Q13:

TRAI apparently refers to Wi-Fi as a catchall technology apt for city-wide, remote and rural deployments in this consultation paper. Wi-Fi is quite obviously a brilliant technology but, as is the case for all IEEE specifications, was designed with specific environments in mind:

- Indoor technology
- No QoS
- Range less than 300m

It can be argued that an indoor technology may be used outdoors; in fact the world is full of IP67 compliant outdoor AP's to prove this argument. Indeed, there is no problem in providing outdoor hotspots for Wi-Fi. However, putting a Wi-Fi AP into an IP67 enclosure doesn't in any way turn Wi-Fi into an outdoor technology apt for rural deployments. This is due to physical limitations of the modulation techniques used in Wi-Fi where the cyclic prefix is designed for indoor applications at less than 300m distance and this is a design issue intrinsic to IEEE 802.11. Hence, putting Wi-Fi to work at longer distances will very quickly exceed the multipath capabilities of Wi-Fi beyond the correctional capabilities of MIMO causing dramatic performance issues or downright network failure.

The world is full of examples of failed Wi-Fi deployments. We know of very few City-Wide Wi-Fi networks that actually work, in any case for each of the networks that works there are probably 99 networks that fail. In fact, the only ones that work are those that respect the above mentioned physical limitations of Wi-Fi. A good example could be Verizon`s Fios deployment at Long Island where each hotspot has a very limited range of operation around 200m. Bad examples could be several WISPS in Spain fooled into believing that Wi-Fi would be a good and cheap way of service delivery at several kilometres distance. They all learned the hard way that one would be lucky to get 1Mbps performance at 2 km distance (if and when the network worked after adding a new client that is) when they believed that 802.11n provides 300Mbps. By now, the same WISPS have all turned to IEEE 802.16-2012 but have in the mean time wasted a lot of money on failed Wi-Fi deployments.

All over the world, "Technology Neutrality" and "De-licensed" all too often translates to "Frequency Abuse". There is indeed a high risk that widespread delicensing of 5GHz frequencies for outdoor Wi-Fi translates to abuse hindering the deployment of alternative technologies apt for service delivery of rural broadband. So we believe that TRAI should carefully consider a policy change in order favour rural broadband deployments.

An example could be the "Vive Digital" initiative in Colombia where the Colombian government, through a combination of national fibre deployment and IEEE 802.16-2012 (Wimax), is providing broadband coverage to every village in the country even within the Amazon jungle. They're doing this because they've realized that rural deployments are not the prime business focus of mobile operators who tend to centre their efforts on dense population areas. As the amazon jungle occupies 60% of the Colombian territory having only 7.5% of the population they've realized that the only way to provide broadband to these areas in a reasonable time is to undertake the deployment on a government basis.

India faces a similar problem having thousands of villages without any broadband coverage whatsoever. IEEE 802.16 can solve such problems due to its kilometric reach with cell sizes ranging from 5 to 15kilometers. Hence, rural broadband have a solution today for India using an adequate combination of advances in the national fibre deployment together with the right wireless technologies for the problem at hand.

IEEE 802.16-2012 is an outdoor technology, having full level 2 QoS, is designed for ranges up to 15km and uses bandwidths ranging from 1.75MHz to 10MHz. By contrast, IEEE 802.11 is an indoor technology, having no QoS, is designed for ranges up to 300m and uses bandwidths ranging from 20MHz up to 160MHz for the latest 802.11ac standard.

If we compare the throughput of 802.11n say, using 2x40MHz channels in order to provide 300Mbps gross throughput, to 802.16 using the same spectrum (8x10MHz channels), the latter is able to provide 296Mbps net throughput. Note the distinction between gross and net throughput. The key is that IEEE 802.16 is deterministic in performance and is thus capable of guaranteeing service delivery. On the other hand everybody knows that Wi-Fi is totally un-deterministic, and hence one would be lucky to obtain a 20% performance in dense environments. So the question should be raised whether it is reasonable that a single outdoor "frequency hungry" 802.11ac AP should be allowed to interfere with sixteen 802.16 frequency efficient base stations?

Indeed, the solution to both problems could be straight forward:

- Allow sufficient adjacent frequency for Wi-Fi operation in dense environments.
- Prohibit the use of Wi-Fi beyond its physical limitations, i.e. restrict cell sizes to say 200m outdoors
- Small cell sizes improves frequency reuse and hence city-wide coverage can be achieved using less overall bandwidth
- Reserve spectrum for long range rural deployments and don't allow indoor technologies like 802.11 to interfere with such frequencies.

In many countries the entire frequency range from 5470 MHz to 5875 MHz is de-licensed and free to use outdoors. Europe is a prime example.

In India, although only the frequency band from 5.825 to 5.875 MHz has been fully delicensed (IND72), TRAI has already foreseen wireless use in the range from 5570 to 5825 MHz (IND69 and IND71), most of it in on a case-by-case basis. Additionally, some outdoor wireless use has been foreseen from 5.150 to 5.250 MHz (IND68). So, in our opinion, there is sufficient spectrum available for potential de-licensing. Delicensing the entire available spectrum would probably lead to frequency abuse so we believe that the "case-by-case" statement of IND69 provides an adequate tool for TRAI to guide the coexistence of city-wide Wi-Fi with rural broadband, ensuring that abuse by indoor technologies do not render the spectrum useless for long range technologies.