Summary

The TRAI Consultation Paper on **IMT – Advanced Mobile Wireless Broadband Services** has sought stakeholder and industry comments on various issues that will facilitate introduction of IMT – Advanced mobile broadband services. The concerned issues can be categorized into 3 major areas:

- Spectrum related issues
- Spectrum pricing
- QoS parameters and security issues

Spectrum related issues

Effectiveness and success of any wireless communication service depends upon the spectrum band and block size allocated to service provider for provisioning of services. Other related issues regularly deliberated upon are mechanism of allocation of spectrum, pricing of spectrum, maximum spectrum permitted, eligibility conditions and roll out obligations to be imposed on service provider. We have discussed spectrum pricing as a different section altogether.

We are of the view that internationally harmonized frequency bands as recommended by international standardization agencies such as ITU-T should be made available. Performance levels and coverage area will determine the minimum block size required for provisioning of new generation services.

We have always advocated market driven pricing of spectrum. This can be achieved by auctioning of spectrum with a reserve price fixed by government. Auction of scarce national resource such as spectrum ensure that only serious players bid and probability of spectrum squatting is less and moreover government receives its share of revenue from industry.

Any entity interested in providing wireless services should be allowed to bid for spectrum. If an entity has sufficient resources to back its bids, it should be allowed to bid for spectrum. Prior experience should not be made mandatory for intenders; upon successful bidding/winning of spectrum new player should take all necessary approvals (such as UASL, security clearance, etc) before spectrum is handed over for provisioning of services.

Once spectrum is auctioned and government has received market based price for national resource, it should be left for winner to determine roll-out time,

technology to be used, etc. If an entity has paid good amounts as spectrum price and is not in a hurry to get return on his investment, it should be left to him to determine best suited business case. Regulator should not only prescribe minimum performance criteria at higher levels such as interoperatability, QoS, QoE, lawful interception, etc and leave actual implementation nitty-gritty to winner.

Further, fair market practice requires that government should not cap maximum number of players but should only decide minimum number of players to be present at any given time. Idea is to ensure that a monopolistic/duopolistic market condition is avoided.

Government should further ensure that the service providers are not unnecessarily and excessively taxed. If market price for the spectrum has already been paid, then further spectrum usage charges, fine on non-compliance to roll-out obligation, etc should not be imposed on successful bidders. Multiple taxation by way of tax, fine, charge, etc should be done without, because ultimate end-user is burdened with such excessive charges.

Pricing of spectrum

We are of the view that spectrum cost should not be more than 10% of the total usage cost to a consumer. We have assumed very conservative adoption rate of 1% of total Indian population and considering families having aggregated monthly expenditure of Rs. 5,000/- upwards on all kinds of entertainment and communication services (ie TV, internet, fixed line, mobile phone, etc) for IMT-A services. This means impact of spectrum cost on monthly bill should not be more than Rs. 500/- ie 10% of monthly bill of Rs. 5000/-.

Our back of envelope calculation with a monthly repayment of 1% (for 20 years) shows that reserve price for spectrum for pan-India should not exceed Rs. 60,000 crore. This will mean that at the end of 20 years, winner has completely repaid cost of spectrum.

Basis same, we are of the view that reserve price for pan India IMT-A spectrum should not exceed Rs. 60,000 crore for the entire spectrum to be auctioned for IMT-A which could be 100MHz, 200MHz or 500MHz. The resulting reserve price for per MHz spectrum cost may be Rs. 600 crore, Rs. 300 crore or Rs. 120 crore for a bandwidth of 100 MHz, 200 MHz and 500 MHz respectively.

If the number of IMT-A adopters increases, percentage contribution of spectrum cost in aggregate monthly tariffs will further come down, making a profitable proposition for both service users as well as service providers.

QoS parameters and security measures

IMT-A architecture is very similar to internet architecture and accordingly appropriate security measures should be built-in so as to avoid crashing of the same at the same time taking care of all the necessary security requirements such as lawful interception. Moreover, mechanisms to authenticate and trace origin of packets should also be built into the system.

Measures similar to CALEA law should be imposed in the national interest.

Moreover, for IMT-A service, not only QoS but QoE should also be prescribed by authorities. A service provider may be fulfilling its contractual requirements in terms of QoS but end user may not be very happy with the experience of using IMT-A service. Metrics to measure QoE should also be tracked by regulator. QoE is usually dependent on service and should be accordingly modified for each service; while QoS can continue to track overall performance and robustness of the network.

Issues for Consultation

1. **Whether there is a need to define a particular user equipment or architecture to be used by the vendors or this may be left to the market forces?**

2. **Whether there is a minimal set of performance characteristics the UE has to meet before it is permitted to enter a network? These characteristics are over and above the inter-operability, protocol conformance and emission tests which presumably the UE has already passed.**

(Combined response to Issue Number 1 and 2 above)

An IMT-Advanced network is based on an all-IP packet switched network with peak data rates of up to approximately 100 Mbit/s for high mobility and 1 Gbit/s for low mobility. This also means that in such network, traditional voice calls are to be replaced by IP telephony.

A variety of service providers will provide wireless communication services using a variety of frequency bands and different technologies. Shift from one network to another network should be a seamless transition for users (provided their UE is enabled to work in other networks as well). Once a UE has already passed tests related to inter-operability, protocol conformance, etc, they should be allowed to operate in all networks. Imposing minimum performance criteria is analogous to imposing artificial entry barrier. A UE with better performance characteristics will provide a better user experience and in the end will find a favorable disposition with its user base and as such will shape the market dynamics as well as technical landscape. We are not in favor of imposing minimal performance criteria for UE as it is against the principle of free market and will not be in favor of end-customer who may be forced to shell out more money for such UE.

Similarly, it should be left to market forces and business cases to decide upon a UE and/or architecture by vendors. Of course, any UE/architecture such selected by a vendor should conform to international standards and requirements as prescribed by Indian laws and regulations. Beyond such point, regulator should not have any interference in decision making of a vendor with regard to UE/architecture acceptability.

3. In addition to what has been described above, what can be the other security issues in IMT-Advanced services? How these security issues can be addressed?

4. What basic security frameworks should be mandated in all networks to protect customer?

(Combined response to Issue Number 3 and 4 above)

Network and services supported by it can be threatened in various ways. For example, some entity may breach into bandwidth allocated to a service provider; a network may come under malicious attacks whereby it cannot provide services or it QoS goes down. Moreover, for a particular service, user identity is being misused.

Wireless services sector is no more in nascent stage and it is a fairly mature market in India. Since the inception of wireless services, service providers have found the ways to secure their bandwidth and would continue to do so to ensure profitability.

Out of all the threats mentioned above, network security is most important, given the nature of services to be provided by IMT-A, network should be made secure from both outside attacks as well as inside attacks. We believe this can be countered by building-in modularity in IMT-A networks. Networks should be such that if one module/portion is compromised, it should not impact the performance of entire network. Centralized architecture will be more prone to crashing in the event of sustained attacks. Modular or de-centralized architecture will not let the entire system to be down if one module shuts down. Essentially, IMT-A architecture should be similar to internet (since threats are similar to internet), something like "managed internet" with defined boundaries. Network should also have a mechanism to test for packet authentication and should maintain a packet register to authenticate origin of packets and minimize spams in the network.

Issues related to user identity are similar to that as in internet applications. However, somebody may be able to compromise user's accounts and also start (mis)using services subscribed by the user. Sustained awareness campaigns should be run to make users aware of

various ways there online presence and identity is at risk. Some kind of malware protection can also be installed on all user equipment.

Since, communication networks forms an integral part of the nation's lifeline, regulator/government may also look at formulating and implementing an Indian version of CALEA law, ensuring that lawful interception is permitted in the nation's interest. Moreover, information requested by authorities should be promptly provided and a court order should not be required to comply with the same.

5. Which spectrum bands should be identified for the IMT-Services in India?

Ideally, we are of the view that government should auction frequency bands and should not be bothered about the type of services offered by a service provider in a particular service band. Let the service provider decide what makes best case and provide that particular service. Essentially, regulator and government should have a technology-neutral and application/service-neutral approach towards this entire game.

Alternatively, government should use/allot internationally harmonized frequency bands for provisioning of not only IMT-A, but on all other services/networks/technologies as well. This will reduce customization burden (both time-wise and resources-wise) on the service provider.

The regulator may wish to look at bands at 3GHz and above as well.

One point to note here is that the fundamental system design and networking protocols remain the same for each band; only the frequency-dependent portions of the radios have to change. Accordingly, government may keep on releasing spectrum in different bands as and when available.

6. What should be the block size of spectrum to be put on auction? How many blocks of spectrum should be allocated/ auctioned per service area?

7. What is the minimum spectrum block size for effective use of 4G technologies?

8. What should be the maximum amount of spectrum which a service provider can be allocated through auction?

(Combined response to Issue Number 6, 7 and 8 above)

IMT-A achieves higher data rates and requires wider radio channels, such as 10 or 20 MHz wide channels. To deliver very high data rate, the system must minimize interference and employ looser reuse.

To ensure fair market practices, the regulator must ensure that at all times a pre-determined number of players must always operate in the market. Instead of capping, maximum number of players, let market forces and spectrum available determine the maximum number of players operating in a service area. Maximum number of service providers should be capped on the basis of optimum level of spectrum slots that are available for a frequency band and not on any arbitrary license based criteria or HHI analysis.

Statistically, for a fair market, 5 to 7 service providers should be present at any time in a telecom circle. This means minimum number of blocks to be auctioned for a good competition and reasonable market share should be around 5 to 7 blocks. The block size of spectrum to be put on auction should be determined on the basis of the minimum performance guarantee. Similarly, maximum spectrum that a service provider can hold should be determined on the basis of subscriber density and extent of its coverage area. A cap on maximum spectrum held could be considered to prevent the eventuality of the creation of monopolistic/duopolistic structures. For example, in a particular area, a service provider can hold maximum spectrum such that minimum number of service providers at any time should be 3 or 4.

Moreover, once spectrum trading and sharing is permitted, issue of maximum spectrum held by a service provider loses relevance. Instead of hoarding spectrum, a service provider will be able to trade the same with other service providers.

9. Whether there is a need to specify the use of particular duplexing scheme based on the band in which spectrum allocation is done? If yes, in the case of TDD, is it required to specify further the

frame duration, mandate frame synchronization using one of a specified set of timing sources and a permissible set of Uplink/Downlink sub-frame schemes compatible with the IMT-A standards?

Regulator must only specify QoS and QoE parameters and minimum acceptable performance related to the same. Let the service provider decide best technology scheme, best suited for that particluer band making best business for him. We are of the view that regulator should only prescribe input and output conditions, sets threshold for performance parameters and treat actual technology used as a black box. Let the service provider decide the optimum architecture and/or technology that makes a successful business case for them, simultaneously fulfilling all government conditions, requirements and also bringing profitability for service provider. Let there be multitude of competent technologies used by different service providers, the same should not be of any concern to the government.

10. What should be the reserve price per MHz in different spectrum bands?

There should be a reserve price per MHz of spectrum. *We are of the view that spectrum cost should not be more than 10% of the total usage cost to a consumer.*

We are considering a monthly EMI of 1% for asset or spectrum cost (spectrum is treated as an asset) for 20 years ie 1% of Reserve Price, which includes capital repayment, interest charge and resulting in zero value at the end of license tenure.

Assuming that the 1% of total Indian population will be using IMT-A. IMT-A can be used to provide all kinds of services. We are considering families having aggregated monthly expenditure of Rs. 5,000/- on all kinds of entertainment and communication services (ie TV, internet, fixed line, mobile phone, etc). As stated above, we are of the view that spectrum should not cost more than 10% of this aggregated value.

ie Spectrum Cost = 10% of Rs. 5,000/-
= Rs. 500/-

Assuming, 1% of total Indian population uses IMT-A:
Total IMT-A adopters = 1% of 1.2 billion
= 12 million

Total monthly spectrum cost for 1% IMT-A adopters
= Rs. 500 * 12 million
= Rs. 6 billion

Considering conservative estimates, Asset Loan will have a repayment of 1%: Monthly EMI at 1%.

So Asset Cost ie Reserve price for spectrum = Rs. 60,000 crore.

Hence reserve price for pan India IMT-A spectrum should not exceed Rs. 60,000 crore for the entire spectrum to be auctioned for IMT-A which could be 100MHz, 200MHz or 500MHz. The resulting reserve price for per MHz spectrum cost may be Rs. 600 crore, Rs. 300 crore or Rs. 120 crore for a bandwidth of 100 MHz, 200 MHz and 500 MHz respectively.

If the number of IMT-A adopters increases, percentage contribution of spectrum cost in aggregate monthly tariffs will further come down, making a profitable proposition for both service users as well as service providers.

11. What should be the eligibility conditions for bidding for spectrum?

Regulator should not impose any kind of entry barrier by way of eligibility conditions for any entity willing to bid for spectrum via open auctions. Any entity willing to apply for and provide communication services should be allowed to bid for spectrum. The only eligibility condition should be minimum net worth requirement and/or any other way that may ensure that the bidding entity has sufficient monetary resources to bid and pay for the spectrum. Technical experience should not be a part of eligibility requirements. If an entity into education business (with sufficient resources) is willing to bid for spectrum, it should not be restricted by regulator. However, winning entity must obtain UASL or any other applicable license/permission to commence provisioning of services. If after a period of time, bid winner is not able to roll-out services and is sitting on spectrum reserve, it's his loss and should not be of concern to government.

12. Should there be any roll out obligations for spectrum given through auction? Should it be different in different bands?

An entity that has won bid and has gained rights to use spectrum via auctions has already paid market value for the country's resource should not be restricted by roll-out obligations. In this case, it is in his own interest that he rolls out services and starts generating cash.

However, if government continues to hand out spectrum at throw-away or subsidized rates, roll-out obligations similar to existing ones should be imposed to ensure optimum utilization of country's resource. In this case roll-out obligation with penalties is a must.

13. Whether there should be any specific rollout obligations in respect of rural areas?

Rural roll-out is the only way out to bridge the digital divide in urban and rural areas. If spectrum is allotted via auction, service provider may or may not be interested in extending full bouquet of services in rural areas, subject to business case. In such cases, it is not fair for the government to impose additional restrictions related to roll-out obligations on winner. Government may ask service provider to follow broad obligations such as network should cover minimum 90% of population and 80% of geography. Another way of fulfilling rural connectivity requirements is through government owned service providers.

However, in case spectrum continues to be allocated free (ie bundled with license as per existing regime) and/or on subsidized value, rural roll out obligations should continue to be imposed on service providers.

14. What should be the spectrum usages charges? Should it be based on revenue share or be a fixed charge?

If the spectrum is being auctioned and winning bidder has already paid market price, there should not be any extra charge levied on the service provider. Regulator should not unnecessarily burden telecom sector with numerous tax/fees/charges in the wake of regulating the sector. If imposed, spectrum usage charges should be based on revenue share.

However, spectrum trading fees as a fixed percentage of bidding amount may be payable to government, incase buying/selling of spectrum takes place.

In case, spectrum continues to be bundled with UASL and/or allotted on subsidized rates, government should continue to levy spectrum usage charges as per current rates.

15. Using MIMO technology what can be the possible infrastructure sharing issues and what can be the probable solutions.

MIMO represents an economical way to (i) to increase user capacity; (ii) to increase coverage; and (ii) to increase cell throughput.

However, implementation of MIMO is limited primarily by (i) complexity in implementation, particularly when number of service providers sharing infrastructure is more than 2; (ii) power consumption; (iii) cost of backhaul fibre run; and (iv) possibility of cartelization in last mile connectivity by end-provider owning this infrastructure.

In case of small cell sites, there may not be space for individual antennas for each service provider and service providers may have to share antenna (may or may not be possible if competing technologies are deployed). If service providers decide to continue to use separate antennas, 3rd of 4th service provider may have to install here antennas at second-best or third-best location which results in competitive disadvantage for such disadvantaged service providers.

The prospect of last-mile infrastructures may also result in a natural monopoly which may also lead to cartelization. Policy makers should have sufficient measures in place to minimize possibility of formation of cartelization. The regulator shall consider mechanism to fund common usage infrastructure, which is accessible to all service providers equally does not unnecessarily create a dominant position for selected few.

16. What regulatory mechanisms are to be provided for delivery of voice services over IMT-A systems?

Traditionally, performance of communication network is measured in terms of Quality of Service (QoS) parameters (such as bit rate, delay, latency, packet dropping, error rate, etc). QoS should continue to be a key parameter for voice services in IMT-A systems. However, since IMT-A systems will primarily deal with provisioning of data related applications and services, regulator must now also consider measuring and prescribing Quality of User Experience (QoE) parameters which may be subjective in nature. QoE parameters may take into consideration every factor that contributes to overall user value such as suitableness, flexibility, mobility, security, cost, personalization and choice, across a variety of user equipments.

A service provider may be living up to the terms of a contract's language, thus rating high in QoS, but, the users may be very unhappy, thus causing a low QoE.

For IP based networks, QoS should be treated as an optimization tool designed to deliver a certain QoE by ensuring that the network elements apply consistent treatment to traffic flows as they traverse the network.

17. Should the interoperability of services to legacy 2G/3G systems be left to market forces?

Interoperability should not be left optional but be made mandatory by regulator. At the end of the day, one should not be carrying different cell phones for different networks viz, one for 2G voice calls, one for 3G data system and another for IMT-A based internet services, but only one sim card that should be able to work on all networks/bands/systems ensuring seamless network transition a reality. This is a serious drawback today – while the handset supports various technologies, but networks do not.

Internationally, countries have allotted different bands for IMT-A and roaming can be achieved only through GSM. This further strengthens are argument to make interoperability mandatory.

18. What are the QoS measurements that can be reported on IMT-A systems? Suggest the appropriate KPI for data and voice services to guarantee customer satisfaction.

Same set of QoS/QoE measurements and metrics can not be applied to IMT-A network as a whole. IMT-A network is capable of providing multiple services on the same network/architecture and accordingly, regulator may look at prescribing a set of metrics and measurements for similar type of services.

For example, TDM telephone and broadcast and cable television are dedicated services, so should have high QoS (lesser echo, noise, interference, call drop, etc). While VoIP and IPTV run on shared infrastructure and should have high QoE; IP's inherent flaws such as lost packet, jitter, latency, network congestion should be minimized for such services.

Moreover the overall network topology also plays an important role. How traffic routes through the core network—how many hops and nodes it must pass through—can influence the overall performance of the network. One way to increase performance is by using flatter architectures, meaning a less hierarchical network with more direct routing from mobile device to end system.

19. In view of the likely deployment of scenarios where the cell radius is scalable to much smaller levels using the concepts of femto and pico cells:

a. What will be the impact of femto cells/SoN architecture on KPI?

b. What will be the impact of Relays/femto cells on spectrum policy?

c. What will be the impact on infrastructure sharing?

d. What policy guidelines are required to encourage low emission low energy and high capacity architecture like femto cells overlaid over macro cells?

Concept of a femtocell is very similar to EPBAX – Main lines terminate at EPBAX and from there last mile connectivity is provided. Similarly, a femtocell is connected to main network of service provider, whether wireless or wired (optical fibre/BWA), and end user connectivity is provided wirelessly using de-licensed spectrum.

A femtocell is particularly useful for indoors where signal strength is less and mobility of user is limited. It also helps in reducing burden on

spectrum of service provider since individual user is not connected to their respective service provider's network but femtocell aggregate all user's data/information and then transmit it to service provider thereby helping in bandwidth usage.

However, deployment of a femtocell may require some change in user equipment (UE). UE should be compatible to work on different frequency bands – licensed spectrum band of service provider and de-licensed spectrum band of femtocell. Moreover, it should be capable of seamless transition from network of femtocell to service provider and vice-versa. Moreover, a femtocell coverage area should seamlessly provide all services supported by conventional network of service provider such as emergency calls, lawful interception, value added services, QoS, location identification, etc. Ability to provide seamless transition is the major performance evaluator for femotcells.

Future spectrum policy should take into account such limited usage on un-licensed spectrum bands and should specify optimum bands for such technology.

Femtocells will also have implications on infrastructure sharing. A facility manager/owner may decide to integrate femtocells to only one service provider thereby resulting in not so advantageous position for other service providers. Cost advantages are obvious but probability of cartelization and/or preferential treatment is also high. New operators have time and again complained against the higher interconnectivity charges demanded by incumbent operators. Regulator by way of policy formulation must ensure that such events do not happen and a femtocell must connect to all service providers.

However such innovative and newer technologies reduces burden on spectrum required to service users and must be promoted both by government and regulator. For a relatively larger coverage, picocells may be deployed on similar lines.