IAMAI Response to the TRAI Consultation paper on Proliferation of Broadband Through Public Wi-Fi Networks

August, 2016

Introduction

IAMAI would like to assert its support to the underlying objective of the consultation paper – expanding Internet access by examining the need to encourage public Wi-Fi networks in the country and address the issues pertaining to the proliferation of public Wi-Fi networks. This is a commendable initiative by the Authority as we have seen that even with moderate expansion in access to data, there has been an explosion in websites, applications and platforms that has had a dramatically positive impact on employment and the country's GDP growth.

India needs to unlock, explore and experiment with different types of technologies viz., Cable, Loons, Drones, VoLTE, VOIP, Satellite technology with the prime focus on *Whitespaces and Wi-Fi technologies* as the next best frontier for innovation, competition and connectivity. In particular, proliferation of Public Wi-Fi as middle and last mile connectivity and a supportive ecosystem to promote it is a major need of the hour.

Overview of Public Wi-Fi Ecosystem Globally

There has been an unprecedented growth in public Wi-Fi hotspot deployments globally. The computed aggregate growth rate has been predicted to increase by 13.23% in 2013-18.[1] There are nearly 9 million public hotspots in the world so far [Fig 4.1] which includes public Wi-Fi hotspots deployed by mobile and fixed-line carriers as well as third-party Wi-Fi service providers and excludes community Wi-Fi. APAC with more than 6 million hotspots constitutes 68% of the global hotspots[2] followed by LATAM and Europe. Among the BRIC nations China and Brazil have the highest number of public Wi-Fi hotspots. India at present has 30,000 hotspots across the country. Recent years have not only seen a significant expansion in the build out of public hotspots but also addition of new capabilities to previous/existing public Wi-Fi generations. The next phase of public Wi-Fi is characterized by a huge expansion of services and revenue streams, and of the variety of service providers. The key technical and market developments in various advanced nations have enabled new business models for existing and new service providers.

Some of the Key Drivers for Global Adaptation of Wi-Fi are:

- **Increased Traffic:** Worldwide, the overall data traffic is set to increase 12 times between 2013 and 2018[3], and mobile data traffic is set to rise at an even higher rate, to reach 11.9exabytes/month by 2017.
- **Increased speeds and reduced latency** – Wi-Fi can provide better speed equivalent to 3G speed as shown in the illustration below depending on the technology in use.
- **Improved quality of service** – as voice and video move to IP, and always-on broadband connectivity becomes vital to ways of living and working, QoS expectations rise and operators need to meet these expectations in order to attract and retain customers.

[1] http://www.wballiance.com/wba/wp-content/uploads/downloads/2015/05/wba-interim-report.pdf
[2] https://www.abiresearch.com/press/global-wi-fi-hotspots-will-grow-to-71-million-in-2/
[3] http://www.wballiance.com/wba/wp-content/uploads/downloads/2013/11/WBA-Industry-Report-2013.pdf

- **Increased mobility** – behavior patterns are shifting so more people are using broadband from mobile devices to stay connected at all times.
- **Network Congestion**- As more and more people use wireless broadband, networks come under pressure. Wi-Fi can help offload data in crowded areas.

In most of the countries the operators have initiated Wi-Fi hotspots at various locations as there is business clarity. In India operators have recently joined the race to provide Wi-Fi under the concept of freemium [Free Premium]. Most of the business models today are highly successful due to such models. The economic logic behind the freemium model is: when supply of a product increases, the demand for its complimentary products also increase. The free product drives the revenue generation by creating demand for not just the other products but also by increasing the number of customers/users. The Success of such models depends on the number of people it attracts to use it.

Following are some of the best case business models adopted worldwide in well established and emerging markets.

Best case Business Models adopted Worldwide

Markets	Business Models	Monetization Options	Description
Well Established	Time-Based Model	Pay –as-you-go Access	The operator offers hourly and daily passes for access to its Wi-Fi network
	Free access driving other services		Wi-Fi as another way to deliver providers' own content, including TV programmes, games and news.
	Wholesale access	B2B2C	TSP/ISP Forming partnerships with venue owners so they could propose Wi-Fi networks with a paid or free model to the end customers. The operator shares the investment costs and revenue with the venue partners
	Bundled Wi-Fi Model	Added value for broadband subscription	Bundles Wi-Fi access in all its mobile data broadband tariffs. Single Account gives millions of connection viz., Roaming packs.
	Advertising and sponsorship	Revenue from ads and sponsors subsidizes the cost of access to consumers	Teaming up with the consumer product brands, where Ads display on the landing page.
	Managed services (venues and outdoor)		Offers managed service for public locations that want to provide Wi-Fi to their customers and employees (e.g., coffee shops, hotels, airports, stadiums, railway stations).
	Cellular offload (user driven)	Cost savings with effective Network management. Free Wi-Fi as a customer retention strategy	Offloads cellular data traffic to Wi-Fi to help alleviate network congestion, lower network operating costs, and reduce (or defer) 3G and 4G capital expense (CapEx) investments.
Growing Rapidly			
	Cellular Offload [Carrier Driven]	The amount of data used will be billed with the existing data plan or bill. Customer Retention and reduction in subscriber churn	Sells Wi-Fi network access to mobile operators on a per-user or per-MB basis.
	Community Wi-Fi Hotspots	Heavy offloading strategy in congested areas. This is a partitioning model.	Wi-Fi connections at home hubs by enabling users to share their Wi-Fi signals with others.

	Hotspots managed by Venues and Brands	Freemium Models	
	Wi-Fi Roaming Services	Wi-Fi roaming in partnership with other operators on a bilateral basis. Connecting to Wi-Fi networks while travelling is crucial to enable operators to monetize actual and latent demand for mobile broadband access.	There is a demand for Wi-Fi roaming among a broad base of consumers, including those who don't use data at all while roaming for fear of bill shock.
	TV everywhere	It is driven by high quality video, which is dependent on good bandwidth and QoS for premium customers.	TV Everywhere (also sometimes known as authenticated streaming or authenticated video on-demand) refers to a business model which enables customers to watch TV on mobile devices or laptop when they are not at home.
	Big Data analytics		Availability and use of consumer data in real time for promotion, spot discount and mobile ads is captured with relevance.

Economics of Unlicensed Spectrum

Radio spectrum is used for different radio communication services based on the level of frequency, coverage/range and use.[4] A part of this radio spectrum is sold or licensed to operators and dedicated for defence purpose and rest fall under unlicensed spectrum. Most of the spectrum which is allocated for mobile communication use and TV broadcast consists of bands that do not have interference issues. Unlicensed spectrum on the other hand is open to use by any certified device/router which is easy and cheap compared to licensing. Unlicensed spectrum maximises productive output in a world where last mile access network can easily interact with sophisticated and popular devices viz., Wi-Fi and Bluetooth.

Wi-Fi service uses unlicensed spectrum in 2.4 GHz and 5GHz bands. Other than these traditional bands, many countries use TV white space for Wi-Fi, aka white-fi which operates under 802.11af standard. Consumers rely on Wi-Fi these days utilizing it seamlessly while they are outside or on the go. Furthermore, unlicensed spectrum will play an important role in proliferation of IoT and smart cities. Seoul, the Korean Capital has almost universal Wi-Fi which is twice the speed of Wi-Fi in the US, whereas, in India, Wi-Fi technology is a highly underused asset. The opportunity cost to use unlicensed spectrum as a gap-filler[5] is missed out. While unlicensed spectrum can be a great opportunity to maximize the use of spectrum, offering up limited bands is futile.

The regulators all over the world are worried about the interference problem that can arise due to these unlicensed bands if put to use. There are many services that use unlicensed spectrum viz., Wi-Fi, cordless phones, home security solutions, Car entry systems etc. The regulators should note that the marginal overhead cost involved in designing the operating rights to minimize the interference is outweighed by the considerable economic value of the unlicensed spectrum.

[4] Radio Spectrum is divided into nine bands, each band performing similar tasks as per the ITU Radio Regulations.
[5] to fill guard bands with low-power devices

Unlicensed spectrum can play a great role in country like India which has 80% unconnected citizens. In India fixed broadband penetration in rural and difficult geographical locations is dismal. Operators too hesitate due to heavy capex and opex. In such conditions unlicensed spectrum is the best substitute. In many countries unlicensed spectrum has provided tremendous economic value. In the US it has provided economic value over $220 Billion[6] in 2014-15. Spectrum lying idle and the bands that are not allocated or lying unused are causing not only economic loss but also wastage of scarce resources. Spectrum is a peculiar resource which is infinitely renewable, divisible in 6 to 8 dimensions, and unused spectrum is a lost opportunity that can never be recaptured.[7]

Wi-Fi Infrastructure Cost Model

Wi-Fi technology helps two or more devices [computer or mobile] to communicate with each other without the help of any land cable or fixed line. To build a Wi-Fi infrastructure is less complex than building traditional telecom infrastructure and is as efficient in terms of performance and cost to the consumers. Internet hotspot gives internet access over a WLAN through the use of a router connected to a link to an ISP. WAP [Wireless access point] is the device that allows wireless devices to connect to a wired network using Wi-Fi. It is different from hotspot which is the physical location.

Existing infrastructure such as electricity poles and bus shelters can be used to mount routers and other equipment. This will reduce the operating cost and required investment for a city wide deployment strategy. The initiatives like smart cities and M2M/IoT proliferation would not be possible with only licensed spectrum. For these models to work in India, major change in outlook is necessary for the policy and regulatory bodies.

Key Wi-Fi Technology Trends and Best Practices Globally

The Wi-Fi platform is evolving rapidly with new best in class technologies emerging and revolutionizing the market. These technologies define the scale, range, coverage, capacity and throughput. The key technological trends seen in the Wi-Fi market are, Hotspot 2.0, 802.11ac, emergence of 11ad and 11ax, White-Fi, VoWi-Fi, 802.11n, Google Fi, Wi-Fi aware , WiGig ,Wi-Fi direct etc. These technologies will create new revenue models and more players in the market providing greater access that can transform the internet economy.

Snapshot of various Wi-Fi Technologies existing and upcoming [Best Practices]

Technologies	Release Date	Frequency Range	Category	Advantages/Specification	Technology presence/in use in India
802.11u [Hotspot 2.0]	2011	2.4/5 GHz	Sim Based Technology [8] based on the protocols of 802.11u.	Mobile Phones automatically connect to the Wi-Fi network once they are in range.	No
802.11ad	2012	60 GHz ISM Band	Multi –gigabit speed wireless communication technology.	7GBPS speed. Short distance and high volume data transfers.	No
802.11ac	2013	5 GHz	Faster Data Rates [at least 500 Mbps @ 5 GHz on a single link and 1gbps for multi-station	802.11ac is a supercharged version of 802.11n works exclusively in the 5GHz band	Yes

[6] http://www2.itif.org/2015-coase-wifi.pdf
[7] http://www2.itif.org/2015-coase-wifi.pdf
[8] http://www.bullseyetelecom.com/details.aspx?p=8496B07276EB38BF&ppid=149353&beid=65CB6FCEBB503ED5

			operation]		
802.11ah	2016	sub-1 GHz	Wireless networking protocol/standard that gives at least 100 Kbps @ sub-1 GHz	Low energy/power consumption. It will allow low rate 802.11 wireless stations to be used in sub-gigahertz spectrum.	This standard is yet to be finalized. [Draft Status]
802.11ax	2019	2.4/5 GHz	Upcoming technologies which can provide a speed of 10gbps and will support technology like MU-NIMO[Multi-user multiple input/multiple output]		
802.11ay	2017	60 GHz			
802.11aj	2016	45/60 GHz			
802.11af/ White-FI	2014	470-590 MHz	This technology allows WLAN operation in TV whitespace/UHF bands.	It has a better range over the other bands i.e., 2.4 and 5 GHz	
Project Loon	2013-14	2.4 and 5.8 GHz ISM Bands	High altitude balloon network operating in stratosphere aka floating cell towers	It is a reliable and cost effective way to beam internet service from sky to ground antennas. The technology will use solar and wind to power the electronic equipment.	The tests to soon begin.
Project- Fi	2015	-	A new intelligent technology which connects to the fastest Wi-Fi or LTE network in an area.	It can connect to two 4G towers at the same time and allow customers to automatically switch between the networks. This can resolve the call drop issues. Most importantly this technology helps you refund the unused data unlike in the current system where the operators charge you in advance for data packs and do not refund or allow carry forward.	No
Wi-Fi aware	-	-	A new technology that allows multiple Wi-Fi devices to communicate with other nearby devices offline.	-	Not yet launched
Li-Fi	2011[9]	Uses light waves from LED light bulbs	The technology is called Optical Wireless Communication [OWC]	OWC which uses visible light communication [VLC] or light waves instead of Radio frequencies [RF]. It is proved capable of sending data at speeds of upto 1GBPS, 100 times faster than most Wi-Fi.	No
Pruthvi (Postage Stamp Chip)	2015	Wi-Fi chip that can uses TV White Space		All the advantages of TV whitespace Wi-Fi has been listed in the next section under Key Suggestions [Unused Spectrum and TV Whitespace]	Yes, testing stage.

Source: Indian Express and Bulls-eye Telecom

A timely intervention in terms of a robust policy framework for public wi-fi will enable India to cash on these innovations and bolster Digital Empowerment in the country. The new advanced technology would:

1. Require less equipment to produce the same quality service as a DSL or cable.
2. Help in faster data speed
3. Require seamless authentication
4. Wider Roaming
5. Low Capex and Opex
6. Lead to improved QoS and Security

Key Ares of Focus in India

Following are some of the key bottlenecks that need to be cleared:

[9] http://purelifi.com/wp-content/uploads/2013/09/Shedding-Light-On-LiFi.pdf

1. **Lack of Public sector participation and Right of Ways [ROWs]**

Lack of Public sector participation, issues of Right of Ways [ROWs] for the private sector, heavy infrastructural investment for the TSPs, lack of government initiative to incentivize the Telcos and private sectors to invest in uneconomical region, uneven broadband roll out and underutilization of the already laid out cable TV networks etc are some of the glaring issues for unsuccessful fiber penetration in the country. There are 55,000 villages in India where the mobile operators cannot reach.

2. **Backhaul is Essential**

Government's focus on Fixed Broadband is essential. For the Wi-Fi technology to work as the last mile connectivity, or as data offload strategy, the government has to seriously think of providing fixed line and optical fibre network to homes or be able to take the connectivity at least to the base station. Otherwise Spectrum assigned will remain underutilized. It has been seen that in most of the cases where optic fiber network has been provided, due to lack of middle and last mile connectivity, the internet has not reached the user.

3. **Healthier Play of Licensed and Unlicensed Spectrum is Necessary**

The gap between the fiber points to the users can be filled by the use of Wi-Fi technology. The country has plenty of idle and unused spectrum that can be used for affordable middle and last mile connectivity and for connecting Wi-Fi clusters. These bands can be brought under unlicensed spectrum or lightly licensed as is the case in many developed and emerging economies.

The five-judge apex court bench headed by Chief Justice S.H. Kapadia in 2012 said auction could be a better option where the aim is maximisation of revenue. The principle that the State owned natural resources should be allocated only by a process of auction is not a principle applicable universally and is so clarified by this Court in Natural Resources Allocation.[10] The court was answering a presidential reference seeking its opinion on whether auction was the only method of allocating natural resources across the board.

Hence, as auction could not be the sole method of dispersing natural resources the government should allow a healthier play of licensed and unlicensed spectrum of certain bands.

For instance, the TV whitespace band or the UHF band was regulated to operate under unlicensed or lightly licensed ways in many countries to provide a platform for innovation in the wireless industry. This helped create methods to provide future broadband wireless services and applications to people at a lower cost. The UHF band is globally used for high power terrestrial TV broadcasting. This band is perfectly suited for Wi-Fi technology. This option has been tested in many developing countries like Kenya, Tanzania, South Africa and the Philippines where internet penetration is low due to geographical issues and expensive fiber.

The Indian Government should periodically re-evaluate spectrum allocation to identify underused or unused spectrum and reallocate it to ensure efficient use of spectrum in each market.

4. **Resolve the Interference Issue with facilitating technology**

[10] In Re, Special Reference No.1 of 2012, (2012) 10 SCC 1

Technically it was observed that for transmitting an unlicensed spectrum one needs to keep the level of the frequencies low to prevent the signals from colliding. But such interference concerns to licensed users, the predominant reason behind the limited allocation of unlicensed spectrum, have greatly diminished with the advent of facilitating technology. Interference-free spectrum use by multiple operators is enabled by some of the best technology Wireless Local Area Network (WLAN), Ultra Wide Band (UWB), Radio Frequency Identification (RFID), Near-Field Communication (NFC)systems, and others supporting cost-efficient and flexible spectrum usage of unlicensed spectrum.

5. Encryption and Privacy

An effective Wi-Fi encryption and privacy protection can give confidence to individuals and businesses to use Wi-Fi technology. In many countries haphazard encryption regulations have affected the growth of Wi-Fi. In India too, regulatory uncertainty surrounding adoption of Wi-Fi technology will undermine the competitiveness of the market by discouraging the internet users. WEP is old standard and has serious security weakness and therefore WPA protocols should be used. WPA2 has come in with even higher secured technology which is based on IEEE 802.11i and provides 128-bit AES based encryption. Fake Wi-Fi hotspots and snooping issues need to be checked with a strong encryption protocol in India. IT administrators deploy technologies where their network is set up in such a way that each user has a separate encryption. Such technologies are available and can be seamlessly deployed at each location or access point.

IAMAI Position on Public Wi-Fi Propagation

Given the abovementioned background, the Association responds to the consultations with the following broad principals in mind:

- Each and every individual should get fair, equal, high quality, high speed and affordable access to the Internet. Open and free access to the Internet should be provided through these networks in a manner that conforms to all principles of net neutrality and the current rules.
- Subject to conformity to all principles of net neutrality and current rules, market forces should determine the relationships between ISPs/TSPs, content providers and other parties active in the digital environment to foster innovation, creativity and the development of hyper competitive yet nascent content industry. No overbearing regulations should impose any burdens on deployment of Wi-Fi networks.
- TRAI should also consider working with the industry and the DoT to identify a roadmap for unbundling the local loop as has been done in the US. This is imperative as in the times to come cable companies will also be at the forefront to drive broadband penetration in India alongside telcos owing to the ongoing digitalization of cable television operations. Given that last mile cable connectivity in India is in a chaotic state and local cable operations in India are largely unorganized, it is important that the regulator, industry as well as the government focus on cable operations to drive broadband through two way interactivity and mandate suitable principles and standards taking a leaf from international best practices to that effect.

Additional measures over and above as provided in the consultation paper may also be taken to expand Internet access to consumers:

Free access for rural consumers: Creating a public subsidy program to enable TSPs to provide free Internet access to rural consumers, along the lines of other national social security programs currently used by the country.

Time based models: Allowing TSPs to provide free Internet access to all consumers at certain time periods when the network utilization is low.

Introductory models: Allowing TSPs to provide free Internet access to new consumers (those who are new to Internet or are using data on the TSPs network for the first time).

Public or community networks: Building access points around the country geographically selected to provide access to those consumers who cannot afford to buy private services.

Income Targeting: Enabling TSPs to provide free Internet access to consumers below a certain income level.

Responses to Issues for Consulation

Q1. Are there any regulatory issues, licensing restrictions or other factors that are hampering the growth of public Wi-Fi services in the country?

Answer:

The Association recognizes the following regulatory challenges that need to be resolved.

1. **Unavailability of adequate unlicensed spectrum:** Commercially significant frequency bands which have been de-licensed completely (outdoor and indoor) in many countries are still licensed or partially licensed in India. This severely limits the capabilities of businesses to deploy the latest technologies and expand service in India.

    a. 5150-5350 MHz
    b. 5725-5875 MHz
    c. 60 GHz ('WiGig'/ V-Band)
    d. 71-76 / 81-86 GHz (E-Band)

    Further, limitations on EIRP and power spectral density and inconsistencies in these limitations across bands hinder proliferation and enhance the cost of deploying access points.

    Additionally, TV whitespace band is the most suited to provide broadband in rural areas as an efficient backhaul media. The lack of enabling regulation for using this band is a major hindrance in enhancing connectivity.

2. **Inadequate backhaul capacity:** Backhaul is critical to internet service. Acquiring Right of Way permissions from various authorities has long been highlighted as a cumbersome process and a barrier for setting up the telecom infrastructure need to invest in more internet backhaul. It is appreciated that the government is already working on bringing a

legislation to 'rationalise Right of Way procedures and charges for laying of telecom infrastructure — currently varying widely across states'[11].

3. **Lack of Wi-Fi infrastructure best practices:** The present Wi-Fi ecosystem in the country is highly fragmented. Lack of flexibility to innovate and scalable best practices have hampered expansion and investment. Areas of most concern are interoperability, common Know Your Customer (KYC) compliance, authentication, accounting and localization requirements. Currently regulations appear to discourage the utilization of resilient and distributed datacenters in which virtual machines can efficiently monitor, manage, process and secure Wi-Fi services. Restrictions exist in the form of requirements for localised billing and customer information within India, onerous KYC regulations, and unclear internet transit requirements. Datacenters (known in the industry as "cloud" technology) are typically large capital investments co-located with appropriate power and other technology. In addition, for reliability, data can be replicated across multiple locations. Removing these barriers would vastly reduce costs and will accelerate expansion of the Wi-Fi sector.

4. **Prescriptive security requirements:** The existing security requirements governing public Wi-Fi networks are prescriptive and adversely impact user experience and convenience. Such requirements discourage users to sign-on to public Wi-Fi services. With new technologies and standards available, providers should be able to address legitimate security concerns without hindering user experience.

5. **Lack of participation of smaller entities and individuals:** Currently reselling of Internet data is not permitted. This restriction prevents small entities and individuals to participate in the Wi-Fi ecosystem and expand Wi-Fi services in neighbourhood, villages, and other areas. To provide Wi-Fi services one needs to take franchisee or become agent of an Internet Service Provider (ISP), which may discourage participation of smaller entities.

6. **Mobile data offload**: Lack of policy clarity on offloading of mobile data by a telecom operator onto the Wi-Fi network operated by another provider is one of the constraints limiting offloading of mobile data on Wi-Fi networks.

Q2. What regulatory/licensing or policy measures are required to encourage the deployment of commercial models for ubiquitous city-wide Wi-Fi networks as well as expansion of Wi-Fi networks in remote or rural areas?

1. **De-licensing spectrum:** The following frequency bands need to be de-licensed completely for indoor and outdoor use in accordance with international best practices and developments.

    a. 5150-5350 MHz
    b. 5725-5875 MHz
    c. 60 GHz ('WiGig'/ V-Band)
    d. 71-76 / 81-86 GHz (E-Band)

[11] http://articles.economictimes.indiatimes.com/2015- 07- 29/news/64996753_1_telecom- infrastructure- digital- india- telecom- service- providers

Specifically for E-Band, a lightweight registration process may be used to ensure that point-to-point E-Band links do not interfere with existing links.

The limitations on EIRP and power spectral density and inconsistencies in these limitations across bands need to be reviewed and aligned with international best practices and developments. For instance, EIRP levels should be increased to provide parity of coverage between 2.4 GHz and 5GHz.

The TVWS band should also be delicensed as a large number of countries have already done.

2. Increasing backhaul capacity: The process of enacting the legislation to rationalize Right of Way procedures and fee for laying of telecom infrastructure across states needs to be expedited. Any such legislation/policy should be premised on permitting deployment of Wi-Fi infrastructure on government buildings/ electricity poles free of cost or at very low cost.

3. **Enabling flexible Wi-Fi infrastructure and service standards**: Wi-Fi providers should be permitted to easily obtain hosting, management, and connectivity services from third parties (Wi-Fi aggregators/hubs) that leverage efficient scalable and resilient datacenters, i.e., cloud technology. Cloud-based Wi-Fi solutions can efficiently provide user authentication, KYC & other compliance, and accounting at scale across millions of users and hundreds of ISPs. Such services will enable all ISPs and Wi-Fi providers to achieve interoperability and economies of scale. The ability to outsource these services to a cloud-based solution will eliminate barriers to entry for new Wi-Fi infrastructure, facilitate expansion in remote and rural regions, and ultimately will reduce costs of Wi-Fi services to users. However, for cloud-based solutions to develop, the regulatory policy necessarily will have to remove regulatory hurdles such as in-country restrictions on data management (since cloud technology relies on pre-existing datacenters in multiple global locations) and requirements for equipment inspection (since cloud technology uses virtual machines). Reference should be made to best practices in other jurisdictions such as in the United States, United Kingdom and Japan by adopting the global standards like hotspot 2.0 and 802.11U.

4. **Defining security requirements at a high level:** Rather than laying down prescriptive security requirements including KYC compliance, the government should define the security requirements at a high level such that the policy emphasizes on outcomes rather than the process. It should allow industry the flexibility to deploy mechanisms to meet such requirements including technological and contractual measures. With modern technologies, Wi-Fi providers should be able to address government's security concerns in a way that would not hinder user experience.

5. **Enabling participation of new players including small entities and individuals to provide Wi-Fi services:** Allowing reselling of Internet data and setting up of public Wi-Fi access points without any legal constraints will go a long way in proliferation of Wi-Fi services. It will allow efficient bandwidth utilization (for e.g. subscribers who have unused bandwidth can put data

for sale), bring down data prices and generate jobs. Multiple aggregator platforms/hubs could emerge to provide authentication, metering and payment services. The market forces should be allowed to mature the ecosystem with innovation and entrepreneurship without any regulatory intervention. While ISPs continue to be liable for meeting licensing requirements, the Wi-Fi aggregators/hubs can enable implementation of such requirements through business agreements with ISPs. This should not be restricted under the reselling clause of the ISP license. All verification/ authentication and service support can be handled by the underlying ISP. Also, outright restrictions with regard to the regulatory, licensing, and legal status of Wi-Fi repeaters, Wi-Fi mesh network devices, and other equipment which might be used to boost signal on customer premises (collectively, CPE or Customer Premises Equipment) must be removed.

6. **Enabling mobile data offload:** The policy should explicitly allow offloading of mobile data by the telecom service providers (TSPs) to Wi-Fi networks that are operated by other providers including fixed line ISPs. The TSPs and Wi-Fi providers need to deploy global standards to enable interoperability.

7. **Mandating Neutral Wi-Fi deployments in public spaces:** The policy should mandate neutral host Wi-Fi deployments in public spaces so that any provider is able to participate by leveraging the scalable cloud infrastructure solutions and there is no monopoly of a particular provider in a specific venue.

8. **Incentivizing hotspots in rural and remote areas:** Public hotspots in remote and rural areas may not have commercial viability for established Internet Service Providers (ISPs). There is a need to incentivize businesses to open Wi-Fi hotspots in such areas. While market forces may determine such incentives, the government may explore the possibility of subsidizing such hotspots through the use of Universal Service Obligation Fund (USOF). The government may also consider reducing the license fee and provide tax exemption for Wi-Fi services especially in rural/ remote areas.

Q3. What measures are required to encourage interoperability between the Wi-Fi networks of different service providers, both within the country and internationally?

There are various market driven models (neutral Wi-Fi networks, direct roaming agreements between ISPs, Wi-Fi hub/aggregator/exchange models) which can allow interoperability between Wi-Fi networks. The government should not mandate a particular model but instead encourage various models to emerge. The government should focus on liberalizing the policies which presently limit the proliferation of Wi-Fi services (such as de-licensing spectrum, simplifying RoW permissions). The issues related to interoperability will also be addressed by market forces as the proliferation of public Wi-Fi increases. The industry (including consortiums like WiFi Alliance, WBA) has been working to develop technologies and standards to enable interoperability and this work needs to be leveraged to mature the Wi-Fi ecosystem.

Q4. What measures are required to encourage interoperability between cellular and Wi-Fi networks?

The policy should allow offloading of mobile data by the telecom service providers (TSPs) to Wi-Fi networks that are operated by other providers including fixed line ISPs. The TSPs and Wi-Fi providers need to deploy global standards (e.g. 3GPP) to enable interoperability.

Q5. Apart from frequency bands already recommended by TRAI to DoT, are there additional bands which need to be de-licensed in order to expedite the penetration of broadband using Wi-Fi technology? Please provide international examples, if any, in support of your answer.

Commercially significant frequency bands which have been de-licensed completely (indoor and outdoor) in many countries are still licensed or partially licensed in India. This severely limits the capabilities of businesses to deploy latest technologies and expand service in India.

Spectrum	Recommendation	Rationale
5150-5350 MHz	License exempt outdoor usage with appropriate power limits aligned with global best practices and developments	Existing international equipment ecosystem. Primary candidate to relieve Wi-Fi crowding at 2.4 GHz
5725-5875 MHz		Existing international equipment ecosystem. Primary candidate to relieve Wi-Fi crowding at 2.4 GHz
60 GHz ('WiGig'/ V-Band)		Last mile fiber alternative for cellular backhaul and fixed Internet
71-76 / 81-86 GHz (E-Band)*		Last mile fiber alternative for cellular backhaul, fixed Internet and village connectivity

*Specifically for E-Band, a lightweight registration process may be used to ensure that point-to-point E-Band links do not interfere with existing links.

The widespread deployment of Wi-Fi Access Points introduces a challenge of how to backhaul them to the nearest high speed internet connection (usually a fiber POP). Given these devices will be deployed close together and at or near street level, short range, high speed (several hundred Mbps) wireless data links are needed. The V-Band and E-Band are ideally suited for these short range, densely deployed, links

The limitations on EIRP and power spectral density and inconsistencies in these limitations across bands need to be reviewed and aligned with international best practices and developments.

- While de-licensing for effectively eliminating spectrum costs is an important step in facilitating public Wi-Fi deployments, technical spectrum use rules should also be modified to promote public Wi-Fi deployment and ensure efficient use of de-licensed spectrum. The international ecosystem for consumer Wi-Fi equipment is concentrated at 2.4 GHz and 5 GHz. In India, the majority of portable Wi-Fi devices operate at 2.4 GHz. The penetration of 5 GHz devices is increasing and, with its relatively larger amount of bandwidth, will be critical to increasing Wi-Fi capacity in the near-to-medium

term. Rules that facilitate the efficient use of 5 GHz are critical. The case of the United States, where FCC has consistently expanded the unlicensed 5GHz bands, demonstrates that such delicensing (a) can be performed without creating wide-scale disruptive interference; and (b) can drive significant economic stimulus.

- In particular, EIRP and power spectral density limitations in at least part of the 5 GHz de-licensed band should be increased so that a 5 GHz access point (AP) can achieve approximately the same range as a 2.4 GHz AP. Matching of EIRPs among the two bands would allow operators to cost-effectively deploy APs supporting 2.4 GHz and 5 GHz (e.g., as opposed to a potentially cost-prohibitive approach with different densities of APs in the two bands).

  GSR 45E dated 28.1.2005 permits unlicensed operations up to 4 W ERP in 2400-2483.5 MHz, while GSR No 46E dated 28.1.2005 permits unlicensed indoor operations of up to only 200 mW EIRP in 5150-5350 MHz and 5725-5875 MHz.

  Note: IND71 to the 2011 National Frequency Allocation Plan already provides that DoT may permit on a case-by-case basis operation of wireless access systems at up to 4 W ERP in 5725-5875 MHz. We suggest that 4 W ERP in 5725-5875 MHz be permitted broadly on an unlicensed basis. To achieve 4 W ERP with a Wi-Fi signal, a proportionate increase in the power spectral density limit is required and also recommended. Operations up to 10 mW EIRP (equivalent to 6 mW ERP) in any 1 MHz sub-band of 5725 to 5825 MHz are currently permitted. In order to permit Wi-Fi signals with 20 MHz bandwidths to operate at 4 W ERP, the power spectral density limit should be increased to 200 mW ERP per 1 MHz of the 5725-5825 MHz band.

- Additionally, TVWS frequencies should also be delicensed for meeting the connectivity needs of remote/ rural areas. International examples of permissive TVWS licensing or outright delicensing include the United States, Canada, United Kingdom, Singapore, Finland, Malawi, South Africa, and Ghana. Pre-license pilots have been permitted in Colombia, Bhutan, Botswana, Brazil, Cote d'Ivoire, Ghana, India, Indonesia, Japan, Kenya, Gabon, Morocco, Namibia, Nigeria, the Philippines, South Korea, Tanzania, Taiwan, and Uruguay.

Q6. Are there any challenges being faced in the login/authentication procedure for access to Wi-Fi hotspots? In what ways can the process be simplified to provide frictionless access to public Wi-Fi hotspots, for domestic users as well as foreign tourists?

The existing regulatory requirements are overly prescriptive discourage users from signing on to public Wi-Fi services. The government should define the security requirements and allow industry the flexibility to deploy modern technologies (for example that allow SIM based identification) to meet those requirements. A number of technologies have been proposed to unify and simply Wi-Fi roaming and access. In general, we support the approach taken by the 802.11u standard, HotSpot 2.0, and Passpoint ("Wi-Fi Certified Passpoint) technologies. Such technologies permit online sign-up, immediate account provisioning, secure registration, adding multiple devices, and the enforcement of operator-specific policies.

Q7. Are there any challenges being faced in making payments for access to Wi-Fi hotspots? Please elaborate and suggest a payment arrangement which will offer frictionless and secured payment for the access of Wi-Fi services.

Payment issue is not specific to public Wi-Fi but needs to be addressed from the larger perspective of digital economy. Unified Payment Interface (UPI) and mobile wallets are example of free market dynamics offering various solutions. Government should not mandate any specific platform(s) and should support emergence of multiple payment solutions. Multiple payment methods should be allowed for access to Wi-Fi hotspots, such as cash, electronic recharge, paper vouchers, online payment, etc.

Q8. Is there a need to adopt a hub-based model along the lines suggested by the WBA, where a central third party AAA (Authentication, Authorization and Accounting) hub will facilitate interconnection, authentication and payments? Who should own and control the hub? Should the hub operator be subject to any regulations to ensure service standards, data protection, etc?

There are issues with a central third party AAA hub. Some of the concerns are: such approaches unnecessarily centralize information, raise innovation barriers, and increase costs of compliance. Moreover, such an approach would represent a security target for hackers providing a single point of critical information storage.

Instead, TRAI could adopt a alternatives models like wi-fi Aggregators providing AAA services or other models oriented at the standardization of AAA APIs which are to be implemented by identity providers (login providers) wishing to participate such that ISPs can connect to each other on mutually agreed commercial arrangement to provide intra-operability of the payment instruments/ balance transfer etc.

The regulatory requirement to host data and infrastructure in-country needs to be relaxed to attract innovation in this area in the Indian market.

Q9. Is there a need for ISPs/ the proposed hub operator to adopt the Unified Payment Interface (UPI) or other similar payment platforms for easy subscription of Wi-Fi access? Who should own and control such payment platforms? Please give full details in support of your answer.

Further to our response to Q7, the ISPs/hubs should be allowed to enter into agreement with any of the payment platforms based on market dynamics. As highlighted earlier, as the proliferation of Public Wi-Fi increases, issues such as payments will get addressed by the market forces.

Q10. Is it feasible to have an architecture wherein a common grid can be created through which any small entity can become a data service provider and able to share its available data to any consumer or user?

The common grid providers might bring the greatest commercial value to the small entities through aggregation that enables those entities to participate in regional or national commercial offerings. In parallel, the common grid providers could make it efficient for the commercial operators to deliver their services over a multitude of small networks. If the end user is allowed to put his own APs / repeaters to enhance his signal and provide to the surrounding communities commercially then there should not be any meaningful technical barrier to a common grid architecture. Multiple common grid

players should be allowed to operate, without being regulated, for reasons as highlighted in our response to Q8.

Q11. What regulatory/licensing measures are required to develop such architecture? Is this a right time to allow such reselling of data to ensure affordable data tariff to public, ensure ubiquitous presence of Wi-Fi Network and allow innovation in the market?

Allowing reselling of data and setting up of public Wi-Fi access points without any legal constraints can go a long way in proliferation of Wi-Fi services by enabling efficient bandwidth utilization (for e.g. subscribers who have unused bandwidth can put data for sale) and bringing down data prices, and can also open huge employment opportunity at bottom of the pyramid..

Multiple grids/ aggregator platforms/hubs could emerge to provide authentication, metering and payment services. Such grid providers can enter into business agreement with ISPs and the compliance requirements can be negotiated between the two parties based on the respective roles and responsibilities.

Notably, there should be no legal obligations on the entities and individuals setting up and providing Wi-Fi services. While ISPs continue to be liable for meeting licensing requirements, the Wi-Fi aggregators can enable implementation of such requirements through business agreements.

Q12. What measures are required to promote hosting of data of community interest at local level to reduce cost of data to the consumers?

For urban areas with greater market potential, the market forces will be adequate to create the local ecosystem. In rural and remote areas, government may have to incentivise the creation of local ecosystem.

For areas where there is inadequate fibre/copper backhaul, refreshing of the data at the local level can be time consuming and expensive. To overcome this challenge, satellite link can be leveraged for backhaul. But this would require policy clarity on use of satellite communication for this purpose.

Moreover, TRAI or the Government must encourage “edge caching” by explicitly permitting such activities without prohibitive regulation or licensing. Such caching benefits both end users by reducing latency as well as cost and ISPs by reducing upstream bandwidth requirements. Provided there are no regulatory or legal hurdles imposed, caching thus presents sufficient incentive to both ISPs and their customers to be driven by market dynamics and there is no need for any regulatory intervention.