alpha$
- Here,
 - BW : Frequency Bandwidth (sum of both sides of duplex bandwidths in case of FDD)
 - R : Rate = Rs 1.4 Millions/Mhz/Year now and increasing it annually to Rs 15.0 Millions/per year in 5 years time.
 - χ : Frequency Band Coefficient 2,1,3 for low, high and 3G spectrum
 - α : Geographic coefficient (1 for all Nepal, 0.9 for Kathmandu, 0.3 for Rural Area, 0.5 for FWDR and/or MWDR, and 0.75 for any other option excluding Kathmandu)
 - γ : Frequency Usage Factor (1 for use defined by Subscriber or revenue based criteria, 5 for excess I.e. hoarding)



Features: *Variable Pricing*

- By counting TRX used as in Nepal
 - Very difficult to keep track of stations and so difficult to determine the fee
- Revenue Based
 - As a % of Revenue
 - Is simple to calculate and favorable to small operators
- Disadvantages:
 - Does not put price on Reservation/Holding/Hoarding
 - Encourages Hoarding

Suggested Pricing Option 2: Fee as a % of Revenue

This Method was suggested by International Consultants

Annual Charge = % of Revenue x Coverage x Development factor x Bandwidth Coefficient x Regional Incentive

Item	Definition	Suggested Value
% Revenue	Operators revenue from service CDMA WLL 2%, GSM 5%	2% ~5%
Coverage	% of Population	Max 100%
Dev. Factor	Takes into consideration different stages of development: 1st 2 Yrs 0.1, then gradually to 1 in 6 years	0.1,0.4, 0.6, 0.8, 1 1 through 6th yrs
Bandwidth Coef.	WLL: 1/30xBandwidth, GSM: 1/7.2xBandwidth	0.033 ~ 1
Regional Coef.	Kathmandu 1, EDR 0.75, central and western Nepal 0.25	1, and 0.75, 0.25

Comments: Does not support usage, No need now to differentiate WLL and GSM



Option 3: Mixed Spectrum Pricing

- Combines positive aspects of both pricing mechanisms:
 - Variable pricing for spectrum *usage* essential to support the offered service
 - Fixed *Higher Pricing* for Spectrum occupied without using (Hoarding Charges)
- Offers a unified approach for both 2G/2.5G and 3G spectrum prices by adopting a single formula



Mixed Pricing – Proposed Formula

$$\text{AnnualSpectrumFeeofCellular}(Rs) = [P]x[AGOR]x\frac{(2BW_L + BW_U + 3BU_{3G})}{BW_T} + Rx(BW_T - BW_E)x[\alpha]$$

Where

P: Percent figure taken as 1 % which should gradually be increased to 4%

AGOR: Annual Gross Operating Revenue

BW_E : Bandwidth Essential for the service, determined

- For 2G and 2.5 G as per the earlier defined subscriber/revenue linked criteria
- For 3G taken as 2x5 Mhz

Total Bandwidth is the sum of the two.

BW_L : Total Spectral Bandwidth in Lower Frequencies (e.g. CDMA800 and GSM/EGMS900)

BW_U : Total Bandwidth in Higher Frequencies (e.g. CDMA1900 and GSM1800).

BW_{3G} : Total Bandwidth in 3G spectrum

BW_T : Total Bandwidth Assigned to the operator = $BW_L + BW_U + BW_{3G}$

R: Annual Rate of Spectrum Charge (Rs./Mhz) for Extra Bandwidth,

R= Rs. 7,000,000/Mhz (For TDD nominal bandwidth, and for FDD sum of transmit and receive bandwidths, e.g. for 2x6Mhz block the bandwidth is 12 Mhz). R should be gradually increased to Rs 28 millions/Mhz/year in next 5 years

α : Regional Coefficient: 1 for all Nepal, 0.9 for Kathmandu, 0.3 for Rural Area, 0.5 for FWDR and/or MWDR, and 0.75 for any other option excluding Kathmandu



Conclusions

1. Assign spectrum based on defined criteria: Subscriber or Revenue criteria, whichever is favorable for network expansion
2. Obtain approval from RFPDC, MOIC to adopt Mixed Spectrum Pricing Formula.
3. Obtain firm Network Roll out plan for next 2 years from operators.
4. Allocate spectrum adequate for current and next two years requirement.



Conclusions (contd.)

5. Revoke excess bandwidth (i.e. bandwidth requirements for over next two years)
6. Charge, as per Mixed pricing formula, for the essential bandwidth and the bandwidth necessary for the next two years requirement
7. Implement the New Spectrum Management Regime by 6 months time



Conclusions (contd.)

8. Provide equal level playing field to all operators by applying the same regime
9. Apply the new Regime equally Make decisions on the issues after
10. Apply the new Pricing and Management regime for the purpose of spectrum usage



Recommendations

- 1 Conduct consultation on the new considerations outlined here to implement the spectrum refarming.
- 2 Make final decisions after taking into consideration the comments from consultation.
- 3 Obtain permission from MOIC to implement the New Pricing Regime
- 4 Apply the new Pricing Regime from FY066/65
- 5 Spectrum Fee shall be paid in advance for upcoming fiscal year and will be adjusted at the end of the year
 - For operators already providing service, payment to be based on previous years fees
 - For new operators fees to be charged on reservation based on proposed business plan

Annex –1:

Subscriber Base Calculation for 2x2.4 Mhz GSM spectrum

Number of BTS	500				
Bandwidth (Mhz)	2x2.4				
Number of Carriers	12				
Frequency Reuse Factor (FRF)	3				
Blocking (Erlang B formula)	2%				
	BTS Configuration	% Dist	No Of BTS	Erl Per BTS	Total Erl.
	Macro	100%	500		
	Omni 3 trx	5%	25	14	350
	1/1/1	50%	250	8.79	2,198
	2/1/1	30%	150	14.07	2,111
	2/2/1	10%	50	19.34	967
	2/2/2	5%	25	24.60	615
	3/3/3	0	-	42.00	-
	4/4/4	0	-	63.00	-
	5/5/5	0	-	72.00	-
	6/6/6	0	-	87.60	-
	8/8/8	0	-	126.00	-
	10/10/10	0	-	150.60	-
	Total				6,240
	Total Capacity for Voice (Erlang)	6,240	Subscribers supported		
	Average Erlang per Station	12.48	Maximum per BTS	738	
	Traffic mE/Sub	25	Average Per BTS	374	
	Loading Factor	75%	Total in the Network	187,200	

Annex -2: Subscriber Base Calculation (contd.)

Frequency Re-Use Factor	3										
Number of BTS for Averaging	1,000	500	750	900	1,000	1,000	1,300	1,300	1,500	1,500	2,000
Subscriber Traffic (mE/Sub)		25	25	25	25	25	25	25	25	25	25
Utilization Factor	70%	75%	75%	75%	70%	70%	70%	70%	70%	70%	70%
Bandwidth (MhzPaired)		2.4	4.4	6	7.2	8	9	9.6	11	12	15
Number of Carriers		12	22	30	36	40	45	48	55	60	75
BTS Configuration	Erl/BTS	Dist %									
Macro		100%									
Omni (3 TRX)	14	5%									
1/1/1	8.79	50%	10%								
2/1/1	14.07	30%	20%	10%							
2/2/1	19.34	10%	30%	20%							
2/2/2	24.60	5%	10%	30%	20%	30%	20%	20%	0%		
4/3/3	49.00	0%	25%	30%	40%	40%	40%	20%	40%	20%	15%
4/4/4	63.00	0		10%	30%	30%	30%	40%	30%	30%	30%
6/6/6	87.60	0			0%	5%	10%	20%	20%	40%	30%
8/8/8	126.00	0							10%	10%	20%
10/10/10	150.60	0									5%
Total											
Average Erlang per Station		12.48	24.21	33.66	43.42	50.26	52.18	57.44	68.62	76.34	85.26
Subscribers supported @ Specified Loading											
Maximum per BTS		689									
Average Per BTS		374	726	1,010	1,216	1,407	1,461	1,608	1,921	2,138	2,387
Total in the Network ('000)		187	545	909	1,216	1,407	1,899	2,091	2,882	3,206	4,775
Access Lines/Mhz Paired		78	124	151	169	176	211	218	262	267	318



Attachment – 1: NDCL Comments

GSM 900

- Impossible to revoke temporary 2 x 4.8 MHz BW
- Currently 2x12 MHz is being used as per the planning of the available BW
- currently 2 million subscribers. Planned to increase the subscribers up to 5.1 million within 2-3 years
- If revoked, negative impact on operation of service, QoS will degrade

GSM1800

Unpractical to limit the NDCL spectrum to 2x12 MHz spectrum BW.

Plan for Expansion of Network 3.5 million project. Already import of equipment with S666 configuration of BTS. If limited to 2x12 MHz BW, problems arises on technical and financial aspects so that the service would be adversely affected. Equipment is already imported to cater the 3.5 million subscriber



Attachment – 1: NDCL Comments (contd.)

CDMA800

Abnormal Frequency allocation table. Guard band is not suitable.

For e.g. the difference of ch no. 349 of operator 2 and channel 370 of operator is only 21 instead of at least 41.

The name of the operators is not mentioned although the operators have already been assigned the spectrum. From this it can't be said that amount of spectrum intended to provide to the NDCL

Channel no. of the proposed is not matched the existing usage of the channel.(existing usage of NDCL is 119, 201, 283; Future paln:160, 242)

If the channel no is changed the mismatch of the terminal device with that of the CDMA network system results the disruption of the service

Being unavailability of the over the air service provisioning (OTASP) in the FWP/FWT, it is necessary to change the channel no. in the network and subscribers' terminal manually. Current no. of subscribers is ~6 lakhs, so it is impossible to change the ch. no. in each terminal of the subscribers. So it is not suitable to change the

channel. usage pattern from the existing channel usage pattern



Attachment – 2: SNPLL Comments

Revoking of 2 MHz frequency will

- lead to the very painful and expensive network re-dimensioning process,
- which will drastically slow down network roll out,
- substantially degrade the QoS provided to the customers, and will definitely
- undermine foreign investor's confidence in the country



Attachment – 3: UTL Comments

GSM1800

Minimum Spectrum should be 20 Mhz in stead of 16 Mhz and should be allocated equitably among all the carriers in 5 Mhz each.

CDMA800

Guard Band between the operators should be given to avoid interference

Other Comments

Spectrum for WiMax should be covered, GSM band should be available for unified licenses. Penalty for unauthorized use of spectrum is required. CDMA operators should also be given 3G spectrum in 2.1 Ghz band. Time frame for spectrum allocation by NTA should be defined



Attachment – 4 SMART Telecom Comments

GSM900

1. GSM might be more appropriate over CDMA technology
2. Due to the varieties in the low cost range of handsets, GSM would be certainly suitable as compared to CDMA
3. Due to good coverage and availability of wide variety of affordable terminals should be given the highest priority

CDMA1800

overlaps with about 10 MHz of GSM1800 band which has imposed a constraint in allocation of GSM 1800 spectrum

GSM would be certainly suitable as compared to CDMA



Attachment-3 Mr. Vaidya's comments

To ensure long term vision of using spectrum for the maximum benefits to all stake holders, viz, the subscribers, the state and also for the operators, I would like to suggest following line of actions:

- a) Eliminate the concept of license of spectrums as a property of the stakeholder. If NTA is considering for the effective and efficient use of spectrum for the benefit of the people the spectrums shall be kept open for all and allocate them as required based on their performance. Non performers should be stripped of the spectrum.
- b) NTA shall adopt the concept of compatibility for effective and efficient use of frequency for specified quality of service. By adopting this concept state could generate the revenues from the precious natural resource.
- c) Assign a base line Frequency Bandwidth at reasonable fee
- d) Additional Bandwidth be provided either on exceeding certain subscriber base or annual income base (AIB). AIB fixing will cater for a situation of high telecom traffic of subscribers resulting in a larger demand for spectrum.
- e) The AIB may be taken as the product of subscriber base and current annual Average Revenue Per Use (ARPU)



Attachment-5 Mr. Vaidya's comments (contd..)

- f) More spectrum be assigned to the operator when the subscriber or revenue base is exceeded
- g) Provide adequate time frame to the current licensees to redraw their network.
- h) After that time frame, if the operators want to retain large chunk without meeting the base lines (subscriber base or AIB), charge them hefty prices, say 'x' times the base price (punitive action against extravaganza) for the spectrum

Typical figure may be :

- a) Base line bandwidth of 2x2.4 Mhz for GSM) or 2x2.5 Mhz (for CDMA) for upto 500,000 subscribers or AIB of upto Rs 4.2 Billions (based on ARPU of Rs 700) per month)
- b) The applicable price may be e.g. annually Rs 10 millions for the base line bandwidth.



Attachment-5 Mr. Vaidya's comments (contd..)

- c) In case more bandwidth is required as a result of attaining the required spectrum efficiency as defined in point (a) above, it be provided only in steps of 2x1.2 MHz (2x1.25) and at pricing of annual Rs 4 millions per/duplex 1 Mhz band (Base Line Spectrum Price: BLSP) for additional subscribers of upto 250,000 or additional AIB of upto RS 2.1 billions. (same price and efficiency as in a above)
- d) Any allocation of spectrum above the limits defined by points (a) and (c) above be charged at 'X.BLSP'. The figure for X may be taken at least 10 resulting in annual charge of Rs 40 millions/duplex one MHZ until those conditions are met.
- e) In order to adjust to the new pricing regime, provide existing operators a grace period (GP) of say One Year so that they can reconfigure their network surrender the highly priced spectrum if they so desire. During this period charge the excess spectrum on the basis of BLSP.

I consider these arrangements will help NTA to attain its goal of efficient and effective utilization of spectrum for the benefits of all.

GM Vaidya, Transmission Engineer (retd. Form NDCL, now free lance consultant)



Attachment-6

DOT India Subscriber linked spectrum allocation

Government of India DOT

ORDERS

Dated: the 9th January, 2008

In supersession of all existing orders relating to subscriber base criteria for allotment of CDMA and GSM spectrum, the following subscriber based criteria shall be followed
No. J-14025/200(17)/2004-NT(CDMA) and, J-14025/200(17)/2004-NT(GSM)

Service Area	Minimum subscriber base (In Lakh) required for allotment of CDMA carriers of nominal 1.25 MHz bandwidth each		
	2.5 MHz (2 carriers)	3.75 MHz (3 rd Carrier)	5 MHz (4 th carrier)
Metro Service Area	No criteria*	5	20
Telecom Circles Category 'A A or B	No criteria*	8	50

Service Area	Minimum subscriber base (In Lakh) required for allotment of different amounts of GSM spectrum		
	4.4 MHz	6.2 MHz	7.2 MHz
Telecom Circles Category 'A' or 'B'	No criteria*	8	30

Attachment-7

TRAI India's Spectrum Assignment Criteria fixing example
(Taken from Cellular Operators Association, India: COAI paper)

TRAI Working

No. of BTS Installed	1000	Spectrum 6.2 Mhz	No Of BTS	Erl Per BTS	Total Erl
	BTS config	% Dist			
	Macro	100%	1000		
	IBS Micro	0%	0		
IBS Micro	2/0/0	0%	0		0
IBS Micro	IBS 2/2/0	0%	0		0
Macro	2/2/2	0%	0		0
Macro	4/4/4	50%	500	60.45	30225
Macro	6/6/6	40%	400	104.04	41616
Macro	8/8/8	10%	100	146.1	14610
	Total		1000		86451
	EPS	86.45			
	Total Cap for Voice mE/Sub Util	86451			
	Subs Supported	71%			
	EPS/Mhz	1,534,505			
		13.94			