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RSM/COAI/2014/212

December 15, 2014

Telecom Regulatory Authority of India
Mahanagar Doorsanchar Bhawan
Jawahar Lal Nehru Marg
New Delhi 110002

**Subject: TRAI Consultation Paper on Valuation and Reserve Price for Spectrum in 2100 MHz Band**

Dear Sir,

This is with reference to the TRAI Consultation Paper dated December 02, 2014, on Valuation and Reserve Price of Spectrum in 2100 MHz Band.

In this regard, please find enclosed our response for your kind perusal.

We hope our views and submissions will merit the kind consideration and support of the Authority.

Kind regards,

Rajan S. Mathews

Rajan S Mathews
Director General

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**COAI Response to TRAI Consultation Paper**
**On**
**Valuation and Reserve Price of Spectrum: 2100 MHz Band**

**Released on December 2, 2014**

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## Preamble

1. We appreciate the effort of the Authority in coming out with this Consultation Paper in line with its previous recommendation to the Government that 2100 MHz should be included in the next round of auctions.

2. The Authority in its recommendations dated October 15, 2014 had stated the importance of making additional spectrum available for the forthcoming auction and had recommended inclusion of 2100 MHz in the auction. The authority recognizing the shortage of spectrum had specifically recommended that the auction should be held only when additional spectrum in 800, 900, 1800 & 2100 MHz bands is made available. It is however submitted that supply in the core bands in 900/1800MHz, is the fundamental requirement of the telecom networks. Additional supply 2100MHz is most welcome, but it must be supplemented with additional spectrum in core 900MHz & 1800MHz bands.

3. At present the spectrum allocated to operators in the 2100 MHz band is very less, even when compared to global standards. To enable the growth of Mobile Broadband in the country, it is important that more spectrum in the 2100 MHz band is auctioned immediately and the same needs to be harmonized internationally. This will also help operators increase their network capacity, and coverage in this band to provide better and affordable services to the consumers in line with the Government's objective to enable internet access to more citizens.

4. There have been many developments regarding spectrum in the period since the last auction of spectrum for Mobile Broadband (MBB) in the 2100 MHz band, which needs to be taken into account to meet the National Telecom Policy 2012 (NTP) Broadband targets. These are:

   NTP – 2012- III.3.
   *"Provide affordable and reliable* ***broadband-on-demand by the year 2015*** *and* ***to achieve 175 million broadband connections by the year 2017 and 600 million by the year 2020 at minimum 2 Mbps download speed and making available higher speeds of at least 100 Mbps on demand."***

5. It is a known fact that most of this growth is going to happen using wireless MBB (Mobile Broadband) technologies. To enable the growth of MBB in the country, it is important that more spectrum in the 2100 MHz band is auctioned immediately and the same needs to be harmonized internationally. The Government itself has recognized in the NTP-2012 that there is a need for additional spectrum for IMT services as stated:

   NTP – 2012- III.20.
   "Ensure adequate availability of spectrum and its allocation in a transparent manner through market related processes. ***Make available additional 300 MHz spectrum for IMT services by the year 2017 and another 200 MHz by 2020."***

6. It is most important to note that a harmonized and structured band plan will bring benefits to consumers, governments and industry, in the form of faster time to market for innovative services and lower prices due to scale economies. A harmonized plan will also facilitate seamless roaming and network interoperability, at a global level.

7. The Authority had also recognized that the 2100 MHz band is one of the most internationally harmonized spectrum bands. This band is being used for HSPA/HSPA+ which are the leading mobile broadband technologies globally. There are 547 HSPA networks in 205 countries and 363 HSPA+ networks in 157 countries which have been commercially launched10. Most of these networks use the 2100 MHz band.

8. We believe that the Government should accept the TRAI recommendation on 2100:

    **"The Authority recommends that the entire 2x60 MHz in the 2100 MHz band should be made available for commercial use. If required, Defence may be assigned spectrum in the 1900 MHz band (1910-1920/1980-1990 MHz). The Authority also recommends that auctions in this band should be carried out along with the auctions in 900/1800 MHz band."**

9. The most important part in this recommendation is to get 2X60 MHz be made available for commercial use. It will not be suitable to auction spectrum less than this. In the last round of auction of 2100 MHz band held in 2010, it was seen that due to the limited amount of spectrum, the auction was skewed and it also resulted in no pan-India 3G operator, except for BSNL/MTNL who were given spectrum by the Government. The Government needs to ensure that such a scenario of limited availability of spectrum is not repeated again.

10. Insufficient spectrum in the 2100 MHz band will not only hurt the growth of mobile broadband services, but will result in fragmented spectrum allocations. This will prevent operators from establishing a pan India footprint, leading to suboptimal use of scarce and valuable spectrum, and will be contrary to the NTP-2012's stated objective of providing broadband on demand and of promoting efficient use of spectrum.

11. Apart from making sufficient spectrum available it is also important to make interference free spectrum available to the operators. In the last allocated 2100 MHz spectrum allocated, due to Interference, the TSPs are not able to provide services in various regions of J&K & Punjab using this band.

12. The TSPs as well as the Associations have been representing this issue of interference in the 2100 MHz band since 2011 to the DoT, WPC and WMOs at circle levels at various occasions, however, the issue remains unresolved till date and the TSPs are still struggling to get clean spectrum in these LSAs to roll out the services, despite paying huge market rice at the time of auction. The delay in resolution is adversely affecting the desired roll-out plans of TSPs in the areas which means considerable and continuous drain on the operational cost and the huge potential revenue loss in addition to competitive disadvantage.

13. It is also pertinent to note that in the absence of the above, it is not possible for the operators to meet the QoS. In places where some of our members have rolled out services, the subscriber's discontent on the services is high. We would thus request the Authority to make specific recommendation to the Government to provide usable spectrum to these operators in the service areas of Punjab and J&K so that they can start rolling out the services.

## ISSUE WISE SUBMISSIONS

**Q1. In the auction for 2100 MHz spectrum held in 2010, certain roll-out obligations were mandated for the successful bidders. Stakeholders are requested to suggest if any changes are required or whether the same roll-out obligations should be mandated in the forthcoming auction, along with justification.**

***COAI Response***

a. We believe that the same roll out obligations that were mandated earlier should continue, however, they should only be mandated for operators who win spectrum in 2100 MHz first time in any LSA.

b. However, the real issue is the practical issues in the implementation of the TSTP that the Government prescribes later. The Authority in the paper has already captured the fact that till now DoT has only issued provisional TSTP, which has lots of practical implementation problems. The operators are already in discussion with the Government regarding these issues. A copy of our submission to the Government vide which we had brought out the discrepancies in the TSTP is enclosed as Annexure – 1. However, till now the Government has not been able to close these issues and issue a final TSTP.

c. It has rightly been noted by the TRAI in its consultation paper that the Government has not issued the list of rural SDCAs for some circles till dates. The ones that have been issued are also incomplete.

d. We request the Authority to take up this issue with the Government and request them to issue final TSTP and also make the rollout obligation period for the current 2100 MHz spectrum holders to commence prospectively from the date all the above issues are clarified and mutually resolved and a final TSTP is issued.

**Q3. Whether the spectrum caps (of 50% of the total spectrum in a band/25% of the total spectrum assigned across bands) prescribed in recently held auctions in the 800/900/1800 MHz bands should also be prescribed for the upcoming auctions in the 2100 MHz band?**

***COAI Response***

a. Yes, the same spectrum caps should be specified for 2100 MHz band also.

**Q5. Should the indexed value of May 2010 auction determined prices of 2100 MHz spectrum be used as one possible valuation for 2100 MHz spectrum in the forthcoming auction? If not, why not? And, if yes, what rate should be adopted for the indexation?**

***COAI Response***

a. We believe that the auction-determined prices obtained in the 2100 MHz band spectrum auction in 2010 do not provide an appropriate basis for the valuation of the 2100 MHz spectrum in 2014. The reasons are as follows:

   i. The key price drivers for the 3G auction in 2010 were specific to that auction and are not applicable for proposed 2100 MHz auctions.
   ii. The auction price in the 2100 MHz auction in India was higher as compared to international benchmarks for similar auctions in the 2100 MHz spectrum band.
   iii. Deteriorating financial performance of the Indian telecom sector since 2010 means operators have limited the operators' ability to pay.

   The details of these are given below:

   i. ***3G auction price drivers are not applicable for proposed 2100 MHz auctions***

   a. **Spectrum scarcity led to hyper-competitive bidding**: Compared to the high demand for spectrum, there was a significant supply constraint, with only 15 to 20 MHz of spectrum made available per LSA across 10 to 12 operators as well as potential new entrants. TRAI has itself acknowledged the fact that that the 2010 auction was conducted in a supply-constrained scenario.

   b. **Operators had a fear of being left out:** The lack of clarity over future spectrum availability for 3G services also compounded the operators' fear that failure to buy spectrum in this auction can prevent them from offering high-speed data services in the foreseeable future. This resulted in skewed bidding strategies of the operators towards a 'must-get spectrum' tactic for premium LSAs.

   c. **The auctions commanded a significant first-mover advantage**: Only a limited amount of spectrum was being auctioned, and at that time, the Government did not communicate the time-frame when further spectrum would be made available. Therefore, the winners of the auction were expected to gain a first-mover advantage in the lucrative mobile data segment, which could give them a several-year head start over the competition.

   d. **Significant premiums were paid to protect the existing revenue base:** The 3G auctions held in 2010 heralded the introduction of an exciting new technology for the telecom sector, offering the potential of high-speed data on the move. Prior to these auctions, the Indian telecom sector was largely a voice-driven market, and 3G spectrum was anticipated to act as the future growth engine for the industry. The auction participants expected that 3G users would pay a premium for high- speed data offerings.

   e. **Lack of visibility on spectrum availability fuelled higher bidding in the 2100 MHz auction**: Some operators were already facing congestion in some of their LSAs and at the same time could not foresee when further spectrum suitable for carrying voice traffic would be made available. This forced them to bid higher prices for 2100 MHz to support expected voice growth.

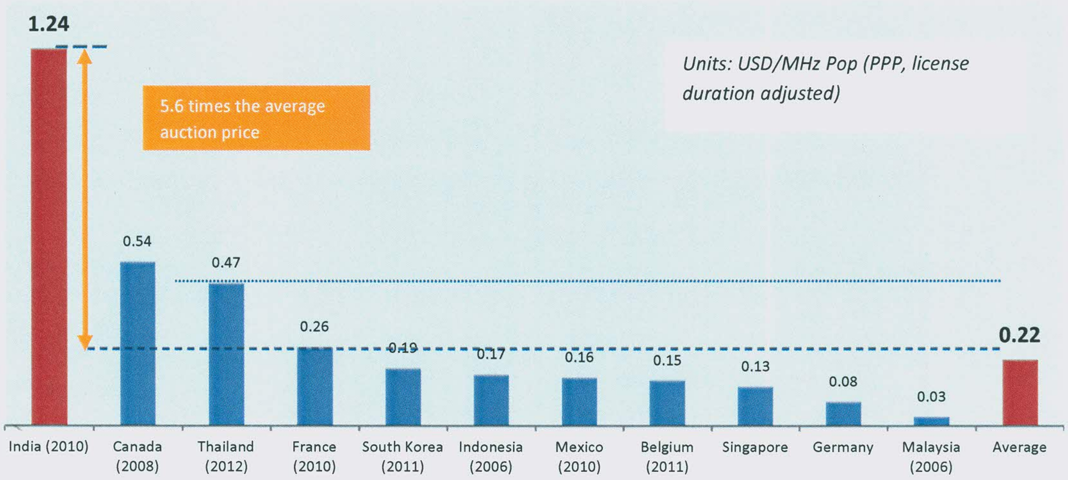
Due to these factors, some bidders were willing to pay a significant premium in order to attract high end ARPU customers towards their network, while other bidders were forced to bid at these prices in order to protect their existing revenue base.

**Since none of the above mentioned drivers are applicable for the forthcoming auctions, deriving the spectrum valuation on the basis of 3G auctions will be inappropriate.**

ii. **The auction price in the 2100 MHz auction in India was higher as compared to international benchmarks**

a. Compared to the auction price of the 2100 MHz spectrum band in other countries, Indian operators paid over **5.6 times** the average price per MHz on a per capita basis. In the light of the above factors, this is not surprising. However, when Indian auction outcomes are compared to those of the more developed markets of the world, the numbers are startlingly high.

***Figure 1: India 2.1 GHz auction price were significantly high as compared to the auction prices in other countries***

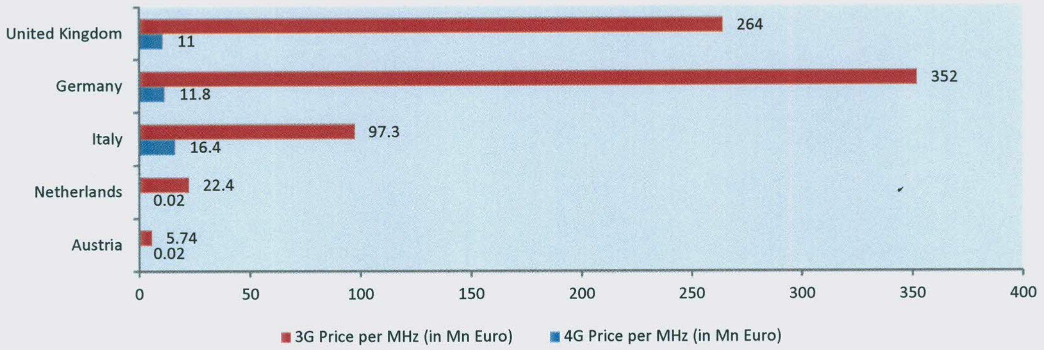



*Source: Global research, CY PwC Report on Spectrum Valuation & Reserve Pricing of 1800 MHz band of August 2013.*

**Figure 1 illustrates how auction participants in India overpaid compared to other countries.**

b. We have also observed that operators tend to overpay when 3G spectrum bands are put up for auction for the first time. This can be corroborated from the 3G auction experiences held in other developed economies in the early 2000s. For example, operators in Germany and the UK paid 35 billion USD and 46 billion USD in 2000 for 3G spectrum respectively. In contrast, in the recent 4G auctions held in Germany and the UK, the spectrum was sold at 3.6 billion USD (in 2010) and 5.7 billion USD (in 2013) respectively. This is illustrated in the figure below.

*Figure 2: Significantly high auction prices paid by operators for 3G spectrum as compared to 4G in other countries (auction price per MHz)*




*Source: Global research, CY PwC Report on Spectrum Valuation & Reserve Pricing of 1800 MHz band of August 2013.*

c. Deteriorating financial performance of the telecom sector since 2010

Since 2010, the industry financial parameters have worsened due to higher debt levels, declining profitability and a sharp slowdown in revenue growth. The debt burden in the sector is huge. It is already around Rs. 250,000 crore and a part of it accrued after the last spectrum auction in Feb 2014.

The deteriorating financial performance of the Indian telecom sector has limited the operator's ability to pay the high 3G like premium paid in 2010 for current spectrum auction.

**Recommendation:** Besides the above discussed points, **the approach suggested by TRAI of using the 3G auction prices as the basis for valuation in the forthcoming auctions is fallible.**

**Q6. Should the value of the 2100 MHz spectrum be derived on the basis of the value of the 1800 MHz spectrum using the technical efficiency factor (0.83) as discussed in Chapter III?**

**&**

**Q7. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the producer surplus model outlined in Chapter III? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.**

**&**

**Q8. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the growth in data usage outlined in Chapter III? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.**

**&**

**Q9. Would it be appropriate to value the 2100 MHz spectrum as the simple mean of the values arrived from different valuation approaches as discussed in Chapter III? If no, please suggest with justification which single approach should be adopted to value the 2100 MHz spectrum?**

***COAI Response***

a. TRAI should adopt a consistent approach for determining the valuation of 2100 MHz as has been used for valuing spectrum in other bands – 800 MHz, 900 MHz and 1800 MHz.

b. TRAI, in its recommendations dated 09.09.2013, has stated:

> "*The Authority is clear that there is no single correct and precise valuation of the spectrum or the reserve price. There are different ways of arriving at the value of the spectrum, all of which have their merits as well as their drawbacks. Rather than count on one method, prudence suggests it would be better to rely on a number of such models to arrive at a final reasonable valuation and then to base a reserve price on such valuation. The valuation has to be based on clear and cogent reasoning, transparency, logic, and the scientific method.*"

c. While arriving at the valuation of 1800 MHz in its recommendations dated September 09, 2013, TRAI has used a probabilistic average valuation that captures the range of possible valuations that have been attempted. Then the valuation of 900 MHz has been arrived using technical and economic efficiency factor based on 1800 MHz.

d. **Since, the valuation of 1800 MHz band is based on simple average of various possible methods of valuation and thus takes the probabilistic average valuation into account, the valuation of 2100 MHz can be derived on the basis of the value of the 1800 MHz spectrum using the technical efficiency factor (0.83).**

e. **Further, 2100 MHz is going to be used for data and is very different from the core and critical spectrum of 900 MHz and 1800 MHz, which are used to provide voice services and will continue to be the predominant mainstay for mobile telephony at least for the next 5-10 years. Since, 2100 MHz is not core spectrum, the valuation needs to be further adjusted and further discounting is desirable.**

**Q10. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum of 2100 MHz band?**

***COAI Response***

a. Auctions are useful when there is uncertainty around the value of the good for sale. As far as setting the reserve prices is concerned, the following are the objectives, in order of preference.

i. Ensure sale
ii. Induce participation
iii. Determine optimal value
iv. Avoid collusion

b. 2100 MHz is not the core and critical spectrum. Due to the tremendous risks and uncertainties associated with predicting data growth, we would like to suggest that far greater caution is exercised in setting the reserve price of 2100 MHz.

c. As submitted above, an underestimate of value /reserve price can easily be corrected at auction, but an overestimate cannot be, since it will lead to fallow/unsold spectrum or result in high prices thus reducing the ability to invest in the network and/or higher prices.

d. There is a need to maintain parity between the reserve price to valuation ratio for 2100 MHz band and other bands such as 800 MHz, 900 MHz and 1800 MHz.

e. TRAI, in its recommendations on spectrum value and reserve price of 900 MHz and 1800 MHz (September 09, 2013), had decided that the reserve price can be pegged at 80% of the average valuation of spectrum. Thus, the same approach should be used for determining the reserve price to valuation ratio for 2100 MHz.

**f. Therefore, we recommend that the reserve price for 2100 MHz spectrum should be pegged at 80% of the valuation of 800 MHz spectrum arrived at by the Authority.**

## ADDITIONAL COMMENTS

1. **Transmit Power regulation** was introduced in 1995 as part of the license condition. Since then, many technical advancements have taken place and the telecom technologies have also evolved. However, this transmit power regulation has not been reviewed in light of these different technology requirements and the same traditional norms are being followed.

2. DoT, vide the Circular No. 800-15/2010-VAS (Pt) dated April 10, 2012 has introduced strong regulation on EMF (1/10$^{th}$ of ICNIRP levels) to ensure that radiation is kept well within the permissible limits. However, the transmit power regulation of 20W (which was fixed for GSM technology when mobile telephony was introduced in India more than 15 years back) remains the same for all kinds of technologies.

3. It is pertinent to note that 2G/3G/4G technologies are all operating at different frequency bands and the free space losses are totally different in different frequency bands but the transmit power regulation is common to all.

4. In 3G especially, the pilot power transmitted is at a very low power level and the operators should be allowed to report the transmit power based on pilot power. Technology wise 3G has only one carrier and every site uses only one carrier, accordingly interference is not a concern. The limit of 20W leads to an unsatisfactory user experience, hence power of 40W/60W should be permitted in 3G as compared to 2G which has multiple carriers and 20W can suffice.

5. 3G is a wideband technology and hence power transmitted is distributed across the wider channel bandwidth. Hence 20W cannot be compared to the power transmitted in GSM across 200Khz bandwidth & CDMA across 1.25MHz bandwidth, Similar is the case with LTE where the channel bandwidth can be from 5MHz to 20MHz.

6. 3G & LTE have new technologies such as MIMO, where power is transmitted in two to four Tx paths. This needs the norms of Transmit power per sector to be revised with the single criteria of EMF levels to be complied by the operators.

7. The DoT norms on EMF directly govern the transmit power set at the base stations to ensure EMF compliance. This creates a dual condition of compliance for the operators as in some technologies, like 3G, this transmit power will have to be changed based on pilot power. There is a need to review this in terms of EMF exposure and interference issues requirements and align both requirements.

8. The EMF guidelines also require that the transmit power be measured at the antenna port and that clearly nullifies the necessity of regulated transmit power settings at the Base station, as long as both EMF exposure and interference are being complied with.

9. Operators now have networks in various technology bands, as compared to the scenario back in the early days, hence, there is a need to review the transmit power regulation.

10. In light of the above submissions it is submitted that the Government should do away with the Transmit Power Regulation. Based on the EMF norms, operators will comply with the guidelines and maintain the desired power level at antennae level, to comply with both with EMF exposure norms as well as interference requirements. However, transmit power can be changed based on the technology being used. A detailed proposal in this regard is enclosed as <u>Annexure – 2</u>.

ANNEXURE-1

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JAC/2013/069
October 18, 2013

**Shri. P.K. Mittal,**
DDG (AS-I),
Department of Telecommunications,
Sanchar Bhawan, 20, Ashoka Road,
New Delhi – 110001

Dear Sir,

**Sub: Resolution of Pending Issues on TSTP for Rollout obligation of 3G Spectrum under CMTS/UAS Licensing using WCDMA Technology**

1. This is with reference to the DoT letter No. 842-1117/2011/AS-IV 11335 dated 4th September 2012 on TSTP (Test Schedule Test Procedure) for Rollout obligation of 3G spectrum and DoT letter no. 842 – 1117/2011/AS – IV (pt.) dated 13th December 2012 on the subject 'delay in meeting 3G rollout obligations'.

2. We have been interacting with various TERM Cells to mutually understand the implementation of the TSTP and based on the field experience it is evident that there are many points that need to be addressed to resolve the difficulties in execution of the TSTP. Considering this we request clarification on the following points and have made suggestions for offering coverage testing of 3G WCDMA network:

   a. **Para 1 (Pre-requisite) of DoT letter dated 4th September 2012**

   **Availability of Digital / Municipal Maps**: Digital maps / municipal maps, drawn to scale, of the DHQ/Towns in lieu of DHQ showing the municipal area are not available at municipal offices for most of the towns. This has been demonstrated to the TERM Cells during the sample tests. This problem remains unresolved.

   **Recommendations**

   i. A direction by the DoT is required to be given to TERM Cells, to specify the office from where a map with the municipal boundaries duly marked will be made available. The DoT should pass suitable instructions to these offices to make such maps (with marked boundaries) available.
   ii. In case of non-availability of the above maps, the TERM Cells should accept the maps already available with the operators.
   iii. Requisite change may please be made in para 1 Pre-Requisite (page 3) to accommodate this.

b. **Para 1 (Pre-requisite) of DoT letter dated 4th September 2012**

**Rural SDCA definition:** Clarity on the Rural SDCA list is required to avoid subsequent ambiguities on the definition of the rural SDCA.

i. We request DoT to provide circle wise list of Rural SDCAs along with towns and villages covered under each Rural SDCA at the earliest (as on date the list has been released by DoT only for Assam, Tamil Nadu, Madhya Pradesh, Gujarat, Himachal Pradesh , Orissa, Bihar and J&K).

ii. The DoT letter no. 20–271/2010–AS–I dated 1st September 2010 on amendment of USAL agreement under 3G rollout obligations for 3G spectrum at para ii. b) mentions that :-

"*The licensee to whom the spectrum is assigned shall ensure that at least 50% of the DHQ in the service area will be covered using the 3G spectrum, out of which at least 15% of the DHQs should be rural SDCAs*".

The letter at para ii. b. ii) also says

"*The operator shall be permitted to cover any other town in a District in lieu of the DHQ. Coverage of a DHQ/town would mean that at least 90% of the area bounded by the municipal / local body limits should get the required street level coverage*"

**Recommendations**

We comprehend from the above mentioned letter and we will implement as given below:

i. An Operator will select any of the rural SDCAs in a district from the list provided by DoT.
ii. An Operator shall offer any one town/ village within the Rural SDCA boundary for meeting the criteria "15% of the DHQs should be rural SDCAs". As per census 2011 data, there are only villages in Rural SDCAs and these shall be interpreted as village/town.

c. **Para 2. iii & iv (Route – selection) of DoT letter dated 4th September 2012**

**50m x 50m Cell Grid Criteria**: It is not practical to offer the DHQ / Towns as per this criteria as we need to make 10 calls in each grid which will be in the volume of few lakhs and is practically not possible. Also if one has to make 10 calls in each 50m x 50m with combination of short duration calls and long duration calls, it is almost stationary testing and will not be able to meet the desired objective.

An estimate of time required for conduct of drive tests based on prescribed TSTP for Delhi and Mumbai is given at **Annexure 1**. This shows that it will take 3.29 years for Mumbai, and 50.6 years for Delhi (city only).

**Recommendations**

i. The grid based concept be dropped and a pre-determined drive test route should be agreed with the local TERM officer for the coverage requirements similar to 2G TSTP.
ii. Measuring inaccessible areas: The drive test route should exclude the inaccessible areas and allow us to prepare result based on actual drivable route.

d. **Para 3 (Conducting tests – for data allocation) of DoT letter dated 4th September 2012**

**Drive Test Setup & Call Setup Details:**

**Test Setup:** Automated script for 4 UEs should be made as per details below:

i. UE 1 configured for short voice call with 60 seconds duration and 10 seconds idle.
ii. UE 2 configured for long voice calls of 30 minutes duration and 10 seconds idle. This is used to generate coverage plots.
iii. UE 3 configured for short video calls with 60 seconds duration and 10 seconds idle.
iv. UE 4 for data downloading form a FTP Server with short sessions (with 60 seconds duration and 10 seconds idle) as required during drive test.

e. **Para 3. iv (Conducting tests – for data collection) & Para 6. x (Interpretation of Results) of DoT letter dated 4th September 2012**

**50% loading of the Carrier:** As per TSTP all test cases are to be performed at 50% loading of the carrier. It is not possible to create 50% loading scenario in the live network where traffic distribution will be dynamic.

50% loading criteria was used during pre-launch testing so that network performance closed to the actual loading can be checked. Now the network is operational from more than three years & we have cells loading from 10% to 90% as per the consumption pattern of the commercial subscribers, which also varies with time as per the traffic conditions. If we try to load network at 50% by setting for testing purpose, it will severely impact end user experience significantly which is not recommended. Therefore, in current scenario we must perform test cases during the normal business hours under the present load.

It may kindly be noted that 3G and CDMA work on same fundamental principle of CDMA and it was only the existing loading (due to commercial traffic) that was used for the TEC testing of CDMA networks.

**Recommendation**

i. Tests should be done on the network with existing subscriber load. No additional simulated load will be added for testing.

f. **Para 3. v. c) (Conducting tests – for data collection) of DoT letter dated 4th September 2012**

**PS 144 Kbps Data**: In TSTP for long and short duration calls, PS 144 Kbps downlink is mentioned. This is not a standard RAB and is not available with most of the vendors. Also, we bring to your notice that as per current subscriber device usage pattern, >90% is based on HSPA and balance is R99.

**Recommendation**

i. We recommend carrying out the drive testing in auto mode (R99/ HSPA)

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g. **Para 6. vii & viii (Interpretation of results)**

**RSCP (Received Signal Code Power) Threshold Criteria:** RSCP criteria of ≥ -93 dBm given in TSTP for AMR 12.2 Kbps voice call, CS 64 Kbps video call, PS 144 Kbps data is very stringent. As per 3GPP, UMTS UE receiver sensitivity is -117 dBm which is much higher than GSM MS (-105 dBm).

**Recommendations**

i. The RSCP criteria for UMTS should be aligned to and brought in co-relation with 2G to bring it to ≥ -105 dBm instead of ≥ - 93 dBm as mentioned in the TSTP.

ii. RSCP and Ec/Io sample should be independently measured and reported against combined measurement as recommended in TSTP.

Considering the many practical issues in the implementation of the prescribed TSTP, we request DoT to kindly take our above submissions into consideration and issue suitable amendments to the TSTP issued vide referred DoT letter dated September 4, 2012.

Keeping in view the above, we would also request to make the rollout obligation period to commence prospectively from the date all the above issues are clarified and mutually resolved.

To discuss the above issues in detail and work out the mutually agreed solution, we request for a meeting with you at your earliest convenience.

Kind regards,

**Ashok Sud**
Secretary General-AUSPI

Rajan S. Mathews

**Rajan S. Mathews**
Director General-COAI

**CC** : **Shri. Anil Kaushal, Member (T), DoT**
: **Shri. S.S. Sirohi, Sr. DDG (Security – TERM), DoT**
: **Shri. A.K. Mittal, Sr. DDG, TEC**

ANNEXURE No. 1 to letter no. JAC/2013/069

**ESTIMATE OF TIME REQUIRED FOR CONDUCT OF DRIVE TEST BASED ON PRESCRIBED TSTP IN DELHI & MUMBAI**

This is with reference to para 2.c) of the above letter. In this regard, please find below the calculations being done by our members in Delhi and Mumbai.

1. **Mumbai Scenario:**

The route selection requires each grid cell of size 50m x 50m, based on this in Delhi itself there will be 17.9 lakhs grid cells out of which 2.69 lakhs grids are falling in accessible area. Further, the TSTP also requires atleast 10 calls in each grid cell. Based on these two parameters, we have done an estimate of time required to do the testing in Delhi and Mumbai and according to that, testing in Delhi alone would require 17 years to complete.

For 10 calls in each grid, we have considered 3 short calls for each of voice, video & data services parallel connected with drive kit and making 3 calls each for duration 60 sec & 10 sec idle as per TSTP document.

It has been observed during the drive test that average time required moving from one grid to other grid and initiating test in this new grid is 8 minutes to 15 minutes. Considering lower side for estimation, minimum time required for drive test in Mumbai is shown in table below:

| Circle | Total No of Grids | Accessible Grids | Time duration for one set of short Call (Sec) | Set of Short calls in each Grid (Nos.) | Minimum time duration for calls between two grids (Sec) | Total Drive test Time (Sec) | Total drive test Time (Years) | Actual Time considering 10hrs drive for 24 working days per month (Years) |
|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E = Ax(BxC+D) | F=E/(3600x24x365) | G=E/(3600x10x288) |
| Mumbai | 394481 | 49447 | 70 | 3 | 480 | 34118430 | 1.08 | 3.29 |

2. **Delhi Scenario:**

The following table represents the calculations being done by another member for Delhi. According to the same, it has been observed that it will take atleast 50 years to do the drive test in Delhi.

Assumptions:

i. Road Length as per Govt. of Delhi website (http://delhi.gov.in/DoIT/DES/Publication/abstract/SA2012.pdf), only for Delhi NCT. NCR area road length will be additional, because these also fall in Delhi Telecom circle
ii. 10 working hours per day considered (8 hours of calls period, one hour for kit setup and settling, one hour for inter-grid movement.
iii. 303 Working days considered assuming 52 Sundays+10 Holidays in a year.
iv. It is assumed, that testing will happen on all the roads and it will be continuous. Practical aspects of traffic Jam, public issues etc. are not considered, which can add further.
v. This way of testing will be stationary testing, stopping at every 50m to make 10 calls.

| Circle | Total Road Km | No. of 50m segments on roads | Call duration (Seconds) | Gap between calls (Seconds) | Time consumed in one grid for 10 calls (Minutes) | No. of Grids covered in a Day (considering 8 Hours/Day only for calls) | Time required/day for moving from one grid to another (assuming 60 seconds for movement) (Minutes) | Kit Setup Time (2 times in a day, 30 minute per setup) Hrs | No. of Days Required to cover all grids | No. of Years (Assuming 303 working days/year) |
|---|---|---|---|---|---|---|---|---|---|---|
| Delhi | 31969 | 639,380 | 60 | 10 | 12 | 42 | 40 | 1 | 15318 | 50.6 |

Recommendations:

As we can see that time required with grid method is too high, which is practically not feasible. So we recommend for amending test procedure to consider continuous drive testing along the agreed drive test route encompassing all motor-able roads in offered town. 50x50m grid clause should be removed from TSTP.

# A. Executive Summary

## 1. Background

BTS Transmit power guidelines for the mobile networks were introduced in 1995 when GSM was the most common network, since then newer technologies have evolved. However, transmit power regulation have not been reviewed and the same norms are being followed for all new technologies such as 3G and LTE. Current guidelines of RF power from DoT on transmit power (RF) from the BTS is 20W at the output of the BTS port. This is common guideline for all type of technologies deployed in the network like GSM, CDMA, WCDMA, and LTE (reference DoT letter number L-14035/08/2010-BWA, dated 15th Sep 2010).

In addition, more stringent EMF level regulations (1/10th of ICNIRP values) have been mandated for compliance by TSPs to ensure radiations from the base stations are kept under limit. These guidelines also govern the transmit power of the base station, thus creating dual condition of compliance,

Given that the new broadband technologies introduced beyond 2010 are having different characteristics like frequency band, MIMO, wide band spectrum usage; it is pertinent for these regulations to be revised by DoT.

## 2. Objective

Aim of this paper is to review the 20W at the output of the BTS port and allow higher suitable transmit power & EIRP limits for 3G & 4G Base stations as they operates on wider carrier bandwidth & discontinuous transmission modes and at the same time EMF (EIRP/EIRPth) from 3G & 4G BTS is much lower than GSM technology as described through medium of this paper.

## 3. Highlights

i. There are significant differences between GSM (narrowband technology) and 3G / LTE technologies (broadband technologies) which necessitate different treatment of RF Power related to these technologies:

   a) Power in GSM is across a narrow 200KHz channel vs. 3G/LTE which is in wideband say 5MHz, 10MHz or 20MHz

   b) GSM has continuous power transmission irrespective of the traffic in the BTS, while 3G / LTE-FDD / LTE-TDD have variable/discontinuous power transmission owing to following aspects

      I. Pilot power, which is typically 10% of the total transmit power of Node-B in 3G network, is continuous and total power is based on the amount of voice & data traffic in the Node-B,

      II. Power transmission is only in fraction of time in case of LTE-TDD deployments

      III. Continuous power transmission in LTE-FDD networks is only transmitted on some RE (Resource Elements)

   c) MIMO is mandatory in LTE and optional in 3G which is not applicable for 2G networks

ii. 3G and LTE are wideband technologies; they need higher transmit power for coverage & capacity. Global deployments in US, Europe, China and APAC markets for 3G & LTE are using 40W to 80W of transmit power in the BTS irrespective of bands (3G in 900 and 2100, LTE-FDD in 1800, 800, 2100, 900 band, LTE-TDD in 2300, 2600 band) to take care of growth in mobile broadband traffic.

iii. 3G & LTE emission mask ensures that the out of band emissions are same even if the transmit power of the BTS is >20W. These emission masks are defined by 3GPP standards in 3GPP TS 25.104 section 6.6.3.1.1.1 and 6.6.2.2.1 for 3G / UMTS, and TS36.104 for LTE base stations.

iv. Power density (RF power per MHz) in 3G & LTE is lower than GSM even with BTS RF Power is 60W and 80W respectively as shown in the table below:

**Table -1**

| | Units | GSM | UMTS(3G) | UMTS (3G) | LTE-TDD | LTE-FDD | LTE-FDD | LTE-FDD |
|---|---|---|---|---|---|---|---|---|
| BTS Transmit Power | Watt | 20 | 20 | 40 | 40 | 40 | 40 | 40 |
| Carrier BW | MHz | 0.2 | 5 | 5 | 20 | 5 | 10 | 20 |
| Power/MHz | dBm | 50 | 36 | 39 | 33 | 39 | 36 | 33 |
| MIMO | | No | Optional | Optional | Mandatory | Mandatory | Mandatory | Mandatory |
| TDD Ratio | No | No | No | No | Yes(3:1) | No | No | No |
| Total Max Transmit Power /MHz ( with MIMO & TDD as | dBm | 50 dbm @ 20 Watt | 20 \| 36<br>40 \| 39<br>60 \| 41 | 20 \| 36<br>40 \| 39<br>60 \| 41 | 20 \| 36<br>40 \| 39<br>80 \| 42 | 20 \| 36<br>40 \| 39<br>80 \| 42 | 20 \| 36<br>40 \| 39<br>80 \| 42 | 20 \| 36<br>40 \| 39<br>80 \| 42 |
| Pilot Power | dBm | 43 | 30 - 33 | 30 - 36 | 36 - 38 | 36 - 38 | 36 - 38 | 36 - 38 |
| Frequency Band | MHz | 900, 1800 | 900, 2100 | 900, 2100 | 2300, 2600 | 1800, 900, 2100, 800 | | |

v. EIRP and EIRP/EIRP$_{th}$ for 3G / LTE is significantly lower than that of GSM (using peak power in each of the respective technologies), as defined in the table below:

**Calculated Value for Worst Case (at 100% loaded case):**

**Table -2 ( refer annexure for calculation details)**

| Technology | Power(W) | EMF Scenario 1 (At Ground) – EIRPt/EIRP$_{th}$ | EMF Scenario2 (At Adjacent Bldg.) – EIRP/EIRP$_{th}$ |
|---|---|---|---|
| GSM900 (4/4/4) | 20W/Carrier | 0.06092 | 0.01896 |
| GSM1800 (4/4/4) | 20W/Carrier | 0.03147 | 0.00979 |
| UMTS | 60W/Carrier | 0.02445 | 0.007607 |
| LTE | 80W/Carrier | 0.03644 | 0.01134 |
| **Total EIRP/ EIRP$_{th}$** | | **0.15327** | **0.04769** |

vi. $EIRP/EIRP_{th}$ for usage of UMTS and LTE (irrespective of bands 800, 900, 2100, 1800, 2300, 2600) will be significantly lower considering only pilot channel or reference symbols in the LTE. Due to spread spectrum nature of the 3G and LTE technologies, irrespective of the bands and the channel bandwidth, the $EIRP/EIRP_{th}$ for 3G & LTE will be lower and compliant with the required levels for EMF exposure.

**Measured values at heavily loaded sites:**

**Table -3**

| **Technology** | **No. of Operators** | **EMF Scenario 1 (At Ground) – $EIRPt/EIRP_{th}$** | **EMF Scenario2 (At Adjacent Bldg.) – $EIRP/EIRP_{th}$** |
|---|---|---|---|
| GSM900 (4/4/4) | 2 | 0.00065 | 0.00010 |
| GSM1800 (4/4/4) | 2 | 0.00072 | 0.00118 |
| UMTS (2100MHz) – 60W | 2 | **0.00036** | **0.00023** |
| LTE-TDD (2300MHz) – 80W | 1 | **0.00003** | **0.00002** |
| **Total $EIRP/ EIRP_{th}$** | | **0.00176** | **0.00153** |

Also, it shall be noted that in a typical network, not all the 100% resources are always used and transmitted. Thus the above values with traffic are on the higher side. In practice typically not more than 30-40% of the resources (whether codes or PRB) are used and the TTI (Transmit Time Intervals) of not more than 40-50% are used.

## 4. Inference & Recommendations

i. From the calculated method and field measurement results shown above for a heavily loaded site, it is clear that the EIRP/EIRPth values for 60W/80W power of 3G and LTE are well within the limits of EMF exposure guidelines described by DoT.

ii. Transmit power per MHz (power density) for 3G & LTE base station (having transmit power of 60W & 80W respectively) is lower than that of a GSM base station,

iii. $EIRP/EIRP_{th}$ for 3G and LTE base station is lower than that of GSM base station. This is pertinent to 3G deployment in 2100MHz or 900MHz band and LTE deployment in 2300MHz or 1800MHz band,

iv. 3GPP specifications ensure same out of band emission norms for 3G and LTE base station with transmit power of 43dBm (20W) or higher,

v. 3G and LTE base stations with transmit power of 60W & 80W respectively, comply to the 3GPP specifications and are within emission levels as per EMF regulations,

vi. Suggested modifications for EIRP value in case of 3G, LTE-FDD, LTE-TDD deployments by taking average transmit power during a frame. This is mandatory as LTE technology (FDD&TDD) consistent power is only transmitted during specific Resource Elements. Additionally in LTE-TDD base stations are transmitting power only during specific intervals of time (downlink sub-frames), while at other time intervals its only in the receiving mode with no transmitting power (uplink sub-frames). Similarly in 3G only the CPICH is

vii. transmitted as full power (30-33dBm) , only when users are scheduled the further additional delta power is required

viii. Given the above facts, the limit of 20W at the output of the BTS port is outdated and should be reviewed and TSPs should be allowed to configure transmit power in 3G and LTE base stations beyond 20W, maintaining compliance to the EMF norms.

ix. Increasing the power will not have any interference impact on adjacent carrier so far operator is complying with the 3GPP mentioned ACLR and SEM requirements

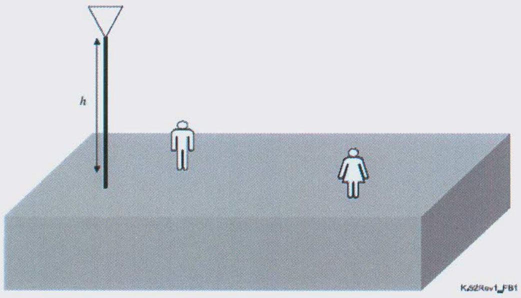
## ANNEXURE I

### B. Introduction

EMF measurement scenario described below as per guidelines

**Calculation Scenario 1:**

The calculations are done on roads at the ground level.



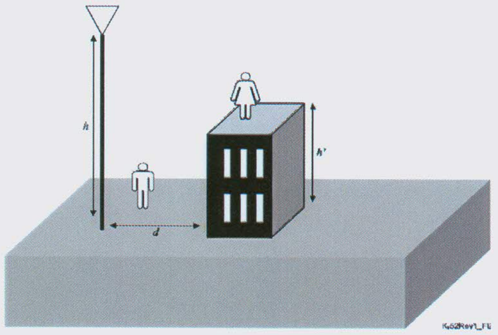

For 400 MHz < f < 2000 MHz,

$EIRP_{th} = \{(f*\Pi)/ (2000*Asl)\}*(h-2)^2$

For f > 2000 MHz,

$EIRP_{th} = (\Pi/Asl)*(h-2)^2$

**Calculation Scenario 2:**
The calculations are done on the adjacent building roof top.




For 400 MHz < f < 2000 MHz,

$EIRPth = \{[(f\Pi)/ 2000*Asl)\}*((d^2+(h-h')^2)/d))^2$

For f > 2000 MHz,

$EIRP_{th} = (\Pi/Asl)*((d^2+(h-h')^2)/d))^2$

## 1. 3G NodeB Transmit Power & Spatial Emission Mask (as per Standard)

### i. 3G BTS Transmit Power

| Power Scenario | Band | BTS Transmit Power | BTS Transmit Power @ different loading | | |
|---|---|---|---|---|---|
| | | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2100/900 | 20Watt | 33 dBm | 40 dBm | 43 dBm |
| Scenario-2 | 2100/900 | 40 Watt | 36 dBm | 43 dBm | 46 dBm |
| Scenario-3 | 2100/900 | 60 Watt | 36 dBm | 44.7 dBm | 47.7 dBm |

### ii. 3G BTS Out of Band Emission (Spatial Emission Mask as per Std.)

**SEM Requirement**
SEM requirement for UTRAN/FDD systems as defined in 3GPP TS 25.104 section 6.6.3.1.1.1 has been reproduced for reference. Spectrum emission mask values, BS maximum output power **P ≥ 43 dBm**

| Band | Maximum level | Measurement Bandwidth |
|---|---|---|
| 9kHz - 150kHz | -13 dBm | 1 kHz |
| 150kHz - 30MHz | | 10 kHz |
| 30MHz - 1GHz | | 100 kHz |
| 1GHz - 12.75 GHz | | 1 MHz |

**Filter ACLR Requirement**
Minimum ACLR requirement defined by 3GPP TS 25.104 section 6.6.2.2.1 for an offset of 5 MHz from the edge frequency is **45 dB** and that from an offset of 10 MHz is **50 dB** to meet above mentioned OOB emission requirement

### iii. 3G BTS EIRP

EIRP = TX Power – Combiner Loss – (Cable Length x Unit Loss) + Antenna Gain (dBm)
Typical Assumption: Combiner Loss: 1 dB, Cable Loss: 1 dB, Antenna Gain (18 dBi)

Note: EIRP (T) is same as EIRP, as only one 3G carrier is assigned

| Power Scenario | Band | Transmit Power @ BTS Port in Watts | EIRP in dBm | | |
|---|---|---|---|---|---|
| | | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2100 / 900 | 20 | 49 | 56 | 59 |
| Scenario-2 | 2100 / 900 | 40 | 52 | 59 | 62 |
| Scenario-3 | 2100 / 900 | 60 | 52 | 60.7 | 63.7 |

## iv. 3G BTS $EIRP_{th}$

**Calculation Scenario 1:**

$EIRP_{th}$ = (∏/Asl)*(h-2)^2

Typical Assumption: f=2149, Asl =-18, h=24

Note: $EIRP_{th}$ is same for all loading and power configuration

| Power Scenario | Band | Transmit Power @ BTS Port | $EIRP_{th}$ (in Watts) |
|---|---|---|---|
| Scenario-1 | 2100 | 20Watt | 95890.4 |
| Scenario-1 | 900 | 20Watt | 44828.7 |

**Calculation Scenario 2:**

$EIRP_{th}$ = (∏/Asl)*((d^2+(h-h')^2)/d))^2

Typical Assumption: f=2149, Asl =-18, h=24, h'=5, d=25

Note: $EIRP_{th}$ is same for all loading and power configuration

| Power Scenario | Band | Transmit Power @ BTS Port | EIRPth (in Watts) |
|---|---|---|---|
| Scenario-2 | 2100 | 20Watt | 308179.3 |
| Scenario-2 | 900 | 20Watt | 144073.8 |

## v. 3G BTS EIRP/ $EIRP_{th}$

**Calculation Scenario 1:**

| Power Scenario | Band | EIRP/ EIRPth- Scenario 1 | | |
|---|---|---|---|---|
| | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2100 | 0.0008 | 0.0042 | 0.0083 |
| Scenario-2 | 2100 | 0.0017 | 0.0083 | 0.0165 |
| Scenario-3 | 2100 | 0.0017 | 0.0123 | 0.0244 |

| Power Scenario | Band | EIRP/ EIRPth- Scenario 1 | | |
|---|---|---|---|---|
| | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 900 | 0.0018 | 0.0089 | 0.0177 |
| Scenario-2 | 900 | 0.0035 | 0.0177 | 0.0354 |
| Scenario-3 | 900 | 0.0035 | 0.0262 | 0.0523 |

### Calculation Scenario 2:

| Power Scenario | Band | EIRP/ EIRPth- Scenario 2 | | |
|---|---|---|---|---|
| | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2100 | 0.0003 | 0.0013 | 0.0026 |
| Scenario-2 | 2100 | 0.0005 | 0.0026 | 0.0051 |
| Scenario-3 | 2100 | 0.0005 | 0.0038 | 0.0076 |

| Power Scenario | Band | EIRP/ EIRPth- Scenario 2 | | |
|---|---|---|---|---|
| | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 900 | 0.0006 | 0.0028 | 0.0055 |
| Scenario-2 | 900 | 0.0011 | 0.0055 | 0.011 |
| Scenario-3 | 900 | 0.0011 | 0.0082 | 0.0163 |

## 2. 4G eNodeB Transmit Power & Spatial Emission Mask (as per Standard)

### i. 4G BTS Transmit Power

Ir-respective of the band the transmit power in 4G will be as follows

| Power Scenario | Band | Transmit Power @ BTS (2x2 MIMO) in Watts | BTS Transmit Power (2x2) @ different loading in dBm | | |
|---|---|---|---|---|---|
| | | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2300 / 1800 / 900 /2100 / 2600 | 20 | 33.00 | 40.00 | 43.00 |
| Scenario-2 | 2300 / 1800 / 900 /2100 / 2600 | 40 | 36.00 | 43.00 | 46.00 |
| Scenario-3 | 2300 / 1800 / 900 /2100 / 2600 | 80 | 39.00 | 46.00 | 49.00 |

### ii. 4G BTS Out of Band Emission (Spatial Emission Mask as per Std.)

**SEM Requirement**
SEM requirement for 5, 10, 15 and 20 MHz channel bandwidth (E-UTRA bands >1GHz) for Category A as defined in 3GPP TS 36.104 has been reproduced for reference

| Frequency offset of measurement filter -3dB point, Δf | Frequency offset of measurement filter centre frequency, f_offset | Minimum requirement (Note 1, 2) | Measurement bandwidth (Note 5) |
|---|---|---|---|
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f_offset < 5.05 MHz | $-7dBm-\frac{7}{5}\cdot\left(\frac{f\_offset}{MHz}-0.05\right)dB$ | 100 kHz |

| | | | |
|---|---|---|---|
| 5 MHz ≤ Δf < min(10 MHz, Δfmax) | 5.05 MHz ≤ f_offset < min(10.05 MHz, f_offsetmax) | -14 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.5 MHz ≤ f_offset < f_offsetmax | -13 dBm (Note 7) | 1MHz |

**Filter ACLR Requirement**
Minimum ACLR requirement defined by 3GPP TS 36.104 for an offset of 2.5 MHz from the edge frequency is **45 dB** to meet above mentioned OOB emission requirement

### iii. 4G BTS EIRP

EIRP = TX Power – Combiner Loss – (Cable Length x Unit Loss) + Antenna Gain (dBm)
Typical Assumption: Combiner Loss: 1 dB, Cable Loss: 1 dB, Antenna Gain (18 dBi)
Note: EIRP (T) is same as EIRP, as only one 4G carrier is assigned

| Power Scenario | Band | EIRP in dBm | | |
|---|---|---|---|---|
| | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2300 / 1800 / 900 /2100 / 2600 | 49.0 | 56.0 | 59.0 |
| Scenario-2 | 2300 / 1800 / 900 /2100 / 2600 | 52.0 | 59.0 | 62.0 |
| Scenario-3 | 2300 / 1800 / 900 /2100 / 2600 | 55.0 | 62.0 | 65.0 |

### iv. 4G BTS EIRPth

**Calculation Scenario 1:**
$EIRP_{th}$ = (∏/Asl)*(h-2) ^2

Typical Assumption: f=2337.5, Asl=-18, h=24

Note: $EIRP_{th}$ is same for all loading and power configuration

| Power Scenario | Band | Transmit Power Per sector | $EIRP_{th}$(in Watts) |
|---|---|---|---|
| Scenario-1 | 2300/1800/900/2100/2600 | 20/40/80 Watt | 95890.37 |

**Calculation Scenario 2:**

$EIRP_{th}$ = (∏/Asl)*((d^2+(h-h')^2)/d))^2

Typical Assumption: f= 2337.5, ASL=-18, h=24, h'=5, d=25

Note: $EIRP_{th}$ is same for all loading and power configuration

| Power Scenario | Band | Transmit Power Per sector | $EIRP_{th}$(in Watts) |
|---|---|---|---|
| Scenario-1 | 2300/1800/900/2100/2600 | 20/40/60 Watt | 308179.30 |

### v. 4G BTS EIRP/$EIRP_{th}$

**Calculation Scenario 1:**

| Power Scenario | Band | Transmit Power @ BTS( 2x2 MIMO) in Watts | EIRP/ EIRPth- Scenario 1 | | |
|---|---|---|---|---|---|
| | | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2300 / 1800 / 900 /2100 / 2600 | 20 | 0.0008 | 0.0042 | 0.0083 |
| Scenario-2 | 2300 / 1800 / 900 /2100 / 2600 | 40 | 0.0017 | 0.0083 | 0.0165 |
| Scenario-3 | 2300 / 1800 / 900 /2100 / 2600 | 80 | 0.0033 | 0.0165 | 0.0330 |

**Calculation Scenario 2:**

| Power Scenario | Band | Transmit Power @ BTS( 2x2 MIMO) in Watts | EIRP/ EIRPth- Scenario 2 | | |
|---|---|---|---|---|---|
| | | | 0%(pilot) | 50% | 100% |
| Scenario-1 | 2300 / 1800 / 900 /2100 / 2600 | 20 | 0.0003 | 0.0013 | 0.0026 |
| Scenario-2 | 2300 / 1800 / 900 /2100 / 2600 | 40 | 0.0005 | 0.0026 | 0.0051 |
| Scenario-3 | 2300 / 1800 / 900 /2100 / 2600 | 80 | 0.0010 | 0.0051 | 0.0103 |

## 3. GSM Transmit Power & Spatial Emission Mask (as per Standard)

### i. 2G BTS Transmit Power

| Power Scenario | Band | Transmit Power per carrier | BTS Transmit Power |
|---|---|---|---|
| Scenario-1 | 900/1800 | 20Watt | 43 |

### ii. 2G BTS Out of Band Emission (Spatial Emission Mask as per Std.)

**SEM Requirement**
SEM requirement for GSM/EDGE systems as defined in 3GPP TS 45.005 has been reproduced for reference

| Band | Frequency offset outside relevant transmit band | All BTS except multicarrier BTS | Multicarrier BTS |
|---|---|---|---|
| | | Maximum power limit | Maximum power limit |
| 9 kHz to 1 GHz | | | Wide Area |
| | ≥ 2MHz | -36 dBm | -25 dBm |
| | ≥ 5MHz | -36 dBm | -20-4,2* (Δf - 5) dBm (Note) |
| | ≥ 10MHz | -36 dBm | -36 dBm |
| 1 GHz to 12.75 GHz | ≥ 2MHz | -30 dBm | -25 dBm |
| | ≥ 5MHz | -30 dBm | -20-3* (Δf - 5) dBm (Note) |
| | ≥ 10MHz | -30 dBm | -30 dBm |

**Filter ACLR Requirement**
Minimum ACLR requirement for GSM/EDGE systems as defined in 3GPP TS 45.005 mentions that at a channel band width of 200 KHz and frequency offset value of 400 KHz allowable ACLR value should be >=60 dB for class II base stations

### iii. 2G BTS EIRP

EIRP = TX Power – Combiner Loss – (Cable Length x Unit Loss) + Antenna Gain (dBm)

Typical Assumption: Combiner Loss: 1 dB, Cable Loss: 1 dB, Antenna Gain (18 dBi)

| Power Scenario | Band | Transmit Power per carrier | EIRP (dBm) |
|---|---|---|---|
| Scenario-1 | 900/1800 | 20Watt | 59 |

### iv. 2G BTS EIRP (T)

EIRP (T) = EIRP (BCCH) watts + (EIRP (BCCH) watts x 0.9 x 0.9 x (Carrier Per sector-1)

Typical Assumption: 4/4/4 BTS configuration

| Power | Band | Transmit Power per | EIRP (T) (dBm) |
|---|---|---|---|

| Scenario | | carrier | |
|---|---|---|---|
| Scenario-1 | 900/1800 | 20Watt / 4TRX | 64.36 |

## v. 2G BTS EIRPth

**Calculation Scenario 1:**

$EIRP_{th}$ = {(f*∏)/ (2000*Asl)}*(h-2)^2

Typical Assumption: f= 935, 1810.2, Asl=-18, h=5

Note: EIRPth is same for all loading and power configuration

| Power Scenario | Band | Transmit Power @ BTS Port | EIRPth (in Watts) |
|---|---|---|---|
| Scenario-1 | 900 | 20Watt<br>4 TRX | 44828.75 |
| Scenario-2 | 1800 | 20Watt<br>4 TRX | 86790.38 |

**Calculation Scenario 2:**

$EIRP_{th}$ = {[(f∏)/ 2000*Asl)}*((d^2+(h-h')^2)/d))^2

Typical Assumption: f= 935, 1810.2, Asl=-18, h=24, h'=5, d=25

Note: $EIRP_{th}$ is same for all loading and power configuration

| Power Scenario | Band | Transmit Power @ BTS Port | $EIRP_{th}$ (in Watts) |
|---|---|---|---|
| Scenario-1 | 900 | 20Watt/4 TRX | 144073.8 |
| Scenario-2 | 1800 | 20Watt/ 4 TRX | 278933.1 |

## vi. 2G BTS EIRP (T)/$EIRP_{th}$

**Calculation Scenario 1:**

| Power Scenario | Band | Transmit Power per carrier | EIRP(T)/$EIRP_{th}$ |
|---|---|---|---|
| Scenario-1 | 900 | 20Watt<br>4 TRX | 0.06092 |
| Scenario-2 | 1800 | 20Watt<br>4 TRX | 0.03147 |

**Calculation Scenario 2:**

| Power Scenario | Band | Transmit Power per carrier | EIRP(T) /EIRP$_{th}$ |
|---|---|---|---|
| Scenario-1 | 900 | 20Watt<br>4 TRX | 0.0190 |
| Scenario-2 | 1800 | 20Watt<br>4 TRX | 0.0098 |

## 4. Total EIRP/EIRP$_{th}$ for different Site configurations

### Calculation Scenario 1:

The following tables summaries the EIRP/EIRPth for different frequencies at different transmit power at BTS port and BTS Transmit Power per Port at different loading values.

Height of the antenna is considered as 16m.

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.06092 | 0.06092 | 0.06092 |
| GSM 1800 | 20 | 0.03147 | 0.03147 | 0.03147 |
| UMTS-900 | 20 | 0.00177 | 0.00888 | 0.01772 |
| UMTS-2100 | 20 | 0.00083 | 0.00415 | 0.00828 |
| LTE-900 | 20 | 0.00177 | 0.00888 | 0.01772 |
| LTE-1800 | 20 | 0.00092 | 0.00459 | 0.00915 |
| LTE-2100 | 20 | 0.00083 | 0.00415 | 0.00828 |
| LTE-2300 | 20 | 0.00062 | 0.00308 | 0.00615 |

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.06092 | 0.06092 | 0.06092 |
| GSM 1800 | 20 | 0.03147 | 0.03147 | 0.03147 |
| UMTS-900 | 40 | 0.00354 | 0.01772 | 0.03535 |
| UMTS-2100 | 40 | 0.00165 | 0.00828 | 0.01653 |
| LTE-900 | 40 | 0.00354 | 0.01772 | 0.03535 |
| LTE-1800 | 40 | 0.00183 | 0.00915 | 0.01826 |
| LTE-2100 | 40 | 0.00165 | 0.00828 | 0.01653 |
| LTE-2300 | 40 | 0.00123 | 0.00615 | 0.01228 |

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.06092 | 0.06092 | 0.06092 |
| GSM 1800 | 20 | 0.03147 | 0.03147 | 0.03147 |
| UMTS-900 | 60 | 0.00354 | 0.02621 | 0.05229 |
| UMTS-2100 | 60 | 0.00165 | 0.01225 | 0.02445 |
| LTE-900 | 80 | 0.00705 | 0.03535 | 0.07054 |
| LTE-1800 | 80 | 0.00364 | 0.01826 | 0.03644 |

| | | | | |
|---|---|---|---|---|
| LTE-2100 | 80 | 0.00330 | 0.01653 | 0.03298 |
| LTE-2300 | 80 | 0.00245 | 0.01228 | 0.02450 |

**Measured value:**

An isotropic antenna was set-up at ground level and the value of EIRP/EIRPth was measured using the spectrum analyzer.

| Technology | Power(W) | EIRP/EIRPth | |
|---|---|---|---|
| | | Peak (d=25m) | Average ( d=25m) |
| GSM900 4 TRX | 20 | 0.00136 | 0.00065 |
| GSM1800 4 TRX | 20 | 0.00186 | 0.00072 |
| UMTS | 40 | 0.00106 | 0.00036 |
| LTE | 40 | 0.00003 | 0.00002 |

**Calculation Scenario 2:**

The following tables summaries the EIRP/EIRPth for different frequencies at different transmit power at BTS port and BTS Transmit Power per Port at different loading values.

Height of the antenna is considered as 16m. The distance between the antenna and the user is considered as 25m and the height at which the user is present is considered as 6m.

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.01896 | 0.01896 | 0.01896 |
| GSM 1800 | 20 | 0.00979 | 0.00979 | 0.00979 |
| UMTS-900 | 20 | 0.00055 | 0.00276 | 0.00551 |
| UMTS-2100 | 20 | 0.00026 | 0.00129 | 0.00258 |
| LTE-900 | 20 | 0.00055 | 0.00276 | 0.00551 |
| LTE-1800 | 20 | 0.00028 | 0.00143 | 0.00285 |
| LTE-2100 | 20 | 0.00026 | 0.00129 | 0.00258 |
| LTE-2300 | 20 | 0.00019 | 0.00096 | 0.00192 |

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.01896 | 0.01896 | 0.01896 |
| GSM 1800 | 20 | 0.00979 | 0.00979 | 0.00979 |
| UMTS-900 | 40 | 0.00110 | 0.00551 | 0.01100 |
| UMTS-2100 | 40 | 0.00051 | 0.00258 | 0.00514 |
| LTE-900 | 40 | 0.00110 | 0.00551 | 0.01100 |

| | | | | |
|---|---|---|---|---|
| LTE-1800 | 40 | 0.00057 | 0.00285 | 0.00568 |
| LTE-2100 | 40 | 0.00051 | 0.00258 | 0.00514 |
| LTE-2300 | 40 | 0.00038 | 0.00192 | 0.00382 |

| Technology | Power (W) | 0% | 50% | 100% |
|---|---|---|---|---|
| GSM 900 | 20 | 0.01896 | 0.01896 | 0.01896 |
| GSM 1800 | 20 | 0.00979 | 0.00979 | 0.00979 |
| UMTS-900 | 60 | 0.00110 | 0.00815 | 0.01627 |
| UMTS-2100 | 60 | 0.00051 | 0.00381 | 0.00761 |
| LTE-900 | 80 | 0.00219 | 0.01100 | 0.02195 |
| LTE-1800 | 80 | 0.00113 | 0.00568 | 0.01134 |
| LTE-2100 | 80 | 0.00103 | 0.00514 | 0.01026 |
| LTE-2300 | 80 | 0.00076 | 0.00382 | 0.00762 |

**Measured value:**

The isotropic antenna was set-up at a distance of 25m from the antenna and 5m above ground level and value of EIRP/EIRPth was measured.

| Technology | Power(W) | EIRP/EIRPth | |
|---|---|---|---|
| | | Peak (d=25m) | Average ( d=25m) |
| GSM900 4 TRX | 20 | 0.00019 | 0.00010 |
| GSM1800 4 TRX | 20 | 0.00357 | 0.00118 |
| UMTS | 40 | 0.00073 | 0.00023 |
| LTE | 40 | 0.00004 | 0.00002 |

## ANNEXURE II

(BTS Power used by operators across the globe)

| S.No. | Top Global Operators | Region | Technology | BTS Configuration ( 1T/2R, 2T/2R, 4T4R, 8T8R etc) | Max. BTS Transmit Pwr used | Pwr Distribution - across network |
|---|---|---|---|---|---|---|
| 1 | T Mobile | US | UMTS | 2T2R | 2x20W,2x40W and 2x60W | 2x20W in most sites.<br>2x40W and 2x60W in some |
| | | Germany | UMTS | 2T2R | 2x40W & 2x60 W | 2x40W in most sites<br>2x60W in some |
| 2 | Telefonica | Europe | GSM, UMTS, LTE | GSM: 1T2R, UMTS: 1T2R, LTE: 2T2R | GSM: 10W/TRX; 20W/TRX; 40W/TRX<br>UMTS: 20W/C; 40W/C<br>LTE: 20W/TxPort and 40W/TxPort | |
| 3 | Vodafone | UK | UMTS | 1T2R | 40W | Mainly 40W |
| | | Germany | UMTS | 1T2R | 20W,40W | 40W |
| 4 | France Telecomm | D.R.Congo | GSM, UMTS, LTE-TDD | GSM: 1T2R, UMTS: 1T2R, LTE: 2T2R | GSM: 15W/ TRX<br>UMTS: 20W/ Carrier<br>LTE: 40W/ Carrier | GSM 100% 60W (S444)<br>UMTS 100% 40W (S222)<br>LTE 100% 40W (S111) |
| 5 | Optus | Australia | UMTS | 2T2R | 2x40W and 2x60W | |
| 6 | TeliaSonera | Europe | UMTS | 2T2R | 2x60W | |
| 7 | LTC | Laos | UMTS | 1T2R | 20W,30W,60W | 30%-20W, 30%-30W, 40%- 60W |
| 8 | AIS | Thailand | UMTS | 1T2R | 20W and 40W | 40W in suburban |
| 9 | O2 | Germany | UMTS | 1T2R | 40W | Mainly 40W |

# Corrigendum

RSM/COAI/2014/214

December 19, 2014

Telecom Regulatory Authority of India
Mahanagar Doorsanchar Bhawan
Jawahar Lal Nehru Marg
New Delhi 110002

**Subject: Corrigendum to TRAI Consultation Paper on Valuation and Reserve Price for Spectrum in 2100 MHz Band**

Dear Sir,

Please refer to the COAI Response submitted to TRAI vide letter bearing No. RSM/2014/212 dated 15th December 2014. We wish to submit that our response to **point "f"** under **question No.10** may please be read and replaced as follows:

**"f. Therefore, we recommend that the reserve price for 2100 MHz spectrum should be pegged at 80% of the valuation of 2100 MHz spectrum arrived at by the Authority."**

We request you to kindly consider the above changes in the COAI Response to TRAI Consultation Paper on Valuation and Reserve Price for Spectrum in 2100 MHz Band.

Kind regards,

Rajan S Mathews
Director General

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