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**THE TELECOMMUNICATION INTERCONNECTION USAGE CHARGES (THIRTEENTH AMENDMENT) REGULATIONS, 2017**

**(5 of 2017)**

**TELECOM REGULATORY AUTHORITY OF INDIA**
**NOTIFICATION**

**New Delhi, the 19th September 2017**

**File No. 10-8/2016-BB&PA ---** In exercise of the powers conferred upon it under section 36, read with sub-clauses (ii), (iii) and (iv) of clause (b) of sub-section (1) of section 11, of the Telecom Regulatory Authority of India Act, 1997 (24 of 1997), the Telecom Regulatory Authority of India hereby makes the following regulations further to amend the Telecommunication Interconnection Usage Charges Regulation, 2003 (4 of 2003), namely:-

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| **1**. (1) These regulations may be called the Telecommunication Interconnection Usage Charges (Thirteenth Amendment) Regulations, 2017 (5 of 2017). |
| (2) They shall come into force with effect from the 1st October, 2017. |
| **2**. In Schedule I of the Telecommunication Interconnection Usage Charges Regulation, 2003 (4 of 2003), in the table under column "1. Termination Charge", for the words and figures "Re. 0.14 (paise fourteen only) per minute", the words and figures ---<br>"(a) Re. 0.06 (paise six only) per minute with effect from the 1st October, 2017 to the 31st December, 2019; and<br>(b) 0 ( Zero) with effect from the 1st January, 2020"<br>shall be substituted. |

**(S.K. Gupta)**
**Secretary**

**Note 1**. The principal regulations were published vide F.No. 409-5/2003-FN dated 29.10.2003 (4 of 2003) and subsequently amended vide notifications Nos. --

(i) 409-5/2003-FN dated 25.11.2003 (5 of 2003) (First Amendment);

(ii) 409-5/2003-FN dated 12.12.2003 (6 of 2003) (Second Amendment);

(iii) 409-5/2003-FN dated 31.12.2003 (7 of 2003) (Third Amendment);

(iv) 409-8/2004-FN dated 06.01.2005 (1 of 2005) (Fourth Amendment);

(v) 409-8/2004-FN dated 11.04.2005 (7 of 2005) (Fifth Amendment), which has been set aside by Hon'ble TDSAT vide its Order dated the 21.09.2005 in appeal No. 7 of 2005;

(vi) 409-5/2005-FN dated 23.02.2006 (1 of 2006) (Sixth Amendment);

(vii) 409-5/2005-FN dated 10.03.2006 (2 of 2006) (Seventh Amendment);

(viii) 409-2/2007-FN dated 21.03.2007 (2 of 2007) (Eighth Amendment);

(ix) 409-22/2007-FN dated 27.03.2008 (2 of 2008) (Ninth Amendment);

(x) 409-12/2008-FN dated 09.03.2009 (2 of 2009) (Tenth Amendment);

(xi) 409-8/2014-NSL-1 dated 23.02.2015 (1 of 2015) (Eleventh Amendment);

(xii) 409-8/2014-NSL-1 dated 24.02.2015 (2 of 2015) (Twelfth Amendment);

**Note 2**. The Explanatory Memorandum explains the objects and reasons of The Telecommunication Interconnection Usage Charges (Thirteenth Amendment) Regulations, 2017 (5 of 2017).

**Explanatory Memorandum to the "The Telecommunication Interconnection Usage Charges (Thirteenth Amendment) Regulations, 2017"**

## A. Interconnection

1. Interconnection allows subscribers, services and networks of one service provider to be accessed by subscribers, services and networks of the other service providers. If networks are efficiently interconnected, subscribers of one network are able to seamlessly communicate with those of another network or access the services offered by other networks. Without an effective interconnection, the market would develop as discrete islands and economic benefits associated with market expansion and liberalization would be limited. For competition to develop and the market to evolve efficiently, it is essential that subscribers of one network communicate with those of another network.

2. In a broader sense, the term interconnection refers to the technical and commercial arrangement under which service providers connect their equipment, networks and services to enable their subscribers to have access to the subscribers, services and networks of other service providers. Interconnection is the lifeline of telecommunications. It is one of the foundations of viable competition which in turn is the main driver for growth and innovation in telecommunications markets. Good interconnection arrangements promote efficient infrastructure development, providing incentives for operators to build networks and use other networks.

## B. Interconnection usage charges (IUC)

3. Interconnection Usage Charges (IUC) are wholesale charges payable by a Telecom Service Provider (TSP) to another telecom service provider (TSP), for terminating or transiting/carrying a call from its network to the network of the receiving TSP. The IUC mainly consists of termination charges, origination charges and carriage/transit charges. Briefly these are as follows:

### (1) Termination Charges

4. These are the charges payable by the originating service provider, whose subscriber originates the call, to the terminating service provider, in whose network the call terminates. When the customer of a TSP calls a customer on the network of a mobile or a fixed line operator, the TSP pays a wholesale charge to

the applicable mobile or the fixed line operator. These rates are known as "mobile termination charges" (MTC) and "fixed termination charges" (FTC) respectively. The method of collection of such charges varies by type of interconnection arrangement in place. If the mobile subscriber has to pay for both outgoing and incoming calls it is called Mobile Party Pays or MPP regime. In another regime called Calling Party Pays (CPP) regime, the subscriber who initiates the call only pays for the call.

**(2) International Termination Charge**

5. International termination charges are the charges payable by an International Long Distance Operator (ILDO), which is carrying calls from outside the country, to the access provider in the country in whose network the call terminates.

**(3) Origination Charges**

6. The call-originating service provider pays the carriage and termination charges for the calls from the tariff collected from the consumer and retains the residual towards the expenses of originating the call. This residual amount is called the origination charge. Where consumer tariff is under forbearance, origination charge is not specified. Keeping the origination charge under forbearance provides flexibility to the service provider in offering tariff.

**(4) Carriage/transit charges**

7. Inter-circle calls are carried by National Long Distance Operator (NLDO). The charges to carry calls from one service area to another service area are called carriage charges. When two telecommunication networks are not directly connected, an intermediate network is used through which the calls are transmitted to the terminating network. Such an intermediate network is known as the transit network and the corresponding charges are transit charges. <u>These charges were not part of this consultation process.</u>

**C. Arrangements before inception of IUC Regulations in India**

8. Initially, the Department of Telecom (DOT) was the sole provider of telecommunication services in India and therefore there was no need to share any revenue between telecom service providers. Subsequently, the telecom market was opened for private participation. Since more than one service

providers were now involved in completion of a call, there was a need to prescribe the manner in which revenue derived from telecommunication services would be shared between them. A revenue share regime was therefore put in place by the TRAI vide "The Telecommunication Interconnection (Charges on Revenue Sharing) Regulation 1999". Revenue sharing arrangements for calls originated from a mobile service provider's network terminating in a basic service provider's network, were specified. Revenue sharing arrangements were also prescribed between access service providers (both mobile and fixed) and long distance/international long distance service providers for carrying long distance/international long distance calls. Mobile subscribers were required to pay for receiving calls.

**D. Evolution of IUC Regulations:**

9. TRAI issued the first IUC Regulation on 24th January 2003 which laid down cost-based interconnection usage charges replacing the earlier revenue sharing arrangements. The Regulation became effective from 01.05.03. In this Regulation, the Interconnection Usage charges differed on the basis of type of network in which the call originated or terminated and the distance travelled in a particular network. However, in the process of implementation, various concerns with respect to the IUC regime such as sustainability of the IUC regime over time, consistency among the different Schedules of the IUC Regulation etc. were raised by service providers. For improving and streamlining the IUC regime further, TRAI issued a revised IUC Regulation on 29.10.2003. This Regulation superseded the IUC Regulation dated 24.01.2003 and came into effect from 1.2.2004. This Regulation prescribed a uniform termination charge of Re.0.30 per minute for all types of calls.

10. In 2006, TRAI reviewed the IUC after following a public consultation process and discussions with the industry. TRAI notified an amendment to the IUC Regulation on 23rd February 2006, which was implemented on 1st March, 2006. In this amendment to the Regulation, TRAI decided to place a ceiling on carriage charges while other IUC components were kept the same.

11. The next review of IUC components was undertaken by TRAI by issuing a consultation paper dated 31st December 2008. Amendment to the IUC Regulation was notified on 9th March 2009. This amendment became effective on 1st April 2009. In this amendment, the termination charge for local and national long-distance voice calls to fixed-line and mobile was revised

downwards from the erstwhile charge of Re.0.30 per minute to Re.0.20 per minute.

12. Some TSPs challenged the above regulations before the Hon'ble TDSAT. Hon'ble TDSAT passed its judgment on 29.09.2010 and directed the Authority to consider determining the IUC afresh, on the basis of its observations and directions. The Authority filed an appeal in the Hon'ble Supreme Court challenging the order of Hon'ble TDSAT on various technical and legal grounds including, inter-alia, the principal legal issue of whether the validity of TRAI's Regulation framed in exercise of powers conferred under section 36 of the TRAI Act, can be challenged before the Hon'ble TDSAT under section 14 of the TRAI Act, 1997. The Authority also prayed the Hon'ble Supreme Court to allow the appeal and set aside the final judgment and order dated 29.09.2010 passed by Hon'ble TDSAT. The Hon'ble Supreme Court passed an order that the Hon'ble TDSAT does not have jurisdiction on TRAI's regulations framed in exercise of powers conferred under section 36 of the TRAI Act.

13. As per Order of the Hon'ble Supreme Court, the Authority filed a report in the Hon'ble Supreme Court on 29.10.2011.Since neither Hon'ble TDSAT nor the Hon'ble Supreme Court had stayed the applicability of the IUC regime, which was put in place through the amendment in the IUC Regulation of 2009, the changes to the IUC regime put into effect by the Authority remained in force.

**E. Prevailing IUC Regulations**

14. After following a due consultation process, the Authority issued the Telecommunication Interconnection Usage Charges (Eleventh Amendment) Regulations, 2015 dated 23.02.2015, through which, the termination charges w.e.f. 01.03.2015 were prescribed as below:

**Table : Termination Charges prescribed through the Telecommunication Interconnection Usage Charges (Eleventh Amendment) Regulations, 2015**

| Type of call | Type of traffic | Termination charge |
|---|---|---|
| **Local and national long distance call** | Wireless to wireless | ₹ 0.14 per minute |
| | Wireless to wireline | 0 (Zero) |
| | Wireline to wireline | 0 (Zero) |
| | Wireline to wireless | 0 (Zero) |
| **International call** | International incoming call to wireless and wireline | ₹ 0.53 per minute |

* Wireless means full mobility, limited mobility and fixed wireless access services.

15. Subsequently, through the Telecommunication Interconnection Usage Charges (Twelfth Amendment) Regulations, 2015 dated 24.02.2015, which became effective from 01.03.2015, the Authority prescribed a ceiling for domestic carriage charge as ₹ 0.35 per minute.

## F. Regimes for retail charging of telecommunication services

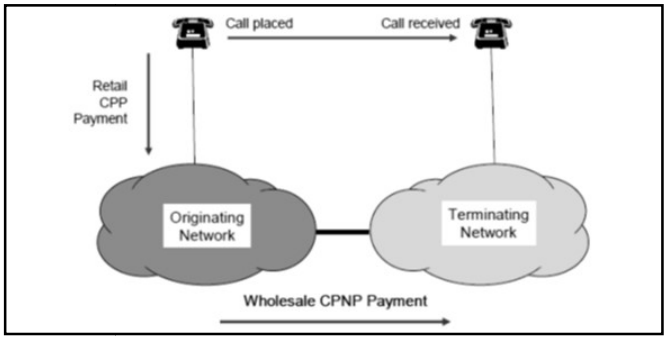
16. For retail charging of telecommunication services, there are predominately two regimes as outlined below:
    (i) **Calling Party Pays (CPP) Regime**: Under CPP, the calling party pays to his/her service provider for the call, while the called party does not have to pay for the call.
    (ii) **Receiving Party Pays (RPP) Regime**: Under RPP, the called party also pays for the call.

17. With retail charging regime as CPP, either of the following two regimes can be used for wholesale charging between TSPs:
    (i) Calling-Party-Network-Pays (CPNP) regime
    (ii) Bill-and-Keep (BAK) regime

### (1) CPNP regime

18. Under the CPNP regime, the originating TSP pays termination charge for terminating calls in the networks of other TSPs as indicated in the following figure.

**Figure: CPP and CPNP charging regimes**




19. Internationally, the CPNP regime is generally, implemented by setting cost-oriented or cost-based termination charges i.e. the termination charges are set to recover appropriate costs in roughly the manner in which the TSPs incur them. Cost-oriented or cost-based termination charges have an economic rationale; however, there is no single, simple way to estimate the termination cost. Such estimation is a complex exercise, even more so because most of the costs incurred by the TSPs may not even be relevant in the context of estimating relevant costs for terminating traffic. The moot question in a cost-based exercise is what are the relevant costs to be taken into account for determining the termination charge. A related issue is whether current costs or historical costs have to be considered. Lastly, there are a number of methodologies like Fully Allocated Cost (FAC), Long Run Incremental Cost (LRIC) plus and Pure LRIC, which are used in various jurisdictions across the globe. Therefore, the regulator has to choose the methodology to be used for determining IUC.

**(2) BAK Method**

20. In this method, a TSP does not have to pay any termination charge to its interconnecting TSP. Each TSP bills its own subscribers for outgoing traffic that it sends to other interconnecting TSPs and keeps all the revenue received from its subscribers.

## G. Prevalent Costing methods for estimation of cost-based or cost-oriented termination charges

21. The two most commonly used methods for estimation of domestic termination charges are (i) Fully Allocated Cost (FAC) Method and (ii) Long Run Incremental Cost (LRIC) Method. LRIC also has variants such as LRIC+ Method and pure LRIC Methods. These methods are briefly described below.

**(1) FAC method**

22. The core idea in the FAC method is to simply divide the total cost that the service provider incurs amongst the services it provides to arrive at termination charges. FAC is, generally, based on historic costs because accounting data reflect the firm's actual costs. In this method, shared and common costs are assigned to individual services or service elements. This method is generally used with top-down costing methodology. It uses accounting data submitted by service providers in their balance sheet, profit & loss account and accounting separation report.

**(2) LRIC method:**

23. In any LRIC method, termination cost is estimated on the basis of the following basic assumptions:

(i) The dimensioning of network is done for an equivalent TSP[1] i.e. a TSP who has a fair share in the relevant market.

(ii) This TSP incurs costs that would occur in a competitive market. Thus the method uses present costs i.e. forward looking costs.

(iii) The method of costing is long-run costing i.e. the size of the network deployed is reasonably matched to the level of network demand.

(iv) The method allocates the costs to wholesale services i.e. off-net incoming calls.

24. In the LRIC method, the network demand for an equivalent TSP is identified. In order to meet this demand, an efficient network is dimensioned. The costs of the various network elements are then computed on the basis of present costs. These costs are then allocated to wholesale service (i.e. off-net incoming minutes) in order to determine termination cost per minute.

| Termination cost as per LRIC method<br>= (Total annualized termination cost computed on a long-run incremental cost basis)<br>*divided by* (No. of off-net incoming minutes to be served in the year) |
|---|

25. In the LRIC+ variants, a certain portion of the common costs is also allocated for the purpose of computation of termination cost. The costs that are common to both the wholesale business and the retail business of the TSPs are termed common costs e.g. costs pertaining to the corporate office, head offices etc. This add-on is called the mark-up for common costs.

[1] An equivalent TSP is a representative TSP in each LSA. It has an average size, which can be determined through the Herfindahl-Hirschman Index (HHI).

| |
|---|
| Termination cost as per LRIC+ method<br>= (Termination cost as per LRIC method) *plus* (Mark-up for common costs) |

26. In the pure LRIC variant, the relevant increment is the wholesale call termination service and it includes only avoidable costs.

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|---|
| Termination cost as per Pure LRIC<br>= (Avoidable cost if wholesale termination service is not provided) *divided by* (No. of total off-net incoming minutes)<br>= (Total annualized cost for providing entire range of services *minus* Total annualized cost for providing entire range of service excluding wholesale termination minutes) *divided by* (No. of total off-net incoming minutes) |

27. A summary of the foregoing discussion yields the following conclusions:

(i) The LRIC method allows recovery of direct costs of providing the termination service.

(ii) The LRIC+ variant not only allows recovery of direct costs of providing the termination service but also a common costs is allocated to the termination service.

(iii) The Pure LRIC variant allows recovery of avoidable costs and is the most appropriate as it reflects the true cost of providing a service.

## H. Consultation process:

28. The Authority issued a Consultation Paper (CP) for Review of Interconnection Usage charges on 05.08.2016 to seek the views of stakeholders on various aspects of IUC. Stakeholders were asked to submit written comments by 05.09.2016 and counter-comments by 19.09.2016. On the request of some stakeholders, the dates for submission of comments and counter-comments were extended up-to 17.10.2016 and 31.10.2016 respectively. Written comments were received from five industry associations, 12 TSPs and 6 other stakeholders, including companies, organizations, firms and individuals. Counter-comments were received from four TSPs and one association. The comments and the counter-comments received from the stakeholders were placed on the TRAI's website– www.trai.gov.in.

29. In the CP dated 05.08.2016, the Authority had sought the views of stakeholders on the following broad issues related to IUC:

a. In view of the recent technological developments in the telecommunication services sector, which of the following approaches is appropriate for prescribing domestic termination charge (viz. mobile termination charge and fixed termination charge) for maximization of consumer welfare (i.e. adequate choice, affordable tariff and good quality of service), adoption of more efficient technologies and overall growth of the telecommunication services sector in the country?

(i) Cost oriented or cost based termination charges; or

(ii) Bill and Keep (BAK)?

Please provide justification in support of your response.

b. In case your response to the Q1 is 'Cost oriented or cost based termination charges', which of the following methods is appropriate for estimating mobile termination cost?

(i) LRIC+

(ii) LRIC

(iii) Pure LRIC

(iv) Any other method (please specify)

Please provide justification in support of your response.

c. In view of the fact that the estimates of mobile termination cost using LRIC method and LRIC+ method yielded nearly the same results in year 2011 (as filed in the Hon'ble Supreme Court on 29.10.2011) and in year 2015 (as estimated for the Telecommunication Interconnection Usage Charges (Eleventh Amendment) Regulations, 2015 dated 23.02.2016), would it be appropriate to put to use the estimates of mobile termination cost arrived in the exercises of year 2011 and year 2015 in the present exercise?

d. If your response to the Q3 is in the negative, whether there is a requirement of running the various LRIC methods afresh using the information on subscriber, usage and network cost for F.Y. 2015-16 for estimation of mobile termination cost?

e. In what manner, the prescription of fixed termination charge as well as the mobile termination charge from wire-line networks as 'zero' through the Telecommunication Interconnection Usage Charges (Eleventh Amendment) Regulations, 2015 is likely to impact the growth of the Indian

telecommunication services sector as a whole? Please support your viewpoint with justifications.

f. Whether termination charges between different networks (e.g. fixed-line network and wireless network) should be symmetric?

g. Which approach should be used for prescribing International Termination Charge in the country? Should it be kept uniform for all terminating networks?

h. Whether, in your opinion, in the present regulatory regime in the country, the stand-alone ILDOs are not able to provide effective competition owing to the presence of integrated service providers (having both ILDO and access service licenses) and, therefore, there are apprehensions regarding sustainability of the stand-alone ILDOs in the long-run?

i. If your response to the Q8 is in the affirmative, which of the following approach should be used as a counter-measure?
   (i) Prescription of revenue share between Indian ILDO and access provider in the International Termination Charge; or
   (ii) Prescription of a floor for international settlement rate (levied by ILDO upon the foreign carrier) for international incoming calls; or
   (iii) Any other approach (please specify)
   Please provide justification in support of your response.

j. Is there any other relevant issue which should be considered in the present consultation on the review of Interconnection Usage Charges?

30. The Authority on 15.12.2016 further asked TSPs to submit detailed information related to cost network element used in providing services, subscriber base, Minute of Usage, data usage etc. The Authority also asked TSPs to furnish information on traffic during different hours of a day on 27.1.2017.

31. The Authority wanted to listen to the viewpoints of all the TSPs prior to the discussion in an open house. Therefore, a one-day workshop was held on 18.07.2017 at Delhi to discuss the issues threadbare with the TSPs. Subsequently, an Open House Discussion was held on 20.07.2017 at Delhi to discuss the issues with other stakeholders.

32. During the workshop, TSPs have presented their preferred cost methodology before the Authority and other TSPs. They were allowed to comment/question on the method/cost data presented by each other. The issues raised in the CP and the views of stakeholders thereon are examined in the succeeding paragraphs.

## I. Analysis of issues:

### (1) Approach to be used for Termination Charges

33. A few of the TSPs and a few other stakeholders have favored a regime of cost-oriented termination charges. They have argued that in India, where the CPP regime has been adopted for retail tariffs, market players can be compensated for their work done in terminating off-net incoming calls only, through a cost-oriented termination charge regime.

34. On the other hand, a few TSPs and some stakeholders have favoured a Bill and Keep (BAK) regime. They have argued that termination charge acts as floor for retail tariff. They also contend that a BAK regime would prevent incumbent TSPs from recovering their costs of operations from their competitors and, thereby, would enable greater competition in the sector. Supporters of BAK regime argue that BAK provides a solution to address the issue of market power of call-terminating networks. They also argue that the theory and practice of identifying an optimal termination charge is complex. The result is that any determination of a termination charge, even if done with great care and at a cost, could be disputed by a set of TSPs who perceive it to be loaded against them. Various factors like determination of costs, the method of allocation, determining costs sensitive to traffic volumes and the extent to which different products/ services should contribute to common costs, etc. can, at times, be debated. They further argue that a termination charge becomes an effective floor for retail tariffs. BAK helps to remove this barrier to retail pricing for off-net calls (i.e. inter-TSP calls) and has been proven to result in significantly higher levels of calling activity as TSPs are given the flexibility to offer innovative customized tariff plans to their subscribers.

35. They have also argued that the cost of terminating voice traffic in most modern (and in even hybrid) networks is close to zero and negligible and therefore any cost-based method is not relevant anymore. Moreover, as the modern networks are being majorly built for data capacities, there is no incremental cost attached to voice termination or origination. Further, they have argued, that the

continuance of IUC has the counter effect of benefits of the technology not being passed onto the subscribers.

36. At the same time, it is argued by the detractors of BAK method that BAK may result in 'a race to the bottom' in which case the TSPs may be incentivized to set prices well below costs to enter new market segments and capture larger market share. This may result in inadequate investment in network infrastructure and consequent inefficiencies in capturing positive externalities.

37. The establishment of an IUC regime is an activity that has far reaching consequences for the telecommunications sector. It is an important tool for giving the desired direction and impetus to growth of telecom services. It can enable competition, increase consumer welfare, ensure sustained growth of telecommunications and thereby promote the economic development of the country. Although termination charges are wholesale inter-operator tariffs and not directly the retail tariff of customers, it would be naïve to assume that they have no bearing on the retail tariff.

38. The Authority noted that during the last exercise, it did not find merit in implementation of BAK regime for wireless to wireless calls. However, it would be worthwhile to re-examine the suitability of BAK with the latest technological trends in the mobile telephony.

**Technological Evolution**

39. Traditionally, voice calls have been carried over public switched telephone networks/ 2G network using circuit switched (CS) networks. In Circuit Switch networks, the communication takes place over a dedicated circuit. However, in recent times, TSPs have built packet-switched (PS) networks (not limited to but include 4G network) to carry voice. The Packet Switch networks differ from Circuit Switch networks in that they group all transmitted data into suitably sized blocks, called packets, which are routed independently of their respective destinations. This means that in a Packet Switched based voice call, there is no single dedicated network path reserved for the call; instead, various paths can be used in parallel while other services such as video and data may be carried over the same paths. A Packet Switched voice call is typically carried over Internet Protocol (IP) and is typically referred to as a Voice over IP (VoIP) call. Naturally, Since Packet switched based call uses latest IP technologies and voice travel in the form of data, it become cost effective for TSPs. TSPs world over are rapidly migrating to such technologies in their access/ radio network. It is worthwhile to

mention that most of the TSPs have already migrated to IP technologies in their backhaul and backbone network.

40. In India, the telecom sector is currently going through a phase of rapid modernization and advancement. The old technologies are being replaced by more efficient new technologies. All major service providers have either committed to IP based LTE networks or have declared plans of doing so in the future. Voice calls, in future, will be provided using IP-based technology, which is the most efficient mode of delivery by any available parameter, be it cost, quality or efficiency of delivery. One mobile operator has started voice service using the technology of Voice-over-LTE (VoLTE) at a very large scale. The largest operator in the country has also launched VoLTE services while the other operators have announced plans to launch VoLTE services shortly. Incidentally, these are the large service providers whose networks witness maximum off-net terminating calls. Similarly, a few wire-line TSPs have started voice over their managed IP networks/ NGN access networks.

41. Further, under the current licensing framework in the country, the access service providers can also provide 'Internet Telephony'. When voice is transmitted over public internet, it is termed as Internet Telephony. When a TSP uses Internet Telephony for terminating a call to its subscriber, the receiving party separately pays for the data transfer done in receiving the call. Thus, a TSP can, potentially, deliver a voice call reaching at its point of interconnection to its subscriber either as (i) Circuit Switch call (ii) Packet switched call/VoLTE call (or call over managed IP) (iii) Internet telephony call.

42. During the workshop, on the one hand, one leading operator presented that cost of terminating the call in all IP network is close to zero (0.11 paisa per minute). On the other hand, some other operator who has mix of 2G/3G technologies submitted that cost of termination of call in their network is very high compare to this. The Authority noted the difference of cost of call in packet switched network and circuit switched network calls. The difference in cost of delivery would be accentuated in case of an Internet Telephony call. It is essential for the Authority to promote technologies with lesser costs so that consumers can benefit from lower tariffs. With a view to promoting new and more efficient technologies, the Authority is expected to be forward looking and base its regulations on the most efficient technology.

43. The Authority further noted the general direction of telecommunication services sector is towards Packet switched networks and Internet Telephony where voice

calls would be transported as data. In Internet Telephony, the call receiving party may have to pay data charges while receiving a call. At this juncture, one may be tempted to ask – Does CPP regime (which requires that the call receiving party pays nothing for the call) still hold good?

44. The Authority has taken note of the submissions of some stakeholders that there is no need to depart from the time-tested principle of cost-based domestic termination charge in the short-run when the underlying network is predominantly CS network at present and only a small part of it is likely to be replaced with PS network and Internet Telephony in near future.

**Incentive for Technology Upgrade**

45. The Authority examined that when clear demonstrable large difference exist in the cost of providing same services, why TSPs are not migrating to newer technologies such as VoLTE.

46. With the evolution of technology and convergence, more and more networks are migrating towards IP network worldwide. Regulators the world over are working towards facilitating mi**g**ration towards Next Generation Networks (NGN) which will be IP based networks so that innovative services could be provided to the customers. In Internet networks which are IP based networks there are no interconnection charges and networks can connect globally without any need for interconnection charges. The Authority is of the view that termination charges work as disincentive to deployment of new technologies such as VoLTE and migration to IP networks by operators. Moving towards BAK will encourage adoption of latest technologies and the deployment of IP-based telecom networks. Since IP based networks are poised to be the networks of the future for providing telecom services, a BAK regime should be seen as a natural facilitator for the development of technology.

47. Accordingly, The Authority is of the view that in case the present regime of cost-based domestic termination charge is continued for long, it would hamper the movement of the sector towards (i) deployment of more efficient technologies; and (ii) more innovative and customer friendly tariff offerings; and, in turn, it would be detrimental to the growth of telecommunication services sector. In case, a TSP continues to get a cost-oriented termination charge estimated on the basis of yester-years' network technology (such as 2G or 3G), where is the

incentive for him to migrate towards a more efficient network technology (such as 4G) requiring capital investments in short-run.

48. The Authority further noted that more than 80% of the spectrum held by various service providers is liberalized spectrum wherein they can use any technology of their choice. Since 2010, Operators are acquiring spectrum which can be used for 3G/4G technologies. The Authority further noted that there are no new networks launched using the standalone 2G technology in the past five years. Practically all telecom service providers have embarked upon the path of modernizing their networks. This is to carry traffic on IP in major Parts of their network and to cater to the requirements of the market. Operators are increasingly running their networks for data services and voice is becoming a by-product. IP based technologies are primarily for data services with voice running as an application. As data for demand has been increasing, the share of voice will keep on reducing and there would be hardly any cost to carry voice traffic, including terminating traffic.

49. As mentioned above, the cost of terminating the call in packet switched network is so small that if majority of operators move to packet switched technologies there would be no need to fix the termination charge and it will virtually amount to BAK. BAK or sender-keeps-all is a method of interconnection pricing in which the originating service provider keeps the revenue billed i.e. there is no settlement of termination charges for off-net calls.

**Consumer Tariffs**

50. It has been observed that reducing termination rates has benefitted consumers and enhanced competition. Going the full distance i.e. reducing terminating rates to zero by introduction of the BAK regime would help in immediately realizing these benefits. The Bill and Keep regime will encourage flat rate billing and time differentiated charges, both of which will improve capacity utilization and will be in the interest of consumers. It will also reduce the inter-operator off-net traffic imbalance, and thus could help in convergence to an equilibrium situation.

51. The Authority further analyzed the case of suitability of BAK regime in the country. The Authority observed that when a TSP establishes a network, it is not only for sending but also for receiving calls. The operator, therefore, does not do anything special or extra to provide for receiving another service provider's calls.

Thus, additionality of costs for receiving calls, in the strictest sense, is close to zero. The revenue from termination charges does not go to pay for any specific additional expenditure caused by the call termination, but it is just a partial compensation of the total costs incurred for creating and operating the network. Measuring costs caused by another service provider's incoming calls is more challenging and there is no general agreement across regulators as to any single methodology that can be adopted to arrive at the termination price. Depending on the methodology used, the result is different. There is, therefore, a case for introduction of a Bill and Keep regime.

**Pro-Competition**

52. BAK provides a solution to address the issue of market power of call terminating networks. When a call is placed to a particular consumer of the terminating network, the originating network typically has no choice but to purchase the termination service of the terminating operator to which the called party belongs. Thus networks that terminate calls to their subscribers have market power in respect of the terminating call.

53. BAK represents an approach to interconnection charging in which the networks recover their costs only from their own consumers rather than from their interconnecting operators. In respect of cost recovery under BAK, the European Commission made the following observations:

> *"Given the two-sided nature of call termination, not all related termination costs must necessarily be recovered from the wholesale charge levied on the originating operator. Even if wholesale termination rates were set at zero, terminating operators would still have the ability to recover their costs from non-regulated retail services. Rather it is a question of how these financial transfers are distributed across operators in a way that best promotes economic efficiency to the benefit of consumers."* [2]

54. The Authority has observed a clear trend in the market of very low tariffs for on-net calls and higher tariffs for off-net calls, especially from the incumbent operators. The justification offered by these operators is that they incur cost of IUC for off-net calls. It is intriguing because there should also be a cost for on-net calls as work done for terminating call is the same. This price differential,

[2] EC recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in EU (Draft commission Staff Working Document Explanatory Note(Brussels, 2008) http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/termination_rates/explanatory.pdf)

which is higher than the IUC rate, is clearly a way for incumbent operators to subsidise on-net calls, and is anti-competitive. Moving to BAK method will result in elimination of price differential between on-net and off-net calls and will reduce overall tariffs for customers. The elimination of IUC will result in direct benefit to customers through lower tariffs.

55. The theory and practice of identifying an optimal termination charge is complex. The result is that any conclusions on termination charge, even if arrived at with great care and at a cost, could be disputed by a set of operators who perceive it to be against them. Various factors like determination of costs, method of allocation, determining costs sensitive to traffic volumes and the extent to which different products/services should contribute to common costs, etc. can at times be debated.

56. A termination charge becomes an effective floor for retail tariffs. BAK helps to remove this barrier to the retail pricing for off-net calls (i.e. inter operator calls) and has been proven to result in significantly higher levels of calling activity as operators are given the flexibility to offer innovative customized tariff plans to their consumers.

57. The European Commission also summarized the advantages often associated with BAK, in particular that:

> *"Bill and Keep obviates the need for regulatory intervention and resolves the termination bottleneck. Moreover, it is further argued that Bill and Keep leads to lower retail prices for call origination and appears to increase usage due to the price elasticity of demand. Furthermore, proponents of Bill and Keep consider that it facilitates development of innovative offers, e.g. flat-rate offers promoting increased usage. It also brings immediate benefits by decreasing transaction and measurement costs. Finally, Bill and Keep takes account of the call externality."* [3]

[3] EC recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in EU (Draft commission Staff Working Document Explanatory Note(Brussels, 2008) http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/termination_rates/explanatory.pdf)

**Traffic Asymmetry**

58. One argument is BAK does not lead to optimal outcomes where traffic flows between operators is asymmetric. Traffic balance can be expected if termination rates and retail prices, notably the relative on-net and off-net prices, are approximately set to theoretically optimal levels. This is because individuals' propensity to call each other, if undistorted by artificial price differentials, would be unlikely to vary between networks in a way that would lead to traffic imbalance. In fact, the pricing method itself can influence whether or not traffic is in balance. The asymmetry in traffic in a healthy competitive environment will always exist to some extent.

59. In fact, BAK will be a catalyst for traffic symmetry. It gives TSPs appropriate incentives to serve their customers efficiently and brings market discipline to competition. The cost methodology based IUC system implies that TSPs recover network costs from competing TSPs through IUC charges. This system confers monopoly power on the called party's TSP with respect to call termination without providing any incentive for reducing its costs through efficient operations and adoption of low cost technologies. This monopoly status also leads to disparity in on-net and off-net tariffs thus creating an unnecessary tariff asymmetry. While this monopoly power enabled TSPs to charge above-cost rates, BAK's dependence on customer payments discourages a TSP from charging high rates to its subscribers because they could, in turn, seek lower prices from competing TSPs. This leads to a situation where no TSP can charge above cost thus bringing in tariff symmetry. This tariff symmetry stops the arbitrage in on-net and off-net tariffs, leading to a symmetry of traffic. Evidently, the demand for cost-based IUC till there is traffic symmetry is a vicious circle. Only by removing the cost based IUC, this vicious circle can be broken.

60. The other opposition to BAK is that it has never been attempted or is not compatible in a CPP regime. It is relevant to point out here that BAK is a wholesale charging regime and is applicable in both RPP and CPP regimes, leaving discretion to operators on how to charge own customers and how to recover the termination costs, if any. Even in RPP countries, many operators are offering free incoming calls as part of their service offerings thus effectively implementing BAK with CPP.

**OTT Applications**

61. Another aspect that the Authority has considered is the rapid rise of OTT applications being used for voice services. The telecom service providers have

approached the Authority in recent times regarding the impact of OTT applications on their voice and SMS revenues. The OTT applications are able to deliver voice communication at a much cheaper cost than traditional voice networks (2G). It is not disputed that the cost of voice turns out to be fraction of a paisa per minute on the OTT applications and will continue to decline as data rates reduce with implementation of new technologies.

62. In this backdrop, it would be virtually impossible for a telecom service provider to compete against the cost effectiveness of an OTT application, if an additional cost in the form of MTC is imposed. The best way for the telecom service providers to compete would be to reduce their cost to the levels of the OTT applications while maintaining superior quality. This is feasible if all the service providers roll out advanced IP-based networks and bring down their costs, which would also result in MTC becoming redundant.

63. Another issue with proposing any MTC at a time when the OTT applications are becoming more popular is that any customer with an ability to use these OTT applications (smart phone users) will switch from the networks of the service providers thus causing reduction in traffic on their networks. Thus, the cost of the service providers would now need to be borne by the feature phone users who do not have the ability to use OTT applications. This would give rise to a peculiar situation where cost of services for low-cost feature phone users would actually end up being higher than cost of services for smartphone users. The BAK regime would encourage operators to invest in new technology and bring down the cost of voice services close to nil.

64. In view of the foregoing discussion, the Authority believes that BAK will not only strengthen the competitive framework but also ensure better tariff offerings for end consumers maximizing economic value for their telecom spend.

65. Now important question arises as to what is most suitable time frame when BAK regime should be implemented in the sector. The recent trend shows that TSPs are going to adopt packet based technologies very soon. As most of the spectrum they possess allows them to use any technology, they have no reason to delay the process of adoption of new technologies as it ultimately reduces their total cost of operation. As mentioned earlier, there is hardly any cost in termination of the call in packet based technology. However, this migration or adoption of new technologies can not happen overnight. The Authority feels that it would be appropriate if 2 years are given them for migrating to new technologies. After 2 years, majority of the calls will be terminating on the packet based technology in

which voice will be like an application. Therefore, the Authority is of the view that India should adopt BAK regime from 01.01.2020.

66. Now next question arises that what should be the methodology to estimate the mobile termination charge for the period before BAK is implemented in the country. Following paragraphs examine the methodology for estimation of termination charge for the intervening period.

**(2) Methodology for termination charge:**

67. On this issue of methodology used for estimation termination charge, stakeholders have expressed widely divergent views. While some stakeholders have favored the Fully Allocated Cost (FAC) method, many others are in favor of the variant of Long Run Incremental Cost (LRIC) method viz LRIC+ and pure LRIC.

68. The supporters of the FAC method opined that this method assures the recovery of the entire cost, including historical costs, and is a more credible method because it relies on the actual data furnished by the TSPs. They have contended that most variants of the LRIC method consider only incremental cost and, therefore, do not entirely (or, adequately) compensate the full cost; besides, the LRIC method is based on a large set of assumptions on network parameters and, therefore, lacks robustness and is not as sturdy as the FAC method. This method has been long discarded in India as well as internationally and merits no consideration. While abandoning this cost methodology, the Authority had earlier noted that:

*"In most countries of the world, the MTC was traditionally determined with the help of FAC methods using historical costs. Most regulators seek Accounting Separation Reports (ASRs) from the TSPs in their respective countries. These reports contain, inter-alia, segregated costs for various services. Based on the ASRs, many regulators computed MTC per minute as 'the relevant annual cost for providing voice telephony' divided by 'annual voice minutes'. However, as telecom markets started growing, the traffic increased manifold while the relevant costs, particularly the network-related costs, started declining owing to the march of technology and economies of scale. Though market costs of telecom networks declined significantly, incumbent TSPs continued to carry historical costs, albeit depreciated, on their balance sheets. Since the incumbent TSPs had an incentive for gold-plating their costs, the information on costs furnished by them in the ASRs started becoming more and more removed from the actual level of current costs. Further, ironically,*

*the incumbent TSPs were being rewarded for their inefficiencies, if any, in running their networks; this is because full historical costs were being recovered through the MTC."*

69. There are numerous shortcomings of the FAC method which have been identified by regulators and economists the world over. Some of the important ones are summarized below:

    a. FAC method passes on the inefficiencies of operators and deprives consumers of the benefits of newer technologies. Though market costs of telecom networks declined significantly, operators continue to carry historical costs as per their balance sheets. Hence, FAC provides incentive to operators for gold-plating their costs.

    b. FAC method are based on operators' accounts. This makes regulation arbitrary, results in exaggerated costs and harms consumers.

    c. The core of FAC method is the allocation/ attribution of total cost to different services, which is done by allocation/ attribution keys. The difficulties to define and quantify the allocation keys are significant and can only be done by the operators. Operators can allocate too much costs to incoming interconnection traffic leading to exaggerated IUCs.

    d. A further obstacle for FAC method is the difficulty to exclude inefficiencies. These inefficiencies result from inadequate technologies, inappropriate business models, historic costs (sub-optimal decisions in the past) etc. In a FAC method, it is impossible to eliminate these inefficiencies and hence, IUCs are always exaggerated.

70. A few stakeholders have stated that amongst the variants of the LRIC method, the LRIC+ is the most suitable. On the other hand, many stakeholders have favored the Pure LRIC method stating that this method would yield the most appropriate cost of terminating voice call which would, in turn, help the TSPs to provide competitive tariffs in the market. It is worth mentioning that many TSPs and the Cellular Operators Association of India (COAI), who have supported the FAC method in the present consultation process, had favoured the use of LRIC method in TRAI's consultation process of 2008-09. Some TSPs also presented their preferred methods in the workshop held on 18.07.2017.

71. One operator also submitted that The Competition Commission of India vide Determination of Cost of Production Regulation, 2009 has adopted pure long run average incremental cost based method for the purpose of calculating the cost of goods and services to maintain the competition efficiency in the market .

72. The operator further submitted that the list of national regulatory authorities worldwide, who have applied cost-based pricing for mobile termination, is too long to include here, but included leading regulators such as OFCOM (UK), ARCEP (France), ACCC (Australia), ICASA (South Africa), MCMC (Malaysia) and ANATEL (Brazil).

73. The operator submitted that currently, 26 National Regulatory Authorities in the European Area (EEA) have implemented the Recommendation for mobile termination rates and have pure-LRIC-based mobile termination rate applicable. Following table depicts the list of countries adopted pure LRIC costing method for estimation of mobile termination charges.

Table - Adoption of Pure LRIC Model globally

| **Pure LRIC implemented** | **MTR rates via benchmarking of other countries that applied pure BU-LRIC** |
|---|---|
| Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Greece, Hungary, Italy, Luxembourg, Malta, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. | Cyprus, Estonia, Iceland, Latvia and Lithuania |

74. The afore-mentioned operator further submitted that Pure LRIC has also been adopted by regulators outside the European Union, such as those in Norway, Jamaica, Kenya and Tanzania. Only two countries do not follow the Recommendation for MTR within the EU (Finland and Netherlands). The example of European Union is being considered here as our regulatory frameworks have evolved in a rather similar fashion.

75. During the consultation process, one of the TSPs has stated that as per the Reports of consulting firm Ovum Ltd. titled 'Ovum Interconnect Benchmark Q3 2014' and 'Ovum World Cellular Information Service Q3 2014', the ratio of IUC for mobile termination relative to retail price in India is approximately 45% as

compared to 13% in Germany and Japan, 11% in France, less than 10% in UK and 1% in China.

76. The Authority analyzed all the submissions of stakeholders and methods presented before it and also discussed internationally prevalent methods for estimation of termination charges. The Authority observed that in view of the international practices and advantage associated with LRIC, it has already estimated Mobile Termination charge using LRIC methods in 2011 and 2015. The International trend is that countries are moving from FAC to LRIC and not vice versa. Many European countries have already migrated to pure LRIC and therefore going to FAC will be retrograde step. Only issue remains which variant LRIC plus or Pure LRIC to be used for estimation of termination charge now.

77. In the LRIC method, the network demand for an equivalent TSP is identified. In order to meet this demand, an efficient network is dimensioned. The costs of the various network elements are then computed on the basis of present costs. These costs are then allocated to wholesale service (i.e. off-net incoming minutes) in order to determine termination cost per minute.

78. In the LRIC+ variants, common costs are also allocated for the purpose of computation of termination cost. The costs that are common to both the wholesale business and the retail business of the TSPs are termed common costs e.g. costs pertaining to the corporate office, head offices etc. This add-on is called the mark-up for common costs.

79. In the pure LRIC variant, the relevant increment is the wholesale call termination service and it includes only avoidable costs. Pure LRIC measures avoidable cost for carrying off-net incoming minute i.e. service specific costs that arise from the increment of all off-net incoming minutes.

80. As mentioned above, in LRIC+ method, common cost is also allocated in computation of termination charge. Allocation of common costs in termination of voice calls was appropriate when market was voice driven. Now when data which is increasing exponentially , has also become important source of revenue for the operators, using any methodology which allocates common costs to voice service may not be appropriate.

81. Avoidable cost basically refers to the cost that operator would not have incurred, if it was not providing wholesale call termination service to other operators. Thus

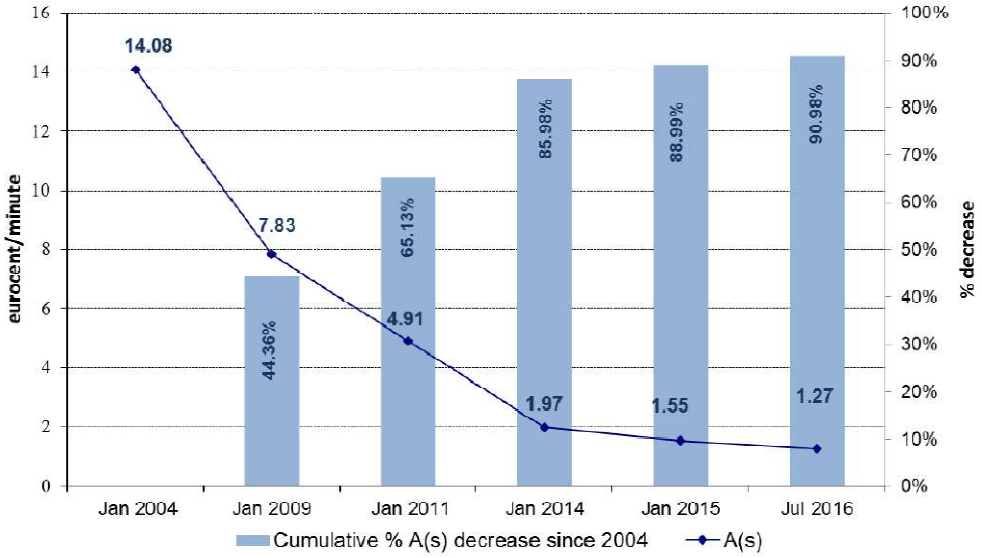
the avoidable cost is the difference between the network costs (CAPEX and OPEX) of an operator providing its full range of services and the network costs (CAPEX and OPEX) of that operator providing its full range of services except for the wholesale call termination service to the other operators.

82. Thus the pure LRIC method allows the recovery of only those costs which would be avoided if a wholesale call termination service is not provided to the other operators.

83. It is obvious that the money receiving TSPs will use this "free money" to subsidize their on-net calls i.e. calls made within their network, thus trying to further increase the disparity in size and consequently increasing monopoly power. Until now, reducing IUC has been pro-competition and happened to also favour smaller network companies. The Authority is of the view that objective of competition and efficiency will be served by aligning termination charge with marginal costs.

84. As per the Report of Body of Electronic Regulators for Electronic Communications (BEREC) titled 'Termination Rates at European Level (July 2016)', there has been a steady decline in mobile termination rates in Europe. The following chart depicts the declining trend in the level of mobile termination rates in Europe.

**Figure 12 European MTRs simple average cumulative decline**



85. In India also, the termination charges have followed a downward trend since their first introduction in 2003. The steady decline in consumer retail tariff rates has coincided with a fall in termination rates during the same period. India has among the cheapest mobile call charges in the world. This has fuelled an explosive growth in the subscriber base through adoption of mobile telephony by the masses.

86. Lower termination charges are therefore likely to benefit consumers overall (both fixed and mobile) because operators will have greater retail pricing flexibility. Operators would be able to offer consumers a wider variety of retail packages and tariff structures.

87. While on the one hand a lower termination charge benefits the consumer, it does not have a negative effect on the telecom operator because it is open to the operator to recover whatever cost it incurs through the retail tariffs, subject to competitive market conditions.

88. Therefore, it is not mandatory for the regulator to cover the full cost of the termination network in the termination charge. A well-designed IUC regime would cover the relevant cost reasonably and provide reasonable incentive to service providers to enable them to offer innovative tariff plans.

89. In case termination charges are higher than cost, the service providers would be able to offer subsidies to customers on retail tariff. Lower termination charges would ameliorate possible concerns regarding exercise of market power by incumbents through on/off-net price differentials. On-net calls are that originates and terminates on the same operator's network. Off-net calls are calls that originate in one operator's network and terminate in another operator's network. Specifically, the concern that large incumbent operators are able to subsidise on-net traffic due to the prevailing rates of termination charge will to a large extent be addressed by a lower termination charge.

90. In a market with asymmetric traffic flows, termination charges set at higher levels than cost become a source of revenue for operators who terminate more traffic on their networks (usually incumbents and larger operators). On the other hand, it is an item of cost for small operators and new entrants. In view of the foregoing discussion and following reasons, The Authority is of the view that pure LRIC is the best method to estimate the mobile Termination cost now on for reasons enumerated below:

(i) Pure LRIC is now the preferred approach of regulators in Europe and other parts of the world for setting mobile termination charges prior to implementation of BAK.

(ii) This cost based approach is based on the 'Avoidable Costs' concept as recommended by the European Commission and being implemented by European regulators

(iii) The setting of IUC to a level of avoidable cost is the least intrusive solution to reduce the anti-competitive behaviour in the market

(iv) This methodology provides the best conceptual framework for estimating the marginal cost of interconnection which ensures operators are compensated for their avoidable costs related to terminating off-net calls in their network.

(v) Pure LRIC cost based approach to setting MTCs is economically efficient and transparent and benefits consumers.

(vi) The pure LRIC approach will reduce the ability of larger operators to discount on-net calling while recovering a proportion of their costs from other operators through the inflow of mobile terminated minutes.

(vii) The pure LRIC approach to MTCs improves the ability of smaller operators to offer flat-rate any-network calling. The resulting increase in competition will benefit consumers and improve dynamic efficiency.

(viii) Pure LRIC based MTCs do not contribute to network common costs that are also supporting data and other origination services, meaning that their operators will need to consider the provision and pricing of coverage and capacity for retail services un-subsidised by incoming MTCs.

91. The Authority has also noted that those who are opposing the LRIC method, their main grievance is with respect to assumptions used in the LRIC method. In fact some of the TSPs have also written to Authority that this is a hypothetical model. The Authority observed that this argument of the TSPs is not correct. The Authority has not made any model for an efficient Hypothetical operator as is done in some of jurisdiction across the globe. In fact, to overcome this shortcoming of the LRIC method, the Authority had estimated the mobile termination charge for an average operator using the industry actual data in 2015 and same approach of using actual industry data for 2016-17 has been used herein for estimating the mobile termination charge. Therefore, the argument of the opponents of LRIC method that it uses a lot of assumptions and a network is created for an efficient hypothetical operator is not correct.

92. Some of the operators also submitted that spectrum cost should be taken into account while estimating termination charge. The Authority examined

international practise in this regard and observed that Pure LRIC method explicitly excludes the common cost and spectrum cost. 'Mobile Call termination market review 2018-2021' of OFCOM ( UK telecom Regulator) clearly stated that: *"Long Run Incremental Cost (LRIC) measures the incremental cost to an operator of providing a service in the long-run. It includes the variable and fixed costs associated with the service increment in question, in this case MCT. LRIC+ includes a mark-up for joint and common costs, such as the cost of the spectrum used by the network. By definition, the LRIC standard, as currently used to set the charge control, does not include such a mark-up."*

93. On the basis of the methodology as already explained in the consultation paper on IUC and actual data collected from TSPs, the Authority estimated Mobile termination charge. The details of each network element considered, their cost and method is annexed as Annexure to the Explanatory Memorandum of the Regulations.

94. All calculations have been done on the basis of cost data, subscriber base, MoU etc for the quarter ending 2016 as data from TSPs were collected for this period only, for calculation of the termination charge. If these numbers are projected for the period for which prescribed termination charge is applicable, the termination charge will be further reduced. However, the Authority refrains itself from using the projections as these create subjectivity in the estimation.

**(3) Outcome of Authority's Analysis**

95. Establishment of a clear outlook for IUC would provide regulatory predictability and enable service providers to plan their networks and businesses accordingly. The Authority has come to the conclusion that the termination charge for the domestic mobile to mobile call should be fixed at six paise per minute (as obtained on the basis of Pure LRIC Method) effective from 01 October 2017.

96. Further, the cost of termination of calls will drastically come down over a period of two years and very small residual value, if any, can be absorbed by the TSPs in their tariff offerings. As a result, the Authority prescribes a Bill and Keep regime for the wireless to wireless calls effective from the 1st January 2020.

97. Accordingly Authority is of the view that -

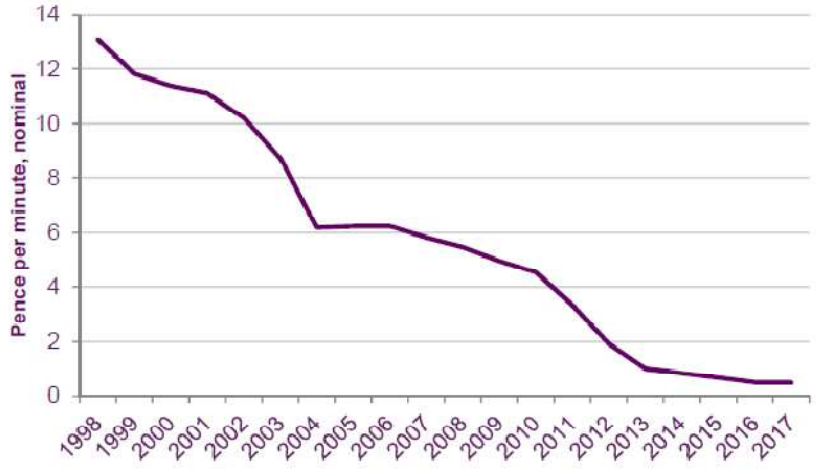
(a) Wirless to wireless termination charge should be reduced from existing 14 paisa per minute to 6 paisa per minute

(b) Bill and Keep (BAK) regime should be implemented for all types of domestic calls from 01.01.2020.

98. The Authority shall keep a close watch on the developments in the sector particularly with respect to the adoption of new technologies and their impact on termination costs. The Authority, if it deems it necessary, may revisit the afore-mentioned scheme for termination charge applicable on wireless to wireless calls after one year from the date of implementation of the Regulations.

99. The reduction of mobile termination charges from Re. 0.14 per minute to Re. 0.06 per minute w.e.f 01.10.2017 will amount to a reduction of about 57%. Such a revision in the mobile termination charge is in line with the international trends. As per the Consultation Paper of OFCOM titled 'Mobile call termination market review 2018-21', there is a declining trend in mobile termination rates in the UK, starting from 24 pence per minute (ppm) in 1995 to less than 1 ppm in 2014; the sharpest reduction in mobile termination rates in percentage terms occurred in 2015. It reduced the wholesale cap by around 80% over a three year glide-path. The following Chart depicts the decline in mobile termination rates in the UK from 1995 to 2017.

**Figure 1: Average MTR in the UK (nominal pence per minute, weighted by subscriber numbers)**




*Source: Ofcom.*

100. The Authority is of the view that after the reduction in the termination charge from Re. 0.14 per minute to Re. 0.06 per minute, the termination charge as a

percent of retail tariff would become about 20%, which would be in line with the international trends as described in the paragraph 75 above.

101. The reduction in the mobile termination charge is likely to yield consumer benefits. As described in the Consultation Paper on 'Review of Interconnection Usage Charges' dated 05.08.2016, the average outgo per outgoing voice minute declined from Re. 0.50 per minute (in quarter ending March 2015) to Re. 0.31 per minute ( in quarter ending March, 2017) after the implementation of the Interconnection Usage Charges (11th Amendment) Regulations, 2015 w.e.f. 01.03.2015 through which mobile termination charge were reduced from Re. 0.20 per minute to Re. 0.14 per minute.

**(4) Fixed Termination Charge and a special case of MTC viz. calls originated from wireline network and terminating on wireless networks**

102. In 2015 IUC Regulations, the Authority followed the BAK method for prescribing fixed termination charges (i.e. wireless to wireline and wireline to wireline) as well as mobile termination charges from wireline (i.e. wireline to wireless) with an aim to promote investment in, and adoption of, wireline networks so that wireline networks may become effective vehicles for the delivery of high-speed Internet in the country. At this juncture, it would be worthwhile to examine as to whether the afore-mentioned step taken by the Authority for uplifting the wireline networks has achieved the desired success in the past one year.

103. The following table depicts the growth in subscriber base of wireline telephony and wire-line broadband services.

Table

| Item | Period from March, 2013 to March, 2015 | Period from March, 2015 to March, 2017 |
|---|---|---|
| **Growth in wire-line telephone connections** | -3.6 | -2.2 |
| **Growth in wire-line broadband connections** | 0.4 | 2.7 |

104. The above table demonstrates that the performances of both wire-line telephony and wire-line broadband services in terms of subscriber bases have improved significantly subsequent to the implementation of zero termination charge for calls from wireline network. The decline of wire-line connections was arrested significantly while wire-line broadband connections witnessed a substantial upsurge. Clearly, the Authority's initiative to boost the wire-line telephony and wire-line broadband segments by way of prescribing BAK regime for fixed termination charges (i.e. wireless to wire-line and wire-line to wire-line) as well as mobile termination charges from wire-line (i.e. wire-line to wireless) has been a success.

105. Therefore, The Authority is of the view that above method for wire-line should continue.

**J. International Settlement Rates and International Termination Charges**

106. Another issue raised in the CP was about prescribing International Termination Charge and Prescription of revenue share between Indian ILDO and access provider in the International Termination Charge. The Authority is of the view that there is a need of more deliberation on the issue, and therefore the Authority will issue separate regulation on this issue.

**Annexure to the Explanatory Memorandum of the Interconnection Usage Charges (Thirteenth Amendment) Regulations, 2017**

## A. Introduction

1. In a generic LRIC method, the Mobile Termination Cost (MTC) is determined on the following basic assumptions:

   (i) The method is run for an equivalent operator[4] i.e. a TSP who has a fair share in the relevant market.

   (ii) The equivalent operator incurs costs that would occur in a competitive market. Thus the method uses present costs i.e. forward looking costs.

   (iii) The method of costing is long-run costing i.e. the size of the network deployed is reasonably matched to the level of network demand.

   (iv) The method determines avoidable costs on account of wholesale termination minutes (i.e. off-net incoming minutes) and thereby avoidable cost per unit off-net incoming minute.

2. In the present review exercise, The Mobile Termination Cost (MTC) has been computed, using the Pure LRIC method, on the basis of the network of an equivalent operator offering wireless services using second generation (2G), third generation (3G) and fourth generation (4G) wireless technologies in each LSA in the country. An equivalent operator in an LSA is an operator which has a fair share of the wireless subscribers in each of three wireless network technologies (viz. 2G, 3G and 4G) in that LSA. The characteristics of an equivalent operator in any LSA are as below:

   (i) It has an average size in terms of subscriber base. The average size has been computed on the basis of the Herfindahl–Hirschman Index (HHI).

| |
|---|
| Total number of wireless subscribers of the equivalent operator in an LSA<br>= (Total no. of wireless subscribers in the LSA) *multiplied by* (HHI of the wireless market segment in the LSA)/ 10,000<br><br>Where HHI of the wireless market segment in an LSA<br>= $\sum^{n}_{i=1} (s_i^2)$<br>where $s_i$ is the percent market share (computed on the basis of wireless subscriber base) of the $i^{th}$ operator in the LSA, and 'n' is the number of operators in the LSA. |

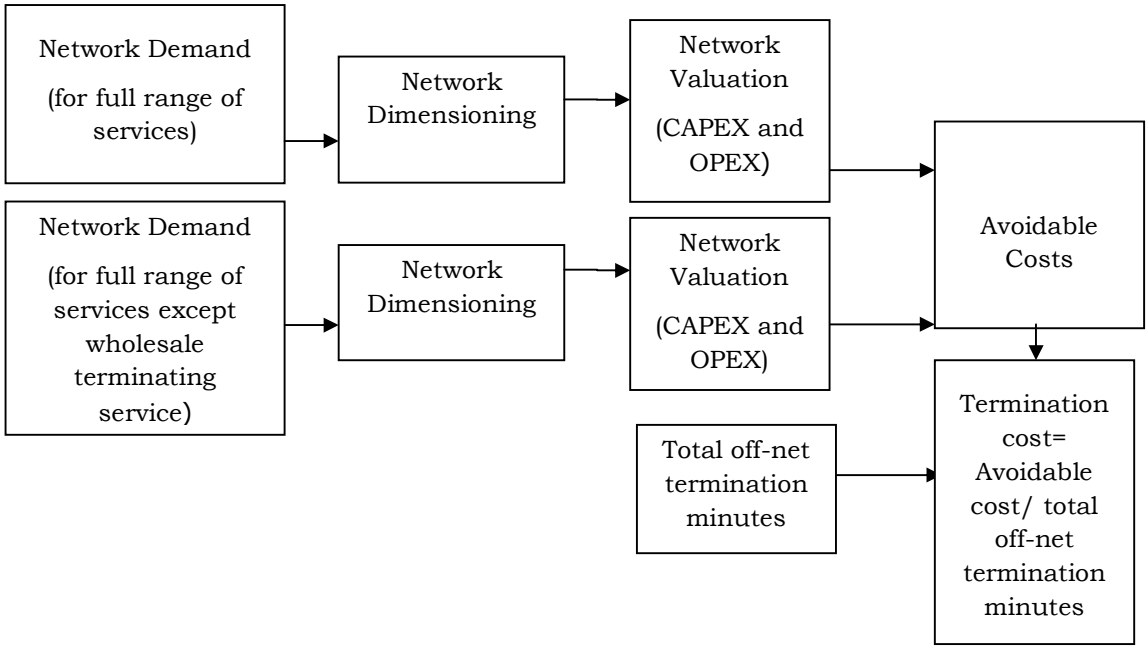
[4] An equivalent operator is a representative TSP in each LSA. It has an average size, which can be determined through the Herfindahl-Hirschman Index (HHI).

(ii) The usage profile of its wireless subscribers matches that of the average wireless subscriber in the LSA. Thus, the average voice Minutes of Usage (MOU), SMS and data usage per subscriber per month in the LSA reflects the usage profile of the subscribers of the equivalent operator.

(iii) It operates efficiently. It has deployed modern technology in its network, its network design is optimal, and its costs reflect the present costs.

3. A block schematic diagram of the pure LRIC method is given below.

**Figure: Block schematic diagram of Pure LRIC Method**




Mobile termination cost as per Pure LRIC Method

= (Avoidable cost if wholesale termination service is not provided) *divided by* (No. of total off-net incoming minutes)

= (Total annualized cost for providing entire range of services *minus* Total annualized cost for providing entire range of service excluding wholesale termination service) *divided by* (No. of total off-net incoming minutes)

**B. Methodology of Pure LRIC**

4. The following steps were taken for determination of mobile termination cost (MTC) for the equivalent operator using Pure LRIC method:

(i) Data collection from the operators

(ii) Determination of demand to be catered by the equivalent operator in terms of coverage and busy hour traffic

(iii) Dimensioning of the radio access network and core network

(iv) Determination of unit costs (capital costs and operating costs) of the elements of the network

(v) Determination of the cost of network - (a) for providing full range of services; and (b) for providing full range of services excluding wholesale termination service separately

(vi) Determination of mobile termination cost

**(1) Data Collection from Operators**

5. In order to capture the traffic demand and network design of the operators and the current costs of network, the operators were requested to submit the following information regarding subscriber base, traffic, network elements and costs for each Licensed Service Area (LSA) separately in a prescribed format:

(i) No. of subscribers as on 31.12.2016

(ii) Traffic handled by 2G, 3G and 4G networks (separately) in the quarter ending December, 2016

(iii) Land coverage based on geo-types for 2G, 3G and 4G Network separately

(iv) Amount of spectrum (in MHz) used for 2G, 3G and 4G services separately

(v) Average radius of cells of base stations for 2G, 3G and 4G networks (separately) based on categorization of geo-types

(vi) No. of radio access network elements

(vii) No. of core network elements and dedicated elements

(viii) No. of base station sites

(ix) No. of sites with 2G base station only

(x) No. of sites with 3G base station only

(xi) No. of sites with 4G base station only

(xii) No. of sites with 2G and 3G base stations

(xiii) No. of sites with 3G and 4G base stations

(xiv) No. of sites with 2G and 4G base stations

(xv) No. of sites with 2G, 3G and 4G base stations

(xvi) Transmission links between BTS to BSC

(xvii) Transmission links between Node B to RNC

(xviii) Transmission links between eNode B to 4G core network

(xix) Backbone Transmission links

(xx) Capital cost of network equipment

(xxi) Operating cost of passive infrastructure per site with 2G base station only in Q.E. December, 2016

(xxii) Operating cost of passive infrastructure per site with 3G base station only in Q.E. December, 2016

(xxiii) Operating cost of passive infrastructure per site with 4G base station only in Q.E. December, 2016

(xxiv) Operating cost of passive infrastructure per site with 2G and 3G base stations only in Q.E. December, 2016 Operating cost of passive infrastructure per site with 3G and 4G base stations only in Q.E. December, 2016

(xxv) Operating cost of passive infrastructure per site with 2G and 4G base stations only in Q.E. December, 2016

(xxvi) Operating cost of passive infrastructure per site with 2G, 3G and 4G base stations in Q.E. December, 2016

(xxvii) Operating cost of active equipment of BTS, BSC and 2G core equipment in Q.E. December, 2016

(xxviii) Operating cost of active equipment of Node B, RNC and 3G core equipment in Q.E. December, 2016

(xxix) Operating cost of active equipment of eNode B and core equipment in Q.E. December, 2016

(xxx) Cost of leasing transmission bandwidth in Q.E. December, 2016

(xxxi) Operating cost of network management system (NMS) in Q.E. December, 2016

(xxxii) Any other relevant capital cost/ operating cost (in Q.E. December, 2016) which may be allocated to wireless access services Network Demand

6. After receipt of the information from the respective operators, the data gaps and inconsistencies in the furnished information were communicated to the operators and revised information was sought from them.

**(2) Determination of demand to be catered by the equivalent operator in terms of busy hour traffic and coverage**

7. In order to serve the subscriber demand, an operator has to meet both capacity and coverage requirements. Accordingly, determination of the demand requires determination of the busy hour traffic to be handled by the equivalent operator as well as the required radio network coverage.

### (2.1) Determination of the busy hour traffic to be handled by the equivalent operator

8. In order to estimate busy hour traffic to be handled by the equivalent operator for the three networks (viz. 2G, 3G and 4G) in each LSA, the following steps were used:

(i) Determination of subscriber base of equivalent operator in each LSA

(ii) Determination of total traffic (voice MOUs – on-net outgoing, off-net outgoing and off-net incoming separately, SMS – outgoing and incoming separately, data transfer – upload and download separately) per subscriber per month in each LSA

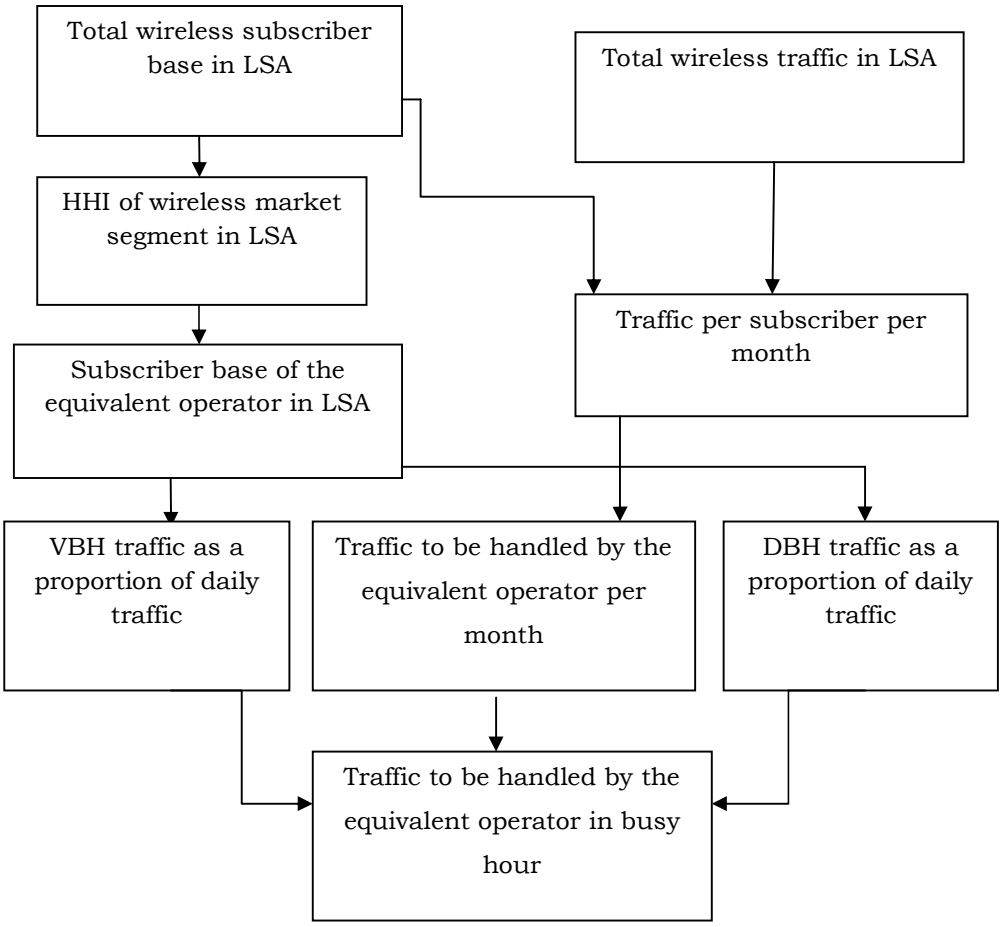
(iii) Determination of traffic to be handled by the equivalent operator per month in each LSA

(iv) Determination of voice busy hour (VBH) traffic and data busy hour (DBH) traffic as a proportion of daily traffic in each LSA

(v) Determination of VBH traffic and DBH traffic to be handled by equivalent operator in each LSA; the maximum of the VBH traffic and DBH traffic is the busy hour traffic to be handled by the equivalent operator in each LSA.

9. The following figure depicts a block schematic diagram to determine the busy hour traffic to be handled by the equivalent operator.

**Figure: Block Schematic Diagram to determine busy hour traffic to be handled by the equivalent operator**




10. LSA-wise total wireless subscriber base, HHI and subscriber base of equivalent operator are given in **Appendix-A**. Voice Busy Hour (VBH) and Data Busy Hour (DBH) traffic as a proportion of daily traffic computed on the basis of information received from the operators for the period from 01.02.2017 to 07.02.2017 is given in **Appendix-B**. The traffic to be handled by the equivalent operator in 2G, 3G and 4G network technology are given in **Appendix-C, D and E** respectively.

**(2.2) Determination of the radio network coverage**

11. Based on the information furnished by the operators, the land area covered by the equivalent operator for the three networks (viz. 2G, 3G and 4G) in each LSA was determined. In order to determine the land area to be covered, each LSA was divided into four geo-types, based on the population density as given below:

**Table: Geo-type wise Population Density**

| S. No. | Geo-type | Population Density (Population per sq. km) |
|---|---|---|
| 1 | Dense Urban (DU) | More than or equal to 20000 |
| 2 | Urban (U) | More than or equal to 8000 but less than 20000 |
| 3 | Semi Urban (SU) | More than or equal to 400 but less than 8000 |
| 4 | Rural (R) | Less than 400 |

12. LSA-wise coverage requirements of the equivalent operator for the 2G, 3G and 4G network types are given in **Appendix-F, G and H** respectively.

**(3) Dimensioning of the radio access network and core network**

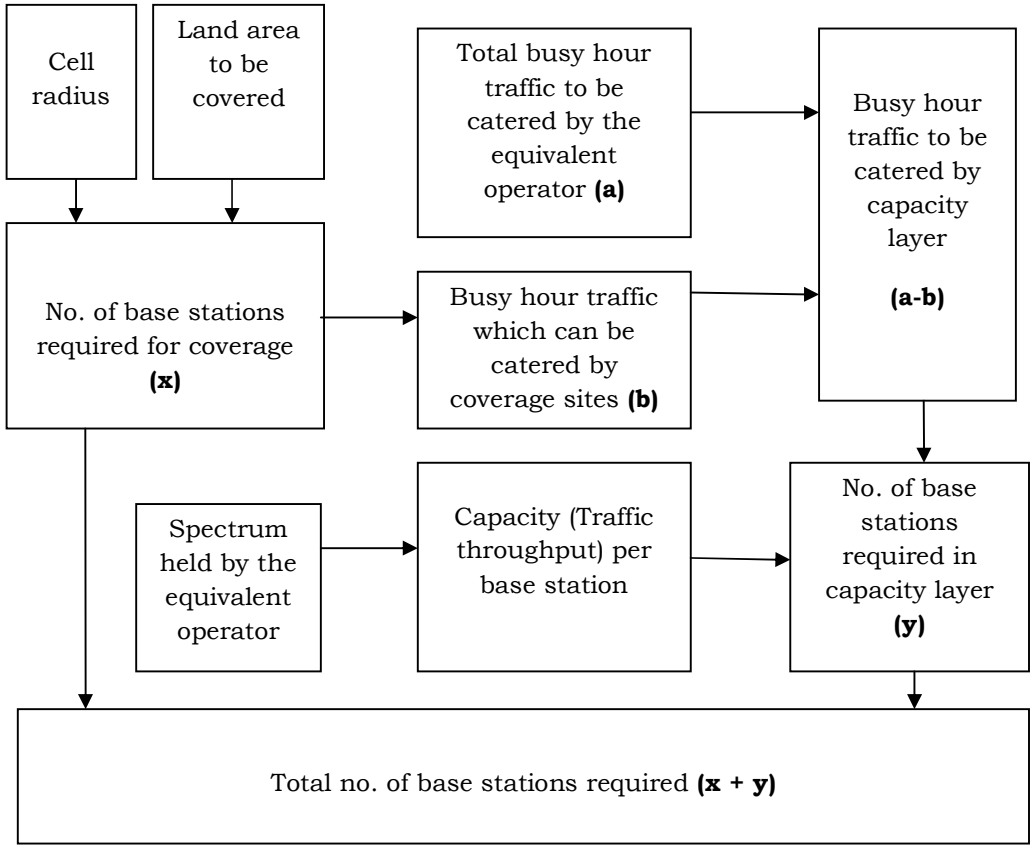
13. Having determined the demand of the equivalent operator (viz. land area to be covered and busy hour traffic to be catered to), two network design parameters (viz. cell radii of base stations and radio spectrum holdings) towards dimensioning of the radio access network, cell radii and radio spectrum holdings were determined as below:

(i) Cell Radius: Average cell radii of the equivalent operator in 2G, 3G and 4G networks in the various geo-types, was determined on the basis of information on cell radii furnished by the various operators, which are given in **Appendix-I, J** and **K** respectively.

(ii) **Radio Spectrum Holding:** The radio spectrum held by the equivalent operator for offering access services in each LSA was determined on the basis of the average radio spectrum held by the operators in various LSAs.

14. On the basis of above, base stations required by the equivalent operator were determined as per the following block schematic diagram.

**Block Schematic Diagram for Determination of BTS Sites**




15. After determination of base stations to be catered to by the equivalent operator, estimations of the following network elements were made:

(i) No. of sites on which base stations of single, dual and triple network technologies are deployed in each LSA

(ii) No. of backhaul circuits in each LSA

(iii) No. of BSC (in 2G network) and RNC (in 3G network) in each LSA

(iv) No. of links between BSC and RNC to Media Gateway (MGW) separately

(v) No. of core elements (e.g. MGW, MSS, GMGW, GSS, HLR etc.) for 2G and 3G networks

(vi) No. of links to carry traffic from 4G base stations to 4G core equipment

(vii) No. of core elements (e.g. MME, SGW, PGW, IMS-elements, HSS etc.) for 4G network

(viii) No. of links between core elements

**(4) Determination of unit costs of the elements of the network**

16. The following unit costs of the elements of the network were determined on the basis of the information received from the operators:
    (i) Unit capital cost and useful life of the elements of radio access network and core network
    (ii) Unit operating cost per annum of passive infrastructure per base station site (for single technology site, dual technology site and triple technology site separately), active equipment of radio access network and core network and network management system (NMS) and unit cost of leasing transmission bandwidth per annum.

17. The Capital costs and useful lives of the network elements are given in **Appendix-L**. Unit operating costs per annum of passive infrastructure per base station site for single technology site, dual technology site and triple technology site are given in **Appendix-M, N and O** respectively.

**(5) Determination of cost of network**

18. Using the number of network elements arrived at in the step (3) above and the unit costs of network elements described in the step (4) above, the total annualized cost of the network (including annualized CAPEX and annual OPEX) for each LSA was determined in the following two scenarios:
    (i) for providing entire range of services
    (ii) for providing all services excluding wholesale termination minutes

19. Towards computing annualized CAPEX for a network element, depreciation was computed using straight line method (SLM) and return on capital employed (ROCE) was kept as 15% per annum.

20. The LSA-wise annualized CAPEX and OPEX of the network for full traffic including off-net incoming minutes are given in **Appendix-P** while LSA-wise annualized CAPEX and OPEX of the network for full traffic excluding off-net incoming minutes are given in **Appendix-Q.**

**(6) Determination of mobile termination cost**

21. Having computed the cost of network in the two scenarios described in the step (5) above, the mobile termination cost was computed using the following formula:

Mobile termination cost

= (Total annualized cost for providing entire range of services *minus* Total annualized cost for providing entire range of service excluding wholesale termination service) *divided by* (No. of total off-net incoming minutes)

22. As the equivalent operator would be liable to pay License Fee (LF) and Spectrum Usage Charges (SUC) on the net interconnection usage charges receivable on account of MTC. Accordingly, MTC (after inclusion of LF and SUC) has been computed as below:

MTC (after inclusion of LF and SUC)

= (MTC prior to inclusion of LF and SUC) *divided by* {1 – (percent difference in off-net incoming minutes and off-net outgoing minutes)* (percent rate of LF + percent rate of SUC)}

23. In the present exercise, LF and weighted average SUC have been taken as 8% and 4% respectively.

24. The steps for computation of MTC (after inclusion of LF and SUC) are given in **Appendix-R.**

**Appendix-A**

| Total subscriber base, HHI and subscriber base of Equivalent operator | | | | |
|---|---|---|---|---|
| **S.NO.** | **LSA** | **No. of total wireless Subscribers in LSA** | **HHI of wireless segment** | **No. of subscribers of the equivalent operator** |
| 1 | Andhra Pradesh | 816,52,967 | 1,784 | 145,65,923 |
| 2 | Assam | 209,14,164 | 2,135 | 44,64,925 |
| 3 | Bihar | 822,56,864 | 1,994 | 164,00,268 |
| 4 | Delhi | 508,81,835 | 1,534 | 78,03,531 |
| 5 | Gujarat | 683,80,330 | 1,699 | 116,20,654 |
| 6 | Haryana | 239,40,820 | 1,682 | 40,26,536 |
| 7 | Himachal Pradesh | 99,02,770 | 1,833 | 18,15,583 |
| 8 | Jammu & Kashmir | 112,72,751 | 2,022 | 22,78,975 |
| 9 | Karnataka | 671,27,721 | 1,758 | 117,97,920 |
| 10 | Kerala | 379,06,029 | 1,998 | 75,74,771 |
| 11 | Kolkata | 281,44,563 | 1,432 | 40,30,143 |
| 12 | Madhya Pradesh | 664,76,479 | 2,105 | 139,94,424 |
| 13 | Maharashtra | 907,67,668 | 1,692 | 153,57,311 |
| 14 | Mumbai | 346,26,323 | 1,581 | 54,75,026 |
| 15 | North East | 122,93,159 | 2,278 | 28,00,248 |
| 16 | Orissa | 327,94,221 | 1,863 | 61,10,849 |
| 17 | Punjab | 363,78,636 | 1,453 | 52,84,600 |
| 18 | Rajasthan | 648,75,164 | 1,786 | 115,89,644 |
| 19 | Tamilnadu | 865,37,150 | 1,687 | 145,99,741 |
| 20 | U. P. (East) | 1016,00,856 | 1,439 | 146,22,899 |
| 21 | U.P. (West) | 632,05,934 | 1,541 | 97,38,464 |
| 22 | West Bengal | 554,36,964 | 2,282 | 126,52,347 |

**Appendix-B**

**Voice busy hour (VBH) and data busy hour (DBH) traffic as a proportion of daily traffic**

| S.No. | Name of licensed service area | 2G traffic | | | | 3G traffic | | | | 4G traffic | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VBH | | DBH | | VBH | | DBH | | VBH | | DBH | |
| | | % voice traffic during VBH | % Data traffic during VBH | % Data traffic during DBH | % voice traffic during DBH | % voice traffic during VBH | % Data traffic during VBH | % Data traffic during DBH | % voice traffic during DBH | % voice traffic during VBH | % Data traffic during VBH | % Data traffic during DBH | % voice traffic during DBH |
| 1 | Andhra Pradesh | 9.1% | 5.9% | 7.4% | 7.0% | 8.2% | 5.9% | 7.5% | 4.1% | 8.5% | 5.4% | 5.8% | 5.0% |
| 2 | Assam | 9.9% | 6.7% | 7.7% | 7.4% | 8.7% | 6.8% | 7.5% | 6.1% | 8.5% | 5.5% | 5.8% | 6.4% |
| 3 | Bihar | 8.9% | 6.2% | 6.9% | 6.9% | 7.8% | 6.5% | 7.1% | 6.7% | 8.1% | 5.2% | 5.5% | 7.4% |
| 4 | Delhi | 8.4% | 6.2% | 7.5% | 5.2% | 7.7% | 5.6% | 7.3% | 5.2% | 7.7% | 4.8% | 5.2% | 5.7% |
| 5 | Gujarat | 8.7% | 6.3% | 7.4% | 5.2% | 7.7% | 5.7% | 7.7% | 5.0% | 8.7% | 5.6% | 5.8% | 6.7% |
| 6 | Haryana | 10.2% | 7.3% | 8.3% | 6.9% | 8.2% | 6.1% | 7.7% | 6.2% | 9.0% | 5.9% | 6.3% | 7.1% |
| 7 | Himachal Pradesh | 9.4% | 7.6% | 8.1% | 8.3% | 8.2% | 7.2% | 7.6% | 8.1% | 8.7% | 6.8% | 6.8% | 8.7% |
| 8 | J&K | 9.4% | 7.1% | 7.1% | 9.4% | 9.0% | 6.7% | 6.8% | 8.0% | 8.9% | 6.5% | 6.5% | 8.9% |
| 9 | Karnataka | 9.3% | 6.5% | 7.5% | 4.1% | 8.4% | 5.6% | 7.6% | 5.0% | 8.9% | 5.3% | 5.8% | 5.6% |
| 10 | Kerala | 9.5% | 6.9% | 8.4% | 5.4% | 8.6% | 5.7% | 8.0% | 5.2% | 9.0% | 5.8% | 6.4% | 7.2% |
| 11 | Kolkata | 8.5% | 5.9% | 7.1% | 6.0% | 7.7% | 6.0% | 7.4% | 6.1% | 7.9% | 5.2% | 6.0% | 5.6% |
| 12 | Madhya Pradesh | 8.7% | 6.7% | 7.6% | 7.2% | 8.0% | 6.5% | 7.5% | 5.5% | 8.3% | 5.4% | 6.0% | 6.5% |
| 13 | Maharashtra | 8.9% | 6.3% | 7.4% | 4.4% | 8.3% | 5.8% | 7.5% | 5.0% | 8.7% | 5.2% | 5.8% | 6.2% |
| 14 | Mumbai | 8.2% | 5.3% | 6.5% | 5.5% | 7.8% | 5.7% | 6.7% | 5.4% | 7.9% | 4.9% | 5.5% | 6.3% |
| 15 | North East | 10.1% | 6.7% | 7.2% | 8.3% | 9.4% | 6.6% | 6.9% | 8.5% | 9.3% | 5.4% | 5.6% | 9.0% |
| 16 | ORISSA | 9.7% | 5.9% | 7.1% | 4.8% | 8.9% | 6.0% | 7.6% | 4.7% | 8.7% | 5.0% | 5.7% | 6.3% |
| 17 | PUNJAB | 9.0% | 5.9% | 7.0% | 6.4% | 8.0% | 6.5% | 7.2% | 7.8% | 8.3% | 5.3% | 6.0% | 6.8% |
| 18 | Rajasthan | 10.1% | 6.8% | 7.6% | 7.6% | 8.2% | 6.7% | 7.8% | 4.8% | 8.9% | 5.5% | 6.0% | 5.8% |
| 19 | Tamil Nadu | 9.0% | 6.0% | 7.6% | 4.1% | 8.4% | 5.8% | 7.9% | 5.0% | 8.9% | 5.2% | 5.9% | 5.8% |
| 20 | UP (East) | 9.3% | 6.5% | 7.1% | 7.4% | 7.9% | 6.0% | 7.2% | 4.7% | 8.0% | 5.2% | 5.6% | 6.1% |
| 21 | UP (West) | 9.1% | 6.6% | 7.6% | 4.5% | 7.8% | 5.8% | 7.5% | 5.1% | 8.4% | 5.4% | 5.8% | 7.7% |
| 22 | West Bengal | 9.8% | 5.8% | 7.3% | 5.2% | 8.6% | 6.4% | 7.5% | 5.4% | 8.6% | 5.5% | 5.6% | 6.4% |

**Appendix -C**

**2G Traffic to be handled by the equivalent operator per month**

| S.No. | LSA | On-net outgoing MOUs | Off-net outgoing MOUs | Off-net incoming MOUs | outgoing SMS | incoming SMS | Data upload (MB) | Data download (MB) |
|---|---|---|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 8739,29,621 | 11379,71,467 | 13671,03,771 | 286044718 | 7982,86,293 | 463,84,512 | 2881,54,522 |
| 2 | Assam | 3421,26,884 | 2471,35,812 | 4257,12,421 | 112487192 | 3272,94,762 | 153,39,195 | 1443,29,652 |
| 3 | Bihar | 12724,99,904 | 9120,35,114 | 20169,26,288 | 74260782 | 7607,57,174 | 481,23,567 | 3806,28,465 |
| 4 | Delhi | 3229,91,174 | 7737,83,348 | 6584,98,104 | 565627029 | 5121,60,281 | 364,84,444 | 1940,09,619 |
| 5 | Gujarat | 6794,34,874 | 7575,74,500 | 7168,60,900 | 73478951 | 4882,44,772 | 568,77,456 | 3543,60,273 |
| 6 | Haryana | 2202,03,636 | 3110,91,136 | 3575,40,454 | 51877343 | 1723,83,443 | 113,21,079 | 920,57,898 |
| 7 | Himachal Pradesh | 1312,64,473 | 1069,57,953 | 1274,07,876 | 10805184 | 763,15,517 | 93,30,440 | 590,92,984 |
| 8 | Jammu & Kashmir | 2779,97,354 | 2027,61,694 | 2368,91,467 | 15275393 | 1445,87,209 | 110,32,763 | 563,68,881 |
| 9 | Karnataka | 5648,25,518 | 8438,14,376 | 9245,34,514 | 262829670 | 7464,28,537 | 462,56,783 | 2781,86,905 |
| 10 | Kerala | 4919,90,448 | 6122,53,836 | 8555,31,732 | 70006525 | 2410,60,422 | 400,10,668 | 2836,49,463 |
| 11 | Kolkata | 1515,50,922 | 3197,18,939 | 3421,42,118 | 528980910 | 2022,11,683 | 105,82,423 | 612,23,115 |
| 12 | Madhya Pradesh | 7339,65,163 | 7384,83,444 | 9744,78,460 | 133424997 | 5389,85,495 | 420,03,514 | 3061,94,356 |
| 13 | Maharashtra | 7370,53,345 | 11337,94,377 | 11755,04,055 | 514952975 | 6765,61,614 | 706,87,330 | 4747,82,019 |
| 14 | Mumbai | 1928,85,688 | 6214,48,729 | 4175,35,514 | 899270735 | 3584,05,062 | 380,00,835 | 1770,80,979 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | North East | 1716,57,557 | 1251,06,240 | 1466,90,268 | 99052892 | 1874,51,969 | 139,93,693 | 1183,19,578 |
| 16 | Orissa | 5269,73,488 | 3609,45,718 | 6369,19,383 | 37927510 | 3348,25,060 | 139,46,993 | 1210,38,282 |
| 17 | Punjab | 3317,00,278 | 4155,75,202 | 4995,45,170 | 356322278 | 2612,39,707 | 329,38,842 | 2005,79,190 |
| 18 | Rajasthan | 6778,45,678 | 7546,84,945 | 10258,27,518 | 72689618 | 5483,07,686 | 546,68,671 | 3965,05,109 |
| 19 | Tamilnadu | 8565,84,436 | 10806,40,033 | 12752,52,355 | 466477779 | 9593,61,177 | 578,80,186 | 3883,21,244 |
| 20 | U. P. (East) | 11431,48,903 | 8112,16,881 | 16920,20,949 | 142030320 | 6067,84,472 | 960,52,122 | 3567,43,613 |
| 21 | U.P. (West) | 6622,95,319 | 5810,11,493 | 8939,29,103 | 121537139 | 3501,72,968 | 320,30,070 | 2727,94,803 |
| 22 | West Bengal | 9473,77,140 | 6831,14,973 | 11529,85,802 | 187829101 | 6237,96,298 | 250,40,829 | 2689,70,990 |

**Appendix -D**

**3G Traffic to be handled by the equivalent operator per month**

| S.No. | LSA | On-net outgoing MOUs | Off-net outgoing MOUs | Off-net incoming MOUs | outgoing SMS | incoming SMS | Data upload (MB) | Data download (MB) |
|---|---|---|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 1592,38,275 | 2103,63,920 | 1737,72,968 | 88211841 | 1287,54,343 | 1167,82,798 | 10387,82,744 |
| 2 | Assam | 426,04,006 | 474,58,380 | 547,29,866 | 11394642 | 351,16,735 | 428,43,922 | 3645,91,699 |
| 3 | Bihar | 385,38,264 | 612,64,057 | 997,19,280 | 4933663 | 415,23,576 | 899,31,305 | 6226,36,457 |
| 4 | Delhi | 1413,65,576 | 2631,62,991 | 2509,12,618 | 11826727 | 828,72,299 | 2369,79,319 | 9191,58,285 |
| 5 | Gujarat | 1227,46,336 | 2056,32,035 | 1725,04,017 | 12276140 | 916,69,247 | 2393,56,194 | 9654,07,122 |
| 6 | Haryana | 501,04,926 | 919,61,142 | 751,27,710 | 9170875 | 249,48,263 | 400,14,987 | 2831,90,132 |
| 7 | Himachal Pradesh | 163,19,342 | 135,38,118 | 150,62,855 | 798716 | 89,08,099 | 154,52,934 | 1402,78,419 |
| 8 | Jammu & Kashmir | 185,14,876 | 209,04,822 | 177,60,568 | 1876644 | 95,99,601 | 102,44,483 | 890,25,174 |
| 9 | Karnataka | 1917,69,259 | 3476,68,114 | 3092,49,834 | 75367701 | 1975,94,868 | 1880,38,626 | 11907,38,198 |
| 10 | Kerala | 576,67,598 | 1673,73,992 | 1065,12,589 | 6453040 | 293,77,746 | 1592,06,816 | 13583,92,436 |
| 11 | Kolkata | 410,13,507 | 606,48,653 | 708,76,773 | 47964278 | 308,81,833 | 833,36,752 | 3263,03,370 |
| 12 | Madhya Pradesh | 1234,61,814 | 1784,67,579 | 1548,24,011 | 15957536 | 419,35,915 | 920,66,212 | 8832,34,011 |
| 13 | Maharashtra | 1497,43,739 | 2615,67,233 | 2373,99,109 | 56545144 | 1006,84,561 | 2976,53,494 | 14423,29,706 |
| 14 | Mumbai | 1129,28,244 | 2092,86,528 | 1700,78,782 | 7999465 | 602,11,769 | 2416,15,454 | 5545,70,110 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | North East | 477,61,172 | 377,40,798 | 448,37,911 | 11436885 | 449,97,079 | 345,76,270 | 3292,92,396 |
| 16 | Orissa | 271,20,629 | 393,75,934 | 484,58,521 | 3186723 | 255,07,439 | 389,24,270 | 3203,69,415 |
| 17 | Punjab | 614,70,200 | 1126,84,054 | 909,40,422 | 41602309 | 286,44,572 | 742,73,676 | 5446,66,957 |
| 18 | Rajasthan | 566,03,541 | 813,93,015 | 841,11,037 | 7029446 | 631,18,581 | 1082,95,799 | 6072,87,879 |
| 19 | Tamilnadu | 1421,34,304 | 1581,37,288 | 1858,23,351 | 55947042 | 1654,54,695 | 2714,87,446 | 15939,92,943 |
| 20 | U. P. (East) | 505,46,184 | 565,42,023 | 754,33,186 | 6178746 | 404,04,590 | 947,31,179 | 5949,86,336 |
| 21 | U.P. (West) | 599,23,961 | 763,57,728 | 664,71,647 | 7712284 | 275,86,882 | 720,95,858 | 5756,32,652 |
| 22 | West Bengal | 647,63,483 | 702,65,849 | 985,04,477 | 19316941 | 647,22,280 | 777,12,469 | 6558,87,592 |

**Appendix -E**

**4G Traffic to be handled by the equivalent operator per month**

| S.No. | LSA | On-net outgoing MOUs | Off-net outgoing MOUs | Off-net incoming MOUs | Outgoing SMS | Incoming SMS | Data upload (MB) | Data download (MB) |
|---|---|---|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 173,48,549 | 2367,01,318 | 233,60,565 | 202,11,370 | 388,15,501 | 11530,75,538 | 108215,03,098 |
| 2 | Assam | 55,37,187 | 746,38,712 | 56,81,517 | 54,76,124 | 102,78,467 | 2899,71,845 | 28857,30,615 |
| 3 | Bihar | 270,64,796 | 2563,48,841 | 256,77,905 | 101,48,398 | 217,16,789 | 10656,30,635 | 98196,79,978 |
| 4 | Delhi | 168,89,800 | 2086,04,782 | 251,74,222 | 94,26,704 | 236,53,405 | 9358,17,837 | 72265,95,469 |
| 5 | Gujarat | 133,42,983 | 1846,00,621 | 166,86,299 | 103,11,128 | 273,92,949 | 10650,26,861 | 95756,84,074 |
| 6 | Haryana | 25,32,635 | 336,34,746 | 31,67,872 | 11,91,572 | 34,83,791 | 1312,04,366 | 12808,78,134 |
| 7 | Himachal Pradesh | 76,32,008 | 985,01,960 | 106,09,149 | 48,55,963 | 117,03,559 | 3916,20,460 | 38595,64,853 |
| 8 | Jammu & Kashmir | 50,73,932 | 590,92,719 | 36,05,256 | 37,39,562 | 70,11,093 | 1565,29,643 | 14068,53,966 |
| 9 | Karnataka | 123,41,482 | 1678,05,626 | 192,45,636 | 133,52,979 | 336,09,125 | 10015,40,647 | 87892,67,543 |
| 10 | Kerala | 38,05,359 | 865,72,335 | 86,88,850 | 47,93,644 | 135,80,733 | 6274,11,183 | 58926,85,326 |
| 11 | Kolkata | 103,28,011 | 966,89,219 | 90,13,063 | 59,90,825 | 138,15,199 | 4092,37,517 | 35292,21,086 |
| 12 | Madhya Pradesh | 145,79,946 | 2140,77,876 | 234,31,959 | 172,79,692 | 396,86,621 | 12428,36,044 | 119598,09,363 |
| 13 | Maharashtra | 177,26,396 | 1983,41,775 | 180,21,239 | 130,70,384 | 264,19,022 | 8330,96,512 | 79546,70,868 |
| 14 | Mumbai | 94,27,777 | 1243,46,398 | 140,15,575 | 47,31,881 | 349,98,944 | 6312,35,245 | 43972,00,401 |
| 15 | North East | 29,18,964 | 379,92,410 | 35,93,553 | 31,79,043 | 65,94,006 | 1558,90,159 | 14651,87,112 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 16 | Orissa | 106,16,997 | 1226,35,128 | 93,49,094 | 53,23,330 | 102,72,975 | 4226,82,321 | 40027,88,107 |
| 17 | Punjab | 89,92,021 | 1204,95,905 | 115,75,088 | 50,78,438 | 113,21,012 | 5496,85,744 | 49752,08,809 |
| 18 | Rajasthan | 134,54,559 | 1785,75,752 | 167,75,748 | 70,05,101 | 185,34,366 | 8159,17,447 | 77515,88,870 |
| 19 | Tamilnadu | 100,06,870 | 1717,88,548 | 163,43,224 | 99,73,679 | 216,81,909 | 10047,67,393 | 88812,29,385 |
| 20 | U. P. (East) | 135,83,431 | 1644,91,972 | 149,82,150 | 82,75,986 | 190,35,736 | 7274,10,001 | 65900,83,016 |
| 21 | U.P. (West) | 113,55,924 | 1474,79,624 | 141,34,750 | 76,49,076 | 179,79,060 | 6038,82,599 | 60691,23,353 |
| 22 | West Bengal | 104,13,718 | 1456,68,693 | 97,32,464 | 88,48,226 | 171,43,947 | 5419,76,060 | 53887,52,987 |

**Appendix - F**

**Total Area under geo-types for 2G Network**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 193 | 803 | 678 | 1,18,966 |
| 2 | Assam | 14 | 204 | 9,149 | 32,151 |
| 3 | Bihar | 125 | 341 | 1,243 | 1,22,918 |
| 4 | Delhi | 273 | 439 | 515 | 136 |
| 5 | Gujarat | 179 | 588 | 6,488 | 98,744 |
| 6 | Haryana | 137 | 197 | 290 | 28,108 |
| 7 | Himachal Pradesh | 11 | 58 | 504 | 21,211 |
| 8 | Jammu & Kashmir | 25 | 131 | 3,623 | 31,241 |
| 9 | Karnataka | 116 | 573 | 6,712 | 87,148 |
| 10 | Kerala | 73 | 438 | 14,248 | 16,696 |
| 11 | Kolkata | 208 | 205 | 263 | 878 |
| 12 | Madhya Pradesh | 202 | 355 | 1,263 | 1,12,562 |
| 13 | Maharashtra | 271 | 928 | 1,123 | 1,10,651 |
| 14 | Mumbai | 267 | 168 | 169 | 726 |
| 15 | North East | 66 | 158 | 294 | 35,102 |
| 16 | Orissa | 89 | 455 | 1,132 | 62,342 |
| 17 | Punjab | 103 | 611 | 2,835 | 29,203 |
| 18 | Rajasthan | 176 | 459 | 4,395 | 1,53,361 |
| 19 | Tamilnadu | 233 | 677 | 11,891 | 71,120 |
| 20 | U. P. (East) | 197 | 510 | 3,237 | 99,815 |
| 21 | U.P. (West) | 149 | 614 | 481 | 58,326 |
| 22 | West Bengal | 65 | 261 | 9,668 | 79,218 |

**Appendix - G**

**Total Area under geo-types for 3G Network**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 193 | 803 | 678 | 36,314 |
| 2 | Assam | 14 | 170 | 333 | 12,075 |
| 3 | Bihar | 125 | 341 | 1,243 | 8,844 |
| 4 | Delhi | 273 | 439 | 464 | 136 |
| 5 | Gujarat | 137 | 465 | 2,874 | 18,310 |
| 6 | Haryana | 112 | 167 | 290 | 9,916 |
| 7 | Himachal Pradesh | 11 | 2 | 57 | 6,435 |
| 8 | Jammu & Kashmir | 23 | 106 | 201 | 4,597 |
| 9 | Karnataka | 79 | 505 | 2,190 | 8,845 |
| 10 | Kerala | 58 | 399 | 2,107 | 6,012 |
| 11 | Kolkata | 208 | 205 | 263 | 878 |
| 12 | Madhya Pradesh | 202 | 355 | 896 | 34,807 |
| 13 | Maharashtra | 271 | 928 | 422 | 46,652 |
| 14 | Mumbai | 51 | 154 | 90 | 665 |
| 15 | North East | 63 | 81 | 294 | 6,872 |
| 16 | Orissa | 89 | 247 | 298 | 10,241 |
| 17 | Punjab | 17 | 361 | 1,146 | 2,450 |
| 18 | Rajasthan | 121 | 459 | 419 | 10,291 |
| 19 | Tamilnadu | 129 | 448 | 1,785 | 29,556 |
| 20 | U. P. (East) | 195 | 510 | 3,237 | 23,304 |
| 21 | U.P. (West) | 149 | 614 | 481 | 9,737 |
| 22 | West Bengal | 43 | 202 | 468 | 18,888 |

**Appendix - H**

**Total Area under geo-types for 4G Network**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 105 | 416 | 678 | 36,314 |
| 2 | Assam | 6 | 67 | 63 | 12,075 |
| 3 | Bihar | 93 | 160 | 86 | 8,844 |
| 4 | Delhi | 180 | 439 | 464 | 801 |
| 5 | Gujarat | 93 | 288 | 364 | 18,310 |
| 6 | Haryana | 41 | 111 | 252 | 9,916 |
| 7 | Himachal Pradesh | 9 | 2 | 57 | 1,613 |
| 8 | Jammu & Kashmir | 2 | 106 | 150 | 4,597 |
| 9 | Karnataka | 79 | 505 | 806 | 8,845 |
| 10 | Kerala | 58 | 331 | 1,036 | 5,410 |
| 11 | Kolkata | 88 | 205 | 263 | 878 |
| 12 | Madhya Pradesh | 75 | 346 | 896 | 34,807 |
| 13 | Maharashtra | 104 | 928 | 422 | 46,652 |
| 14 | Mumbai | 30 | 154 | 90 | 665 |
| 15 | North East | 5 | 81 | 269 | 6,872 |
| 16 | Orissa | 17 | 178 | 298 | 10,241 |
| 17 | Punjab | 17 | 361 | 396 | 2,450 |
| 18 | Rajasthan | 57 | 459 | 419 | 10,291 |
| 19 | Tamilnadu | 122 | 448 | 1,729 | 29,556 |
| 20 | U. P. (East) | 67 | 234 | 283 | 23,304 |
| 21 | U.P. (West) | 101 | 305 | 91 | 9,737 |
| 22 | West Bengal | 43 | 202 | 265 | 18,888 |

**Appendix - I**

**Cell Radii for 2G Network based on categorization of geo-types (in km)**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Circle category- A, B and C | 0.36 | 0.57 | 1.22 | 2.56 |
| 2 | Circle category- Metro | 0.27 | 0.37 | 0.74 | 1.75 |

**Appendix - J**

**Cell Radii for 3G Network based on categorization of geo-types (in km)**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Circle category- A, B and C | 0.30 | 0.47 | 0.83 | 1.75 |
| 2 | Circle category- Metro | 0.26 | 0.39 | 0.71 | 1.59 |

**Appendix - K**

**Cell Radii for 4G Network based on categorization of geo-types (in km)**

| S.No. | LSA | DU | U | SU | R |
|---|---|---|---|---|---|
| 1 | Circle category- A, B and C | 0.30 | 0.42 | 0.70 | 1.76 |
| 2 | Circle category- Metro | 0.19 | 0.31 | 0.52 | 0.94 |

**Appendix - L**

**Unit Capital costs**

| Network Element | Dimension | Units | Unit Price (in Rs.) | Useful life (in years) |
|---|---|---|---|---|
| **TRX** | | per TRX | 23,294 | 10 |
| **BTS** | | 4/4/4 TRX configuration | 7,03,191 | 10 |
| **Node B** | | Per carrier | 7,29,937 | 10 |
| **eNode B** | | Single Band | 9,26,869 | 10 |
| **eNode B** | | Double Band | 9,26,869 | 10 |
| **BSC** | 2,048 | TRX | 219,23,100 | 10 |
| **RNC** | 1,000 | Mbps | 117,28,064 | 10 |
| **MGW** | 20,000 | Erlangs | 180,20,506 | 10 |
| **GMGW** | 50,000 | Erlangs | 450,51,265 | 10 |
| **MSS** | 50,00,000 | BHCA | 508,00,175 | 10 |
| **GSS** | 50,00,000 | BHCA | 396,52,296 | 10 |
| **MME** | 50,00,000 | SAU | 934,01,868 | 10 |
| **SGW&PGW** | 60,000 | Mbps | 2520,00,000 | 10 |
| **IMS (TAS)** | 24,00,000 | BHCA | 407,57,500 | 10 |
| **IMS (S/I- CSCF & BGCF)** | 8,60,000 | BHCA | 104,80,500 | 10 |
| **IMS (PCSCF)** | 9,80,000 | BHCA | 15,07,000 | 10 |
| **IMS (BGW/SBC)** | 2,000 | Mbps | 187,99,551 | 10 |
| **IMS MRF** | 44,000 | ports | 106,86,000 | 10 |
| **HLR** | 200,00,000 | Subscriber | 2340,70,178 | 10 |
| **HSS** | 100,00,000 | Subscriber | 1761,42,512 | 10 |
| **4G GMGW** | 5,000 | Erlang | 36,08,919 | 10 |
| **SMSC** | 2,000 | TPS | 103,85,874 | 10 |
| **IN** | 200,00,000 | Subscribers | 7609,55,074 | 10 |
| **Microwave** | | Per hop | 2,35,597 | 10 |

**Appendix – M**

**Annual Leasing cost of passive infrastructure (in Rs.)**

| S.No. | Service Area | Passive-GBT for Single technology site | Passive-RTT for Single technology site | Passive-RTP for Single technology site |
|---|---|---|---|---|
| 1 | Andhra Pradesh | 5,90,288 | 4,72,877 | 4,36,075 |
| 2 | Assam | 7,13,072 | 5,33,806 | 4,49,713 |
| 3 | Bihar | 7,33,219 | 5,41,725 | 5,64,174 |
| 4 | Delhi | 6,59,348 | 4,99,481 | 5,22,613 |
| 5 | Gujarat | 5,44,818 | 4,32,981 | 4,39,877 |
| 6 | Haryana | 6,44,396 | 4,99,365 | 5,30,996 |
| 7 | Himachal Pradesh | 5,26,443 | 3,79,426 | 4,25,864 |
| 8 | Jammu & Kashmir | 5,86,346 | 5,01,626 | 5,44,688 |
| 9 | Karnataka | 6,04,114 | 5,16,162 | 5,02,917 |
| 10 | Kerala | 5,60,550 | 4,62,211 | 5,21,527 |
| 11 | Kolkata | 5,79,183 | 5,00,509 | 4,65,287 |
| 12 | Madhya Pradesh | 5,53,104 | 4,10,096 | 4,21,723 |
| 13 | Maharashtra | 5,33,230 | 4,41,223 | 4,66,596 |
| 14 | Mumbai | 7,79,909 | 6,40,080 | 6,28,549 |
| 15 | North East | 6,81,165 | 5,58,813 | 6,67,643 |
| 16 | Orissa | 6,04,735 | 4,69,899 | 3,74,702 |
| 17 | Punjab | 5,17,859 | 4,21,961 | 4,38,602 |
| 18 | Rajasthan | 6,46,744 | 5,14,252 | 4,88,976 |
| 19 | Tamilnadu | 5,88,438 | 5,07,482 | 4,59,489 |
| 20 | U. P. (East) | 6,17,012 | 5,40,976 | 6,14,103 |
| 21 | U.P. (West) | 6,54,854 | 5,00,518 | 4,32,965 |
| 22 | West Bengal | 6,02,159 | 4,52,238 | 4,54,129 |

**Appendix – N**

**Annual Leasing cost of passive infrastructure (in Rs.)**

| S.No. | Service Area | Passive-GBT for dual technology site | Passive-RTT for dual technology site | Passive-RTP for dual technology site |
|---|---|---|---|---|
| 1 | Andhra Pradesh | 5,73,928 | 5,73,503 | 5,43,294 |
| 2 | Assam | 8,60,263 | 6,43,611 | 6,81,176 |
| 3 | Bihar | 7,46,648 | 6,97,910 | 6,28,917 |
| 4 | Delhi | 8,47,639 | 6,93,368 | 7,71,345 |
| 5 | Gujarat | 5,86,014 | 5,17,850 | 4,85,790 |
| 6 | Haryana | 6,88,727 | 6,06,278 | 5,33,804 |
| 7 | Himachal Pradesh | 5,98,357 | 5,55,138 | 5,80,463 |
| 8 | Jammu & Kashmir | 6,87,377 | 5,75,279 | 6,09,770 |
| 9 | Karnataka | 6,34,496 | 5,45,075 | 5,11,566 |
| 10 | Kerala | 7,93,716 | 5,23,539 | 5,10,924 |
| 11 | Kolkata | 6,69,146 | 5,66,468 | 5,75,315 |
| 12 | Madhya Pradesh | 5,65,703 | 4,85,923 | 4,79,570 |
| 13 | Maharashtra | 6,62,040 | 6,22,432 | 5,92,298 |
| 14 | Mumbai | 7,28,555 | 6,90,980 | 7,89,288 |
| 15 | North East | 6,92,514 | 5,64,425 | 6,68,194 |
| 16 | Orissa | 6,19,762 | 4,87,475 | 4,38,925 |
| 17 | Punjab | 5,92,558 | 4,98,838 | 4,78,205 |
| 18 | Rajasthan | 6,56,559 | 5,53,052 | 5,80,613 |
| 19 | Tamilnadu | 5,81,177 | 4,62,356 | 5,09,632 |
| 20 | U. P. (East) | 7,60,695 | 6,35,663 | 5,61,273 |
| 21 | U.P. (West) | 7,28,065 | 5,57,435 | 5,87,320 |
| 22 | West Bengal | 7,36,723 | 5,11,956 | 4,76,670 |

**Appendix - O**

**Annual Leasing cost of passive infrastructure (in Rs.)**

| S.No. | Service Area | Passive-GBT for triple technology site | Passive-RTT for triple technology site | Passive-RTP for triple technology site |
|---|---|---|---|---|
| 1 | Andhra Pradesh | 7,01,177 | 6,07,431 | 6,29,062 |
| 2 | Assam | 7,31,037 | 6,47,788 | 8,04,070 |
| 3 | Bihar | 9,19,126 | 8,55,034 | 9,73,720 |
| 4 | Delhi | 12,21,700 | 8,70,641 | 8,48,274 |
| 5 | Gujarat | 7,05,066 | 4,76,190 | 5,82,787 |
| 6 | Haryana | 7,17,970 | 6,87,215 | 6,80,934 |
| 7 | Himachal Pradesh | 5,85,456 | 5,69,162 | 6,08,436 |
| 8 | Jammu & Kashmir | - | - | - |
| 9 | Karnataka | 8,35,643 | 6,92,911 | 6,23,414 |
| 10 | Kerala | 6,55,681 | 5,58,384 | 6,99,671 |
| 11 | Kolkata | 6,92,802 | 9,76,616 | 7,72,832 |
| 12 | Madhya Pradesh | 7,14,577 | 6,15,918 | 6,01,330 |
| 13 | Maharashtra | 6,83,360 | 6,07,818 | 7,17,503 |
| 14 | Mumbai | 7,80,095 | 7,54,946 | 8,32,732 |

| | | | | |
|---|---|---|---|---|
| 15 | North East | 5,92,120 | 5,58,967 | 6,48,835 |
| 16 | Orissa | 5,60,066 | 5,16,167 | 5,25,123 |
| 17 | Punjab | 6,87,199 | 6,25,142 | 6,02,420 |
| 18 | Rajasthan | 7,82,204 | 7,26,791 | 6,16,489 |
| 19 | Tamilnadu | 6,75,717 | 5,60,045 | 7,10,136 |
| 20 | U. P. (East) | 7,48,842 | 8,86,601 | 5,92,662 |
| 21 | U.P. (West) | 7,18,196 | 6,36,570 | 6,72,250 |
| 22 | West Bengal | 7,78,133 | 5,74,783 | 5,52,434 |

**Appendix - P**

**Annualized CAPEX and OPEX of the network with full traffic (including off-net incoming minutes)**

| S.No. | LSA | Capex with full traffic | OPEX with full traffic | Total Cost with full traffic |
|---|---|---|---|---|
| 1 | Andhra Pradesh | 73146,43,422 | 130881,98,117 | 204028,41,539 |
| 2 | Assam | 32980,14,469 | 57865,69,711 | 90845,84,180 |
| 3 | Bihar | 57972,68,674 | 131920,55,517 | 189893,24,191 |
| 4 | Delhi | 43455,25,387 | 63177,01,092 | 106632,26,479 |
| 5 | Gujarat | 59314,24,530 | 114739,69,189 | 174053,93,719 |
| 6 | Haryana | 27326,85,945 | 37212,11,295 | 64538,97,240 |
| 7 | Himachal Pradesh | 20734,97,709 | 20164,55,280 | 40899,52,988 |
| 8 | Jammu & Kashmir | 23647,02,977 | 33930,96,483 | 57577,99,460 |
| 9 | Karnataka | 52368,90,830 | 97848,24,782 | 150217,15,611 |
| 10 | Kerala | 51968,83,540 | 83815,04,904 | 135783,88,445 |
| 11 | Kolkata | 22976,76,157 | 22859,94,186 | 45836,70,342 |
| 12 | Madhya Pradesh | 65454,20,015 | 113128,98,247 | 178583,18,262 |
| 13 | Maharashtra | 79381,54,646 | 124635,82,060 | 204017,36,706 |
| 14 | Mumbai | 25595,97,712 | 34728,88,371 | 60324,86,082 |
| 15 | North East | 24227,61,815 | 36107,24,442 | 60334,86,257 |
| 16 | Orissa | 34826,83,519 | 58887,37,830 | 93714,21,349 |
| 17 | Punjab | 29712,54,281 | 47386,84,500 | 77099,38,781 |
| 18 | Rajasthan | 59213,41,889 | 117563,42,583 | 176776,84,472 |
| 19 | Tamilnadu | 69203,13,903 | 122493,76,348 | 191696,90,250 |
| 20 | U. P. (East) | 63534,52,496 | 121337,18,239 | 184871,70,735 |
| 21 | U.P. (West) | 41786,78,325 | 80373,61,952 | 122160,40,277 |
| 22 | West Bengal | 50644,93,049 | 96398,57,970 | 147043,51,019 |
| | **Total** | **1009473,65,288** | **1747457,53,096** | **2756931,18,384** |

**Appendix - Q**

**Annualized CAPEX and OPEX of the network excluding off-net incoming minutes**

| S.No. | LSA | Capex excluding off-net incoming minutes | OPEX excluding off-net incoming minutes | Total Cost excluding off-net incoming minutes |
|---|---|---|---|---|
| 1 | Andhra Pradesh | 68645,71,857 | 125370,07,287 | 194015,79,144 |
| 2 | Assam | 31483,08,101 | 55582,21,812 | 87065,29,913 |
| 3 | Bihar | 52678,49,135 | 122296,65,550 | 174975,14,685 |
| 4 | Delhi | 39551,42,083 | 59542,57,386 | 99093,99,469 |
| 5 | Gujarat | 56161,55,974 | 110921,08,648 | 167082,64,622 |
| 6 | Haryana | 26220,00,524 | 35369,67,324 | 61589,67,848 |
| 7 | Himachal Pradesh | 20296,24,644 | 19728,81,500 | 40025,06,144 |
| 8 | Jammu & Kashmir | 22844,01,384 | 33002,45,931 | 55846,47,315 |
| 9 | Karnataka | 48908,84,435 | 92906,54,445 | 141815,38,880 |
| 10 | Kerala | 49730,03,526 | 80962,81,786 | 130692,85,312 |
| 11 | Kolkata | 21863,68,327 | 21037,16,616 | 42900,84,943 |
| 12 | Madhya Pradesh | 62474,19,325 | 109676,83,663 | 172151,02,988 |
| 13 | Maharashtra | 75693,53,755 | 120114,64,377 | 195808,18,132 |
| 14 | Mumbai | 23406,31,274 | 30895,34,859 | 54301,66,132 |
| 15 | North East | 23590,25,705 | 35434,98,738 | 59025,24,443 |
| 16 | Orissa | 33066,69,892 | 56630,94,884 | 89697,64,776 |
| 17 | Punjab | 28276,53,934 | 45803,47,083 | 74080,01,017 |
| 18 | Rajasthan | 55615,45,764 | 113032,30,886 | 168647,76,650 |
| 19 | Tamilnadu | 64611,95,977 | 115984,96,079 | 180596,92,056 |
| 20 | U. P. (East) | 58536,44,202 | 112555,36,307 | 171091,80,509 |
| 21 | U.P. (West) | 38714,51,055 | 74757,84,024 | 113472,35,079 |
| 22 | West Bengal | 46614,19,318 | 89670,59,259 | 136284,78,577 |
| | **Total** | **948983,20,192** | **1661277,38,442** | **2610260,58,634** |

**Appendix-R**

**MTC Calculation**

| S.No. | Item | Legend | Value |
|---|---|---|---|
| 1 | Avoidable Cost (in Rs.) | a | 146670,59,750 |
| 2 | Total off-net incoming minutes | b | 2499097,79,221 |
| 1 | Termination cost without LF and SUC (in Rs. Per minute) | c=a/b | 0.0587 |
| 3 | Total off-net outgoing minutes | d | 2331839,93,068 |
| 4 | Difference between off-net incoming minutes and off-net outgoing minutes as a proportion of off-net incoming minutes | e=(b-d)/b | 7% |
| 5 | Percent LF | f | 8% |
| 6 | Percent SUC (weighted average sum) | g | 4% |
| 7 | Total percent LF and SUC | h=f+g | 12% |
| 8 | Termination cost including LF and SUC (in Rs. Per minute) | i | **0.0592** |