

**Comments on the Qualitative Requirements of Public Broadband
Wi-Fi Network, in response to TRAI Consultation Paper.**

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As a probable user stake holder, the following perceived qualitative requirements are presented for considerations.

1. Being a near green field implementation of Public Broadband Wi-Fi Network, a Unified Indian Wi-Fi Network implementation will be in larger national interest. It could be administered through a Government controlled consortia. A unified network will save both financial and technical resources by avoiding duplication of network. Further, it will integrate geographically separated local resources to a unified Wi-Fi network structure, allowing a faster roll out.
2. Currently all Wi-Fi hot spots being located at premium places, they should not be given major weightage for discovering the cost of implementing the future Wi-Fi network.
3. The unified network can be developed by inducting licensed Wi-Fi hot spot operators. Licenses should be provided for geographic locations with range limitations/coverage limits. The licenses could be an individual or a SME or a corporation. This opportunity can be used to generate employment. There should be common network ID with all licensees adhering to the declared terms and conditions. TSPs can be allowed country wide separate SSIDs to converge their mobile network users with Wi-Fi network, using the same account. However unnecessary duplication of network for the benefit of any individual TSP should be discouraged. An initial coverage map can be finalized, based on which licensee can be allowed to install long range Wi-Fi hot spots with predetermined specifications. Overlap areas can also be planned for convenient location of Wi-Fi hot spot base station equipments. The coverage maps should give some freedom for convenient location of Wi-Fi hot spots in the entire geographic area. The TSPs can be made responsible for nurturing individual licensee to establish Hotspots in different parts of the country. However the licensees should be monitored for price inflation in any manner. The on site equipment rooms should be designed with maximum care for minimum power and cooling requirements. DC operation with solar energy should be promoted for all the available equipments.
4. The aim should be to create Wi-Fi hot spots at all the habitats, either permanent or temporary and in and around all the productive assets of the country, including farm lands. The implementation can be non linear and discrete, but all the hotspots should converge to make a countrywide unified

network, supported by central authorization and billing mechanism. The Wi-Fi hotspots should be implemented using both Long Range Wi-Fi base stations and Short range base stations and can run on OFC, Wireless and Satellite backbones.

4. TRAI can standardize a few set of Wi-Fi hot spot configurations in terms of range and user capacity. The aim should be to achieve minimum investment spent on individual Wi-Fi hot spots, so that economies of scale can be achieved from the beginning itself. Long range Wi-Fi hot spots with complete back-end equipment need can be specified so as to help individual licenses to own and operate such hardware with suitable licenses, in plug and play mode. Standardized 4G LTE based plug and play backhaul connectivity attachments for the long range Wi-Fi hot spots can be finalized, to keep implementation cost to the lowest. Award based competition mode can be adopted to discover the specifications and cost of various sets of Wi-Fi hot spots.
5. All ISPs can be made partner members of the Unified Wi-Fi Network controlling consortia for smooth operation of the network. Their primary task should be to augment their respective mobile 3G/4G connectivity in specific areas which will act as backhaul to the remote Wi-Fi hot spots across India. All major TSPs can be given different areas of the country for mobile network augmentation. In some cases, bandwidth pooling among TSPs in specific remote and isolated areas can also be considered as cooperative collaboration for increasing digital footprint.
6. The backhaul connectivity from ISP to Wi-Fi hot spots can be divided into Wired, Wireless and Satellite mode. The planning should be to extend high bandwidth low cost OFC points to all the Wi-Fi hot spots using the current available network with suitable expansions. However Wireless should be kept as backup or replacement of the wired OFC links in the initial period. The existing 4G LTE mobile network can be used to act as the Wireless back haul connecting Wi-Fi hot spots to ISP points, to facilitate immediate roll out. This will facilitate the use of the TSP's already existing back end data offloading network of each cell. The OFC connectivity through Bharat Net project, can act as a OFC backhaul till the Panchayat level.

An alternate set of frequencies (White Space, proposed E and/or V bands or free unused/un-allocated licensed spectrum etc.) can be exclusively developed for providing Backhaul only, with the aim to achieve high throughput long range point to point links for establishing mesh configurations. These links should use directional antennas to reduce multi use of frequency with no interference. A single mesh point can be feed with ISP bandwidth using OFC or Wireless 4G LTE channel to distribute the bandwidth to other link points which in turn can distribute the bandwidth further to multiple Long range Wi-Fi hot spots. In low density rural areas this network configuration will cater to multiple users with minimum ISP bandwidth.

Local server based implementations can further augment the digital experience even with occasional backhaul disconnection. In some cases even Ku/Ka band satellite terminals can be connected to mesh link points to serve as ISP backhaul, in case it is difficult to integrate ISP points either through OFC or Mobile 4G LTE networks. The possibility of integration of 3G/4G as upload bandwidth and satellite as download bandwidth in a multi-source non liner capacity channel mode for the backhaul point can also be explored. This will reduce the cost of satellite ground equipments significantly. The upload bandwidth can also be implemented using multi hop channels over the wireless mode using dedicated backhaul frequencies.

BSNL/MTNL's fixed line bandwidth over traditional copper wire (ADSL+) can also be used as backhaul connection to Wi-Fi hot spots, where it has reach. All land based existing network should be leveraged in place of wireless connectivity possibilities to increase data throughput without any frequency resource limitation. Currently data sharing by individuals are not allowed, however all such high speed connections can be allowed to act as back-end connectivity in the unified Wi-Fi network, creating multiple ISP paths.

7. After mapping the signal coverage map for the nation wide Wi-Fi network, existing Telecom Service Providers can be advised to augment their 4G network at remote places where it is difficult to make provision for OFC based ISP points for the Wi-Fi hotspots. In this situation all long range Wi-Fi hot spots in remote places can get ISP connectivity through the TSP's 4G mobile connections and these links will serve the purpose of backhaul connectivity. The concept of Standardized Long range Wi-Fi hot spots should be promoted to reduce infrastructure cost and reduce technical complexity to the lowest level. Capacity augmentation can be undertaken with additional small range hot spots as per traffic and signal strength requirements. The concept of 2 wheeler, 3 wheeler and 4 wheeler borne Wi-Fi hot spots with provision for temporary OFC link points and/or 4G LTE wireless backhaul can be explored to cater to immediate temporary requirements. Community based local Wi-Fi repeaters should be allowed for increasing signal strength and traffic decongestion on ground floor and basement level.
8. In Andhra Pradesh, the Wi-Fi network can be made to ride on the AP Governemnt's Overhead Fiber to Home OFC backbone. As the OFC will be running across all the Cities and all the villages, select homes/business establishments can be used to establish the Wi-Fi hot spots. The issue of backhaul ISP connectivity will not be a problem, making way for easy roll out of the Wi-Fi network. Being backhaul easily available everywhere, small range Wi-Fi hot spots can be established across the geographic area.
9. As Railtel is running its Optical Fiber Network across the Country along the Railway tracks, it can be made a contact point for extending either branched

fiber or Wireless backhaul links deep into rural territories to specific mesh points for providing ISP bandwidth to a large geographic area in a wireless manner. Long range Wi-Fi hot spots can be connected to this mesh backhaul for sharing ISP bandwidth. Railtel can even integrate locally available 4G LTE service to its OFC network to create wireless ISP backhaul for deeply located Long range Wi-Fi hot spots in rural areas, located around the Railway tracks.

TRAI can release a technical paper regarding Railway Station Wi-Fi hotspot details along with financial implications, for setting a reference for finalizing the eco system for the country wide Wi-Fi network.

Low cost 4G LTE equipment should be extensively used for the Wi-Fi backhaul as part of existing licensed band mobile network or for establishing dedicated point to point links, outside the purview of the existing mobile network.

10. In case Ku/Ka band satellite bandwidth resource is available in limited manner, then the Wi-Fi hot spot backhaul can be operated with limited duration and limited time of day mode, with provision for local servers. The same mode can also be implemented where the wireless backhaul has limited capacity. This mode will help to make Internet available to remotely located people for specific periods of the day.
11. Centralized user management and authentication should be promoted. Authentication of users can be done in 4 ways.
 - a. Current way of OTP using existing mobile network. Good for temporary short term use. The possibility of direct deduction from the mobile balance may also be explored, converting the mobile balance as a wallet for Wi-Fi data.
 - b. User accounts valid in local areas at town level to facilitate Wi-Fi mobility within geographic boundaries. Already registered users with the local service provider can use the network, even if the central authentication is not available or mobile network is congested.
 - c. Nationwide valid user accounts with or without device binding. Devices can be tied to user accounts on exclusively or non exclusively basis. Multiple user accounts and multiple devices per user account can be allowed with suitable restriction mechanisms. The model for user identification should be like the current roaming management in mobile networks.

Authentication can be through AADHAAR number or mobile number or through a separate verified email id created with the controlling consortia.

In case of device binding accounts, there should be means to deactivate them temporarily and/or permanently with a single point contact, to avoid misuse in case the device is lost.

- d. There should be provisions for international users. The user should be able to create temporary user name and passwords by using their Mobile number, Passport number and Visa details. The same can be done over internet from the home country of the foreigner. Accounts can be activated only after reaching to India and getting an OTP in the international roaming activated mobile phone along with geo tagging. When Visa is issued on arrival in India, the same process can be completed in Airport and Port areas where Visa is issued. Free limited internet facility can be made available in such areas with facility for identity/photo recording using CCTV.
12. The possibility of pledging of licensed spectrum by TSPs to the Wi-Fi controlling consortia for the back-haul links in remote areas can be explored. This will help to use the existing available 4G LTE base station hardware for establishing wireless backhaul. The possibility of establishing VOIP and VoLTE type of voice communication with in the Wi-Fi area can also be explored to increase the mobile phone reach to deep into rural territories, without the need for any cellular network.
13. Once a unified structure is planned and the Wi-Fi network is developed as a trusted network, the revenue models can be framed. In this mode the existing TSPs and ISPs will work in close coordination to provide the ISP backhaul connectivity and ISP data. This will generate additional revenue for the TSPs using their existing network in a bulk data mode. This will also decongest their scare mobile bandwidths, by reducing overheads. The implementation of the country wide unified Wi-Fi network will result in data explosion, benefiting all the stake holders. The local Wi-Fi hot spot provider can be supported to recover his investment in ROI model and can be assigned the task of micro management of the site from operation and maintenance point on long term basis. An USO fund can be created to manage any additional revenue once the Wi-Fi hotspot providers get their investment back. Advertisement form of revenue can also be worked out after suitable research.
14. Once a mature trusted country wide Unified Wi-Fi network is rolled out piggy backing on the existing OFC and 4G LTE mobile network and satellite terminals, the Mobile networks can start data offloading thorough the Wi-Fi network, creating a complete seamless digital foot print across India.
15. The best use of a country wide unified Wi-Fi network will be by the Transport Sector. A revenue model can be planned taking that into consideration so as to make the system self sustaining from the revenue generated through transport sector. Specific interface hardware can be developed to integrate the location based service requirement of vehicles using the public Wi-Fi network both for law enforcement and for business management purposes. As the transport sector is a premium sector, a license fee can be charged from automobile device manufactures for hardware codecs, needed for using the Wi-Fi network for transport sector purposes.

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