Comments on TRAI Consultation Paper on
"*Delivering Broadband Quickly: What do we need to do*?"

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Q2. What are the impediments to the deployment of wireless technologies in the access network? How can these deployments be made faster? Please reply separately for each technology.

Wired access networks: DSL and OFC:

Though wireline broadband penetration is not sufficient to cope up with increasing demand, it has a strong case in dense urban areas for alleviating capacity constraints of wireless broadband networks. Following are proposed:

1. As per the TRAIôs recommendations on ñTelecommunications Infrastructure Policyò of April 2011, all government offices, large hospitals and malls, and even JNNURM cities are expected to deploy Distributed Antenna System (DAS) as In-Building Solution (IBS) for providing augmenting capacity and coverage of wireless networks. However, there is no status report available as to the progress of the same. We recommend the following:
    1. **All large buildings/ campuses above a certain thresholds of Sq. Meters shall be equipped with DAS/ Femtocells/ Wi-Fi as in-building solutions**.Energy efficient metal windows shall be recommended for large office spaces to decrease RF signal loss.
    2. **To facilitate the effective use of existing copper lines of about 22 Million held by the government operators, the long awaited policy on "Local Loop Unbundling" be initiated for which TRAI had given its recommendation way back in Apr 2004.** This will provide opportunities for Unified License holders to provide wired broadband services in select areas of operations.
2. Fixed wireless access networks:
    1. Fixed local area wireless networks (such as WiFi or Femtocells) can be connected to the Internet either using DSL/ OFC cables. Recommendations as indicated in (1) will facilitate the same.
    2. **For deployments in semi-urban and rural areas, IEEE 802.11af (as indicated below), or Wireless broadband access networks operating in licensed bands can be a possible solution**. VSAT is also another option which is mentioned under question: 9.
    3. in remote locations microtelecom solutions powered by solar power should be used to reduce dependence on grid power and optimize energy requirements in the context of large tracts of untenanted land and water bodies.

Q7. Are PSUs ideal choices for implementing the National Optical Fibre Network (NOFN) project?

PSUs may be appropriate agencies for the task of building the NOFN but the government should not pay for the entire construction. In a country suffering from extreme deprivation in basic necessities, the government is obligated to focus on more pressing needs than a high speed network that will be used to full capacity at some distant time in the future. Instead the government should invite bids from entrepreneurs in the private sector to use part of the bandwidth, and go ahead with building the network only if a certain (maybe small) percentage of the costs are covered by the private payments. This will ensure that deployment is somewhat aligned with ability to use. This will also put pressure on the government to roll out e-governance applications and on entrepreneurs to come up with applications that can ride off the NOFN.

Q9. Are there any ways in which infrastructure development costs can be reduced? Is it possible to piggyback on the existing private sector access networks so as to minimize costs in reaching remote rural locations?

Yes. Indeed. OFC is just one of the methods of reaching remote rural locations and it is proving to be not only time consuming; but also very expensive (almost double the planned cost).

The other options for providing broadband connectivity in rural and remote areas are:

1. VSAT, specifically on Ku Band (i.e. DTH antenna and fixed GEO satellite system) can be used to provide effective wireless broadband in rural areas. Two way transponders are available at a nominal cost about Rs. 25,000. VSAT provides both access as well as mid-haul. The backbone connection to the Internet or other public networks can happen at Gateways located in the cities where network bandwidth is available in plenty. Transponder bandwidth and availability of the same is an issue. However, as the demand curve is expected to slowly rise, the current Ku band transponders in INSAT system can be used for the time being; augmented by leasing from foreign satellites. The VSAT can be housed in Gram Panchayat as in Community Service Centres. The smaller dish antennas and associated Set Top Boxes and modem consume very little power compared to standalone towers or active OFC elements.
2. Local entrepreneurs such as Cable Operators can provide local connectivity at block level depending on the needs of the customers from this VSAT location, thus extending the coverage to households in case of need.
3. As given in one of the responses, DoT should consider providing authorized access to UHF/VHF (traditionally called TVWS) so that new technologies such as IEEE 802.11af can be used to provide broadband connectivity at rural areas. There can be a PPP model wherein equipment makers such as Cisco and D-Link can set up the infrastructure with possibly some part of cost covered by USOF.
4. A detailed cost comparison has to be done between NOFN and other alternatives mentioned above for each set of GPs. For some GPs, it may be very expensive to extend the NOFN and for these the above alternatives shall be considered.
5. When electricity, water or gas cables and pipes are installed, the construction companies should have an obligation to inform ToD and co-operate with fibre-optic cable installers.

Q15. Are there any regulatory issues in providing internet facility through Wi-Fi Hotspots? What are the reasons that installation of Wi-Fi hotspots has not picked up in the country? What type of business model needs to be adopted to create more Wi-Fi hotspots?

Wi-Fi hots spots can be installed by any of the following:

a. ISP licensees (or Unifled Licensees with only Internet Serices authorization);
b. Unified Access Service Licensees (UASL);
c. Unified Licensees with Access Service authorization
d. Venue owners such as hotels, hospitals, restaurants.

Provision of Wi-Fi hotspots by (a) - (c):

There is less motivation for (b) and (c) to provide Wi-Fi hotspots as this will reduce their 3G data consumption. It is the practice all over that telcos are reluctant to use WiFi for data/ voice offloads as they see it as a substitute and NOT complementary to their 3G/4G offerings. Hence the once that are really interested in providing Wi-Fi are (a). However they are constrained as indicated below:

Currently only UASL and UL holders can provide ñunrestricted Internet Telephonyò Consider a case where a voice caller on a cellular 2G/3G network moves in to a Wi-Fi hotspot. Much like data offload, voice handover shall also occur to the Wi-Fi access networks based on SIM based authentication which is the latest revision of 3GPP specifications. However, if the Wi-Fi hotspot is provided by an ISP, regulation does not allow this voice handover as ISPs are restricted to provide only ñrestricted Internet Telephonyò

Provision of W-Fi hotspots by (d):

A typical working business model for Wi-Fi hotspot is that the location business owner provides the Wi-Fi service and incorporates a Wi-Fi access fee in the actual service invoice (hotel, coffee, office rent). With this arrangement service level is typically high and there is a clear way to bill a consumer or other end user about the service. However, the arrangement between venue owners and ISP/ telcos shall be left to the market.

Even in this case, if the venue owner provides Wi-Fi hot spots through an ISP (category (a) as above), they can offer only ñrestricted Internet Telephonyò, which is likely to affect adoption of Wi-Fi, both by users as well as by venue owners.

Though the above is a very specific use case, in general, ISPs should be allowed to provide ñunrestricted Internet Telephonyò, with a possible ceilings on Interconnect Usage Charges shall be made applicable for Internet to PSTN/ PLMN interconnection proposed by the regulator. **The asymmetric regulation between Voice over PSTN/ PLMN and Internet Telephony should be done away with to promote Wi-Fi in the country.**

Q16. What are other spectrum bands which can be unlicensed for usage of Wi-Fi technology or any other technology for provision of broadband?

An example of opportunistic dynamic spectrum access is in TV white spaces (TVWS). A variation of the ubiquitous Wi-Fi technology that traditionally operates in the 2.4 GHz and 5 GHz, is being tailored to operate in the low frequency TVWS and is popularly known as ôSuper Wi-Fiõ IEEE has made amendment No: 5 to existing IEEE 802.11 standards and the reference standard IEEE 802.22af has been released in 2013. The typical use case of communication in TVWS is often associated with wireless coverage of wide areas for example, suburban and rural areas) where installation of cellular towers and associated facilities can be expensive.

The NTP 12 indicates about the possible use of TVWS for wireless broadband.

We recommend that DoT, initiates steps for the implementation of IEEE 802.11af technologies. One of the essential requirements for the deployment of this technology is the creation of Geo Location Database (GLD) that keeps track of spectrum chunks available along time/ location dimensions for the IEEE 802.11af access point to opportunistically use it. The low frequencies in the UHF/ VHF bands are ideal for improving wireless broadband penetration in the country.

Before the implementation of GDB, DoT can even consider license through authorization method for granting exclusive spectrum in TVWS for quick deployment of IEEE 802.11af networks. This is due to large chunk of spectrum in 300-800 MHz is not used by the broadcaster(s) unlike in many other countries where spectrum holes need to be identified for Super Wi-Fi. Once the GLD is created, the licensed operators need to comply with GLD guidelines.

Q17. How much spectrum will be required in the immediate future and in the long term to meet the target of broadband penetration? What initiatives are required to make available the required spectrum?

Following Table summarizes the current assignment and in pipeline of licensed spectrum in various bands:

Table 1. Currently available (CA) and in Pipeline (P) licensed spectrum allocation across countries

Band	USA		Europe		Australia		Brazil		China		India	
	CA	***P***	***CA***	***P***	***CA***	***P***	***CA***	***P***	***CA***	***P***	***CA***	***P***
700 MHz	70					90						
800 MHz	64		60	0-60	40		65		20		23	
900 MHz			70		50		20		52		36	
1800 MHz		15	120-150	0-20	150		150		90	60	86	
1900 MHz	130	10	15-35		20		20		35	20		
2100 MHz	130	30	120		120		110		30	90	40	30

2300 MHz	20				98						40	
2600 MHz	194		150-190	0-50		140	175			190	40	
Total	**608**	**55**	**540-615**	**0-60**	**478**	**230**	**554**	**0**	**227**	**360**	**265**	**30**

In India, the allocation for mobile services is less than half of that in the rest of other countries, with the exception of China. However, most of the countries including China have initiated the process of vacating some of the spectrum held by incumbents such as government and public utilities as shown under the column ñPò For example, in addition to the 360 MHz shown in the table, unpaired Digital Dividend band 703-803 MHz may also be made available in China for mobile services once the country deploys Digital TV.

Hence in about 2-3 years, most of the countries would have allocated 600-700 MHz of spectrum while India is only planning to release 30 MHz for commercial mobile services.

On a comparison basis, India needs in the range of 300-400 MHz of licensed spectrum to be assigned for commercial mobile services in the near future.

Table 2. Current assignment of spectrum (in MHz) in various bands and way forward

Band	IMT Identified	Current Allocation for Mobile Services	Allocation to Defence	Allocation to Others	Way forward
450-470	2 x 7.5			20	Spectrum held by the broadcaster in UHF/ VHF range, however under/un used shall be released for Super Wi-Fi deployment
698-806	2 x 45		2 x 15		Release of 2 X 45 to be harmonized with APT 700 and auctioned by the end of 2016.
824-844/ 869-889	2 x 20	2 x 5 to 2 x 15	2 x 2.5		
890-915/935-960	2 x 25	2 x 18.6 to 2 x 22.2	1.2 to 4.8	2 x 1.6	
1710-1785/ 1895-1880	2 x 75	Average 2 x 45	2 x 20		Immediate: Licensed Shared Access; Long term: Release Defence holding
1900-1910/ 1980-1990	2 x 10`		2 x 2.5		Swapping: Retain 1900-1907.5 and 1980-1987.5 MHz for Defence and swap it with 1939-1954 MHz for uplink for mobile services supplementing it with the existing downstream frequencies with a block of 2129-2144 MHz.
1920-1980/ 2110-2170	2 x 60	2 x 20	2 x 40 (2 x 5 to be released		Immediate: Licensed Shared Access; Long term: Release Defence holding

			soon)		
2300-2400	100	40	20		
2500-2690	190		40 to Govt Operators some have been surrendered	150 to Department of Space	
3400-3600	200			Possible interference with FSS at 3600-4200 MHz	

Q19. What are the measures required to encourage Government agencies to surrender spectrum occupied by them in IMT bands?

Our proposal is two-fold: a restructuring of the WPC to allow smooth coordination between the MCIT and MoD, and the deployment of Licensed Shared Access (LSA), details of which are given below for sharing government spectrum for mobile services:

1. In India, the Wireless Planning and Coordination (WPC) Wing, the national spectrum manager, is in the Department of Telecommunications and headed by a Wireless Advisor, who holds the rank of an Additional Secretary to the government. He reports to the Member (Technology) who in turn reports to the Secretary of the Department of Telecommunications. In effect, the Wireless Advisor to the GoI is buried under the bureaucracy of one department while its function requires coordination across ministries.
   In case there are competing claims of two ministries to certain blocks of spectrum, or issues regarding the deployment of alternate networks for ministries vacating blocks of spectrum, the matter usually end up at the Cabinet Secretariat of the Prime Ministerôs Office. Further, all spectrum is either held by ministries of the government, or held in reserve for some ministry by the WPC following an agreement on future use, or is part of the unlicensed spectrum bands, or unassigned at the present time. There is no practice of sharing a spectrum band across ministries.

   The abandoned Communications Convergence Bill of 2001 sought to establish a Spectrum Management Committee with Cabinet Secretary as its Chairman. It also aimed to establish the Wireless Adviser to GoI as the Spectrum Manager and act as Member-Secretary of the Spectrum Management Committee. It was envisaged that the Spectrum Manager would be empowered to play a coordinating role across international agencies, between Central and State governments and across various users across the Ministries.

   We recommend that Communication Convergence Bill be revisited to peg spectrum management in the higher levels of government bureaucratic

structure so that it is empowered to make spectrum allocation decisions across ministries.

2. European Commission released ECC Report 205 on Licensed Shared Access (LSA) in February 2014. LSA is a complementary spectrum management tool that facilitates the introduction of new users in a frequency band while maintaining incumbentsô existing services on the same band. LSA ensures a certain level of guarantee in terms of spectrum access and protection against harmful interference for both the incumbents and LSA licensees. In this paper, two different opportunities for LSA technology are identified: (i) LSA Region Jump and (ii) LSA Band Fill. In LSA Region Jump, a country demarcates a frequency band that is used in another region for mobile communication and opens that band under LSA licensing scheme. In LSA Band Fill, the mobile operators have licenses only for a part of a 3GPP band. The rest of the band is licensed to other users. The mobile operators can get the missing parts of the band into use by utilizing the LSA licensing scheme. The same approach can be used to extend the geographical coverage of the existing mobile operator licenses to cover the areas that have been restricted from their license.

In the areas where a 3GPP band is partially licensed to other users, ***LSA Band Fill*** brings a possibility to open the missing parts of the band to the mobile operators so that the existing users can continue their use of the spectrum. In addition to the benefits of the LSA Region Jump, in LSA Band Fill, the user equipment, which is currently available on the local market can immediately be used. In the network, new base stations need to be installed as the mobile operators want to keep their exclusive parts of the spectrum and the LSA extension of the frequency band separately. An illustration of LSA Band Fill is shown in Figure 1.

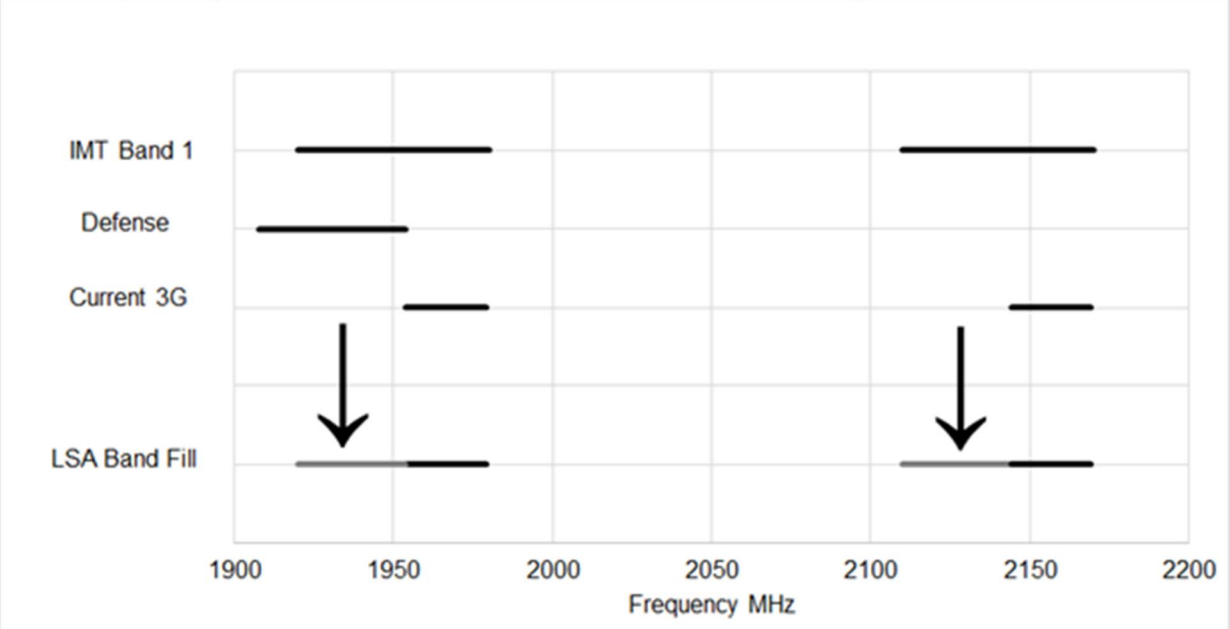

Figure 1. Illustration of LSA Band Fill across different users

One of the promising alternatives is to deploy *LSA Band Fill* option to supplement operators' existing spectrum licenses from the government spectrum holding in 1800 and 2100 MHz bands. While the LSA blocks in 1800 MHz can supplement LTE

offerings of the operators, 2100 MHz can augment spectrum holding for WCDMA services. The assignment method could be a suitably designed auction of the shared spectrum blocks in each of the 22 telecommunications regions in the country. The revenue accruing out of the auction could be directly used to build alternative networks for MoD so that the blocks can finally be vacated for commercial mobile services, similar to the ñincentive auctionsòof the digital dividend spectrum being proposed in the U.S.

An important aspect of the above option is for MoD not to give up their spectrum; instead retain the property rights of the spectrum as an incumbent; share it on needs basis across location/ time dimension; cease sharing if there are any encumbrance or for its own use as and when required; provides much needed flexibility to both MoD and the mobile operators.

Q20. What should be the time frame for auctioning the spectrum in 700 MHz band?

India is a unique position to free-up 700 MHz, thanks to the proliferation of Direct-to-Home (DTH) and digital cable TV networks, even in rural areas of the country. The ecosystem for deployment of wireless broadband services in APT 700 plan is still evolving and networks are being deployed in Australia. However, an indication of the availability of 2 x 45 MHz band for FDD with 10 MHz guard band as proposed is very much required for operators to take this in to account while participating in Feb 2015 auction.

The ideal time for auctioning of 700 MHz in our opinion is end of 2016 when the ecosystem is developed and to some extent mature. This will avoid failure of operators to roll out services due to lack of ecosystem support much as what happened in 2300 MHz band. **However, DoT should freeze the timeline for releasing 700 MHz from the Ministry of I&B and indicate the auction day and how much spectrum will be made available, much before the upcoming auction so that the bidders can take in to this in their business model.**

Q21. Do you agree with the demand side issues discussed in Chapter 5 and Chapter 6? How these issues can be addressed? Please also indicate any other demand side issues which are not covered in the CP.

Others:

There needs to be coordination between ministries to roll out e-governance, health, and education applications in alignment with the availability of the broadband infrastructure for uptake of services. the local common service centres should be tasked with spreading digital literacy.